Factors Influencing the Adoption of mHealth Services in Saudi Arabia: A Patient-centered Study

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Abstract
This study empirically investigates the factors influencing the intention to accept mobile technology in Saudi healthcare service delivery using the extended unified theory of acceptance and use of technology model (UTAUT) with perceived reliability and price value. Accordingly, a conceptual model combining behavioral constructs with those linked to the technology acceptance model is developed. This model aims to identify factors that predict patients' acceptance of mobile technology healthcare service delivery. The developed model is examined using responses obtained from a survey on 545 participants receiving healthcare services in Saudi Arabia. Thus, we have conceptualized the developed model and validated seven hypotheses involving key constructs. Results suggest that performance expectancy, effort expectancy, social influence, facilitating conditions, price value, and perceived reliability are direct predictors of user behavior to accept mobile technology in healthcare service delivery. The results provide empirical evidence to the literature on the effect of facilitating conditions and effort expectancy on mobile health (mHealth) adoption. The results show that the COVID-19 pandemic has significantly increased the adoption of mHealth services in Saudi Arabia.

Keywords: *mHealth; mobile healthcare services; UTAUT; TAM; Technology acceptance*

I. Introduction

Information and communications technology advances in the past years have transformed healthcare service delivery [1]. The growth of mobile technologies and their applications (apps) lead to the emergence of mobile healthcare (mHealth) services [1]. mHealth is defined as the practice in medicine of providing public health through mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices [2]. mHealth is used to deliver healthcare services and access health-related information, such as treatment, diagnosis, medical appointment, and counseling services [3]. Recent studies provide substantial evidence that mHealth can effectively and efficiently improve healthcare service delivery [4-6].

Saudi Arabia ranked 26th in the World Health Organization out of 190 health systems worldwide [7]. The Saudi government has significantly paid attention to its healthcare sector. The Ministry of Health (MOH) plans to launch more than 40 healthcare service initiatives as part of the National Transformation Program 2020[1] and Saudi Vision 2030[2] [8]. The Saudi MOH has launched several mHealth service apps[3], such as the SEHA mobile app that provides online medical consultation services through selective accredited doctors in all medical specialties and Mawid mobile apps that allow patients to book appointments in primary healthcare centers [9]. MOH has launched three main mobile apps in response to the COVID-19 pandemic to support the healthcare service industry. These apps include Tabaud mobile app that tracks the spread of COVID-19, Tawakkalna mobile app that shows the health status of its users, and Tataman mobile app that provides protection and health care for citizens and residents referred to domestic quarantine [9]. Many Saudi public and private hospitals have their mHealth applications that offer different healthcare services. Most of these mHealth apps provide access to medical records and essential services, such as online booking appointment and virtual clinic.

User acceptance and adoption behavior to new technology is an important research topic. Continuous utilization of developed technology is essential to developing maximal value for users and developers. Several models and theories have been developed to examine end-users' new technology adoption. These theories include the technology acceptance model (TAM) [10], theory of planned behavior (TPB) [11], diffusion of innovation (DOI) theory [12], UTAUT [13], and the theory of reasoned action (TRA) [14]. Technology and information science researchers widely employ TAM and UTAUT [15-21]. TAM determines relationships between ease of use, usefulness, and intention to use. TAM hypothesizes that usefulness and ease of use are the main factors that influence user adoption of new technology [22-25]. In contrast, the UTAUT model holds four constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions. The first three constructs are the direct factors that influence user intention to use new technology, whereas the fourth is the direct factor that influences user behavior. Several studies have examined user intention and behavior to adopt mHealth services in different countries, such as the United States [26], the United Kingdom [27], China [28], Bangladesh [2], and the Republic of Korea [29], [30] demonstrates the advance growth of mHealth services, where users' adoption behavior has been widely examined in China, Taiwan, Korea, the United States, and European countries. The study confirmed that European countries are more active and effective in providing mHealth services compared with African countries. Several previous studies have used TAM and UTAUT to identify the factors that affect user acceptance to adopt mHealth services [1], [3], [27], [31-33]. Although Saudi Arabia has one of the highest mobile phone access and usage rates in the world [34], [35], studies have not explored the factors that may influence user acceptance to adopt mHealth services [36]. Nevertheless, studies have examined other areas, such as mHealth prevalence and usage [36] and barriers and solutions [37].

This study aims at understanding the factors that influence user acceptance and adoption of mHealth services in the context of Saudi Arabia. Following UTAUT [13], this study examines the influence of performance expectancy, effort expectancy, social influence, facilitating conditions, price value, and perceived reliability on user behavior to accept mobile technology in the healthcare service delivery. Facilitating conditions and effort expectancy are the most important predictors of Saudi Arabia's mHealth adoption. This study mainly emphasizes on (a) examining mobile technology acceptance in Saudi healthcare services from a patient-centric perspective (b) and extending the UTAUT framework with perceived reliability and price value to explain how these two factors influence users' behavioral intention to use mHealth services,

[1] https://vision2030.gov.sa/en/programs/NTP
[2] https://vision2030.gov.sa/en
[3] https://www.moh.gov.sa/en/Support/Pages/MobileApp.aspx

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and (c) confirming the usability of the theoretical foundation of the UTAUT framework in healthcare services.

The rest of this paper is organized as follows. Section 2 presents a review of relevant literature. Section 3 illustrates the theoretical framework of this study and develops research hypotheses based on the literature. Section 4 presents the research method. Section 5 offers data analysis and hypothesis testing. Finally, Section 6 provides the concluding remarks and future research directions are given

II. Literature review

Health information technology research and practice communities apply technology to transfer the healthcare service industry digitally. The design and development of mHealth services have several research areas, including system design [38], mHealth app implementation [39], user interface design [40], privacy and security legislations of mHealth designs [41], factors that influence user acceptance of mHealth adoption [2], challenges and opportunities for practical application [42], and the effectiveness of mHealth [43].

New technology adoption has extensively been studied in the domain of health services. Therefore, recognizing influential factors affecting user intention to use new technology has been an important research area given the advanced technological development to enable desirable technology adoption. Several theoretical models have been developed to examine user acceptance and usage of new technology [44]. Researchers have widely applied TAM and UTAUT models for measuring users' behavioral intention and acceptance to use new technology [15-21]. Other theoretical models have been used to study user acceptance of new technology, including TPB [11], DOI theory [12], and TRA [14].

Several studies in different contexts of many countries have examined the effect of various factors that influence user acceptance and usage of mHealth services. Many studies have used TAM [24] and UTAUT [3] to identify significant factors that influence mHealth adoption. Table I summarizes the recent studies that examined the factors affecting mHealth adoption in different developed and developing countries. The table also shows the theoretical model, country context, and key factors influencing mHealth adoption used by the studies.

Earlier studies identifying the factors that affect mHealth adoption and user acceptance have focused on hospital professionals' views [45]. Most studies emphasize on examining the factors influencing mHealth adoption in a different context and user groups [2]. They evidently demonstrate that mHealth adoption from the patients' perspective requires further research.

The adoption of mHealth apps has been examined based on several factors [46]. Most recent studies focused on mHealth adoption from patients' perspectives on lifestyles [47], security and privacy [28], resistance to change [32], technology anxiety [32], and perceived value [33]. Few studies have examined the effect of perceiving reliability and price value on mHealth adoption [2] because they focused on famous factors in mHealth adoption.

[24] used a meta-analysis and found that the role of perceived usefulness, perceived ease of use, subjective norm, trust, perceived risk, and attitude positively influenced mHealth adoption in China, Taiwan, Korea, the United States, and European countries. In addition, [1] used TAM and found that perceived ease of use, perceived usefulness, subjective norm, and gender type positively impact mHealth adoption. The study results confirm that mHealth service adoption in developing countries was significantly related to gender. Similarly, [31] applied TAM and found that trust, perceived usefulness, and perceived ease of use positively impact health-seeking behaviors on mHealth apps.

TABLE II. SUMMARY OF THE RECENT STUDIES IDENTIFYING FACTORS AFFECTING MHEALTH ADOPTION

Authors	Theoretical Frameworks	Key Findings	Country
[53]	Post-acceptance model (PAM) and TAM	Perceived usefulness, perceived ease of use, confirmation, and satisfaction.	Republic of Korea
[54]	Experiment	Intrinsic motivation, usefulness, and enjoyment	Canada
[33]	UTAUT	Facilitating conditions, effort expectancy, and perceived value	Thailand
[26]	(Extended unified theory of acceptance and use of technology (UTAUT2)	Performance expectancy, hedonic motivations, price value, and habit	United States
[29]	Systematic literature review	Infrastructure, functional, operational, and social benefits, confidentiality, social aspect, skill, and financial aspect	Republic of Korea
[55]	TAM–TPB	Perceived usefulness, perceived ease of use, social influence, attitudes, self-efficacy, involvement, and perceived behavioral control	Taiwan
[56]	TRA–TAM	Perceived ease of use, perceived ubiquity, health knowledge, social norms & healthcare need.	Taiwan
[57]	TPB, TAM, and gratification theory	Perceived usefulness, perceived enjoyment, ease of use, subjective norms, and perceived behavioral control	United States
[28]	UTAUT2, PMT	Hedonic motivation, functional congruence, social influence, perceived privacy risk, and perceived vulnerability	China
[27]	TAM	Perceived usefulness, perceived ease of use, technology design, and social and cultural influence	United Kingdom

[32] used the UTAUT model to identify factors influencing mHealth adoption and found that social influence, effort expectancy, performance expectancy, resistance to change, and technology anxiety significantly affect individual attitudes toward mHealth service adoption. Moreover, [3] employed the UTAUT model to explore the significant factors that influence mHealth adoption. These factors include performance expectancy, effort expectancy, social influence, and perceived credibility.

[48]'s cross-country analysis in China and Bangladesh showed that China's performance expectancy, social influence, effort expectancy, and price value positively influenced mHealth adoption, which is consistent with [3], [32]. In contrast, Bangladesh's performance expectancy, social influence, facilitating conditions, and perceived reliability significantly impacted users' behavioral intention to user mHealth services. Similarly, [2] found that the factors that influence mHealth adoption in Bangladesh are performance expectancy, social influence, facilitating conditions, and perceived reliability. Furthermore, [49] found that the role of performance expectancy, effort expectancy, social influence, facilitating conditions, and perceived reliability in Bangladesh influenced user adoption to mHealth.

Demand for high reliability of mHealth services has been consistent. Moreover, perceived reliability is a significant factor in technology acceptance as it refers to accurate technical and operational technology features [48]. Reliability is an important factor in encouraging user adoption of technology-based services as it positively influences user satisfaction levels regarding self-service technology [50]. [32] conducted a study in Bangladesh targeting elderly people in 2017 and found that perceived reliability significantly influences mHealth adoption. In contrast, [48] found opposite result in their study in China targeting Generation Y in 2020. Thus, differences in country, culture, targeted group, and duration lead to varying results.

Price value can be a relevant factor in examining technology acceptance that emphasizes technology's practical importance in several domains, including mHealth [48]. In addition, price value was found to be vital and hence received attention from users when accepting new technology. Furthermore, users weigh the received utilities and financial cost of using new technology [51]. [52] used diabetic patients in the United States, Canada, and Bangladesh in 2016 as study participants and found that price value significantly influences mHealth adoption. In contrast, [2] found opposite results in their study in Bangladesh targeting Generation Y in 2020. Thus, different country, culture, targeted group, and time duration will typically lead to opposite results.

To the best of our knowledge, no study has examined the factors that influence the adoption of mHealth apps by extending perceived reliability and price value through UTAUT variables within the context of Saudi Arabia. Hence, this study aims to fill this gap by proposing a comprehensive conceptual model that illustrates user intention to use mHealth apps in Saudi Arabia.

III. Theoretical Framework and Hypothesis Development

Several theoretical models have been developed to examine user acceptance and intention to use new technology [44]. Researchers have widely used TAM and UTAUT to measure user intention to use new technology [2]. Other theoretical models have been used to study user acceptance of new technology, including TPB [11], DOI [12], and TRA models [14].

Many studies have extended existing theoretical models by using additional constructs and moderating variables in these models to determine the factors that affect the intention to use new technology.

This study examines the factors that influence user behavior toward mHealth service adoption in Saudi contexts. The study uses the UTAUT model among other theoretical frameworks for two reasons. First, the UTAUT model was built on the benefits and limitations of different previous models, namely, the motivational model [60], TPB [11], TRA model[61], the model of personal computer utilization [62], social cognitive theory [63], TAM [10], TAM–TPB [64], and DOI theory [12]. Second, the UTAUT model explains 69% of technology acceptance, whereas other models explained approximately 40% [65]. Thus, the UTAUT model has more descriptive capacity compared with other models. The UTAUT has been used widely in studying and examining user acceptance in the healthcare domain [2], [66], [67].

[32] confirmed that the UTAUT model is applicable to studying the adoption factors of mHealth services in developing countries. [13] proposed the UTAUT model to examine user intentions to use new technology and the consequent usage behavior of the system. The UTAUT model has four constructs, namely, effort expectancy, performance expectancy, facilitating conditions, and social influence [13]. Moreover, performance expectancy and effort expectancy factors in the UTAUT model are similar to perceived usefulness and perceived ease of use in the TAM model [65].

To identify the factors that influence mHealth adoption in Saudi Arabia, the conceptual model of this study combines the core constructs of the UTAUT model with perceived reliability and price value. This study adopts [2] with certain variations. First, we used all constructs, except the gender construct as a moderating factor because we assume that Saudi Arabia has no gender discrimination in mHealth services and mobile device ownership compared with Bangladesh. Second, our target population includes the entire Saudi population, not only Generation Y. Figure 1 illustrates the proposed conceptual framework, where the relationship between the hypotheses is shown in the respective constructs.

A. Performance Expectancy

Performance expectancy is defined as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance." Users are motivated to adopt new technology if it has beneficial impacts [51]. Performance expectancy significantly influences users to use mobile phones [68] and services [69]. Moreover, [32] found that performance expectancy is one of the significant factors that affect users' behavioral intention to adopt mHealth services. [70] found that mHealth services are likely to be adopted and used when performance expectancy is high. Thus, the following hypothesis is proposed:

H1. Performance expectancy positively influences behavioral intention to adopt mHealth services.

B. Effort Expectancy

Effort expectancy is defined as "the degree of ease associated with the use of the system" [13]. Effort expectancy is a significant factor in new technology adoption [71]. Users commonly consider the required effort before they intend to use a system [72]. Users typically feel connected to convenient and easy-to-use technologies with less effort [51], [73]. Effort expectancy significantly influences user intention to adopt mHealth services [70], [74] and use them through smartphones [33]. Thus, the following hypothesis is formulated:

H2. Effort expectancy positively influences behavioral intention to adopt mHealth services.

C. Social Influence

Social influence is defined as "the degree to which an individual perceives that important others believe he or she should use the new system" [13]. [75] found that social influence significantly influences new technology adoption. Communities surrounding the user environment can substantially contribute to user intention toward technology by providing them with information and encouragement [76], [77]. Social contacts strongly impact users' mobile app adoption [78]. [70] found that social influence positively affects users' behavioral intention to use mHealth services. Thus, the following hypothesis is asserted:

H3. Social influence positively influences behavioral intention to adopt mHealth services.

D. Facilitating Conditions

Facilitating conditions is the "degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system" [13]. [79] found that facilitating conditions positively influence users' behavioral intention and hence their new technology use. Furthermore, [80] confirmed infrastructure support plays a significant role in information system usage. [33] confirmed that facilitating conditions positively impact user intention to use the smartphone for mHealth services.

Facilitating conditions are recognized as the dominating factors of users' behavioral intention for mHealth adoption [52]. Thus, the following hypothesis is asserted:

H4. Facilitating conditions positively influences behavioral intention to adopt mHealth services.

E. Perceived Reliability

Reliability is the extent to which users believe new technologies will work accurately and consistently [81]. Perceived reliability is the insight of user confidence and trust while interacting with proper and accurate technological functions [82]. Reliability is an essential factor to encourage users' adoption of technology-based services as it positively influences user satisfaction levels toward self-service technology [50]. 2] and [32] found that perceived reliability significantly influences mHealth adoption. Accordingly, the following hypothesis is proposed:

H5. Perceived reliability positively influences behavioral intention to adopt mHealth services.

F. Price Value

Price value is "consumers' cognitive trade-off between the perceived benefits of the applications and the monetary cost for using them" [72]. mHealth apps are more cost-effective in delivering healthcare services, such as emergency, compared with traditional healthcare services, thus reducing hospital visits [83]. In such cases, users will shift their usage to a competing service [84]. [52] found that price value significantly influences mHealth adoption. Accordingly, the following hypothesis is formulated:

H6. Price value positively influences behavioral intention to adopt mHealth services.

G. Behavioral Intention

Behavioral intention is the extent to which users perceive their willingness to use mHealth services [85]. Behavioral intention and actual use behavior are highly correlated [52], [86]. Behavioral intention is the best predictor the existing usages in the healthcare context [66], [87]. Therefore, the following hypothesis is proposed:

H7. Behavioral intention positively influences actual usage behavior in mHealth services.

I. Research Methods

This study uses a quantitative framework to validate the conceptual framework and hypotheses in Figure 1. This framework is based on an online questionnaire targeting Saudi citizens of different ages to examine the factors that influence the adoption of mHealth services in Saudi Arabia

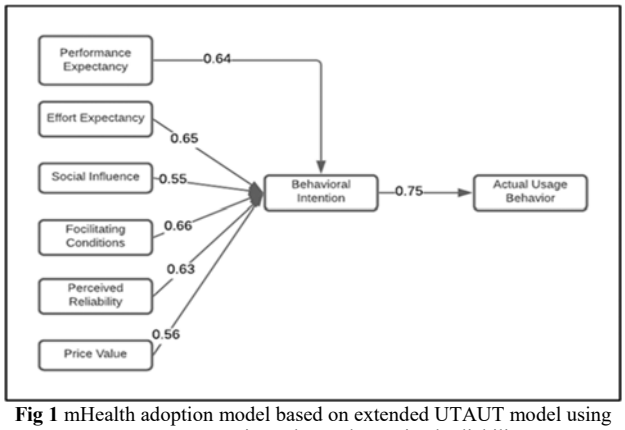

Fig 1 mHealth adoption model based on extended UTAUT model using two constructs: price value and perceived reliability.

A. Measurement Instrument

An online questionnaire adopted from adapted from [13], [72] is developed for data collection. This study has eight constructs: effort expectancy, performance expectancy, facilitating conditions, social influence, price value, perceived reliability, behavioral intention, and actual usage behavior. Different scales were adopted for effort expectancy, performance expectancy, and social influence [13], [72], facilitating conditions [13], [72], [88], perceived reliability [50], [89], [90], price value [72], and behavioral intention and actual usage behavior [72], [87]. Table III in the appendix shows the statements and their respective sources adopted from [2].

To confirm the validity of the questionnaire results, each construct is measured using more than one statement. All items in the questioner (presented in Table IV in the appendix) were measured using a five-point Likert-type scale from "5 = strongly disagree" to "1= strongly agree."

The questionnaire contains three main parts; an introduction to the study and its objectives, questions about demographic and experience data, such as gender, age, education level, mobile phone user experience, and 31 statements covering the eight constructs used in the research model. In addition, the second part includes data about user awareness and experience in using mHealth apps.

TABLE V. DEMOGRAPHIC INFORMATION (N = 545)

Variable	Answer	Frequency	Percentage
Gender	Male	172	31.6%
	Female	373	68.4%
Age	18–29	175	32.1%
	30–39	124	22.8%
	40–49	102	18.7%
	50–59	98	18.0%
	60 or above	46	8.4%
Education level	High school	69	12.7%
	Diploma	62	11.4%
	Bachelor's degree	277	50.8%
	Master's degree	108	19.8%
	PhD	22	4.0%
	Others	7	1.3%
Experience in using mobile phones	1–5 years	17	3.1%
	6–10 years	96	17.6%
	11–15 years	175	32.1%
	16 years and above	257	47.2%
Experience in using mHealth	Less than 1 year	252	46.2%
	1–3 years	214	39.3%
	4–6 years	54	9.9%
	7–9 years	20	3.7%
	10 years and above	5	0.9%
Have you used Sehhaty App issued by the Ministry of Health?	Yes, before COVID-19 pandemic	145	26.6%
	Yes, during COVID-19 pandemic	262	48.1%
	No	138	25.3%
Have you used mHealth services in a hospital you previouslty dealt with?	Yes, before COVID-19 pandemic	264	48.4%
	Yes, during COVID-19 pandemic	99	18.2%
	No	182	33.4%

The questionnaire was initially developed in English and distributed in its Arabic version as the official language in Saudi Arabia. A professional native translator has translated the English questionnaire into the Arabic

language. After the authors and reviewers reviewed the Arabic version of the questionnaire, certain minor changes were suggested in terms of wording to improve the understandability of the questionnaire to the Saudi population. A final version of the Arabic questionnaire was agreed upon.

B. Data Collection

An online self-administered questionnaire was conducted in Saudi Arabia in October 2020 for data collection. The sample of the current study comprised Saudi citizens of different ages. A total of 545 responses were returned and used for the study. Table VI presents the respondents' demographic data. The majority of the respondents were female (68.4%), were below 29 years (32.1%), have a bachelor's degree (more than 50%), and have more than 16 years of experience in using mobile phones and less than 1 year of experience in using mHealth.

The results of the usage of Sehhaty mobile app issued by the Saudi MOH show that approximately 50% of the respondents used the app during the COVID-19 pandemic. The ratio of users of mHealth services for a particular hospital shows that 48.4% of the respondents were using mHealth services before the COVID-19 pandemic, whereas only 18.2% of the respondents used mHealth services during the pandemic. Therefore, the percentage Sehhaty app users experienced a twofold increase in response to the impact of the COVID-19 pandemic, whereas that of mHealth service users for a particular hospital increased by 37%.

According to the world statistics report, mobile app usages, including mHealth [92], in all fields have exponentially increased [91] due to many reasons. These reasons include changes in people's lifestyle, lockdown impact, and government restrictions. These results indicate that the COVID-19 pandemic has positively affected the increase in mHealth app usage. The Saudi government issued several new regulations for the citizens, such as temporary travel suspension, online learning, short-term quarantine, and other rules. Thus, Saudi citizens have been requested to use mobile apps for delivering government, education, and health services. As a result, hospitals accept urgent cases only to reduce their workload. This situation has improved the relevance and significance of mHealth services.

II. Results and Discussion

This study used the Statistical Package for Social Sciences (SPSS) Statistics software version 24 to empirically analyze the collected data. Pearson correlation coefficients are used to measure internal validity and consistency of the model constructs. The Cronbach's alpha is used to measure the reliability, and the Kaiser–Meyer–Olkin (KMO) test to verify the suitability of the sample size. The hypotheses are tested through a simple regression model to measure the influence of the independent variables on the dependent variables. Independent-samples T-test is used to measure the significant differences between the mean of the responses of the study sample according to gender. One-way ANOVA is used to measure the significant differences between the mean of the responses of study sample according to age, education level, experience in using mobile phone and mHealth.

A. Descriptive Statistics

Table VII presents the basic descriptive statistics of the developed model's constructs, which are used to demonstrate the collected data tendency. The overall mean for all the eight constructs is 3.77 with a standard deviation 1.08. This finding indicates that the overall sample perception in all construct is "agree." The high and low mean and standard deviations of each construct are determined mainly by user perceptions of the statement items. The results justify that the mean of the effort expectancy construct increases the highest among other constructs. In contrast, the actual usage behavior construct has the lowest mean among other constructs.

TABLE VIII. DESCRIPTIVE STATISTICS OF THE EIGHT CONSTRUCTS

Construct	Mean	Standard Deviation	Interpretation
Effort expectancy	4.09	1.03	Agree
Performance expectancy	4.04	1.05	Agree
Facilitating conditions	4.01	1.02	Agree
Behavioral intention	3.91	1.07	Agree
Social influence	3.64	1.15	Agree
Perceived reliability	3.54	1.11	Agree
Price value	3.47	1.06	Agree
Actual usage behavior	3.45	1.14	Agree
Overall mean	3.77	1.08	Agree

To measure the validity of the internal questionnaire, the Pearson correlation coefficient is used to determine the statistical relationship between each statement and the total degree of measure attitude to which they belong. Table IX in the appendix shows the results for Pearson correlation coefficients. Validity is appropriate when the Pearson correlation coefficients for all statements are more than 0.50. The values of the Pearson correlation coefficient were between 0.747 and 0.861. Thus, the questionnaire statements have strong internal consistency.

The correlation matrix describes the bivariate associations between every two constructs. Table X shows the correlation matrix of the constructs using the Pearson correlation. The relationship of every two constructs is statistically significant at the level of significance at 0.05 or less, where $p = 0.000$.

C. Hypothesis Testing

The simple regression model is used to test the hypotheses by measuring the influence of the independent variables on the dependent variables. Table XI shows the results of the simple regression measurements.

H1 verifies whether performance expectancy influences user intention to adopt mHealth services ($\beta = 0.64$, $p<0.05$). The results supported H1 and are consistent with prior studies [2], [32], [70]. Therefore, users believe that mHealth is useful and reliable in monitoring their health [32].

Effort expectancy and behavioral intention to adopt mHealth services showed a positive relationship ($\beta = 0.65$, $p < 0.05$), confirming H2. This result is consistent with [70], [74]. Therefore, Saudi users consider effort required before and while using mHealth services. In contrast, certain studies found that effort expectancy does not significantly influence mHealth adoption, such as [47].

TABLE XII. CORRELATION MATRIX FOR CONSTRUCTS USING PEARSON CORRELATION

	Performance Expectancy	Effort Expectancy	Social Influence	Facilitating Conditions	Perceived Reliability	Price Value	Behavioral Intention	Actual Usage Behavior
Performance expectancy	1.000							
Effort expectancy	0.624**	1.000						
Social influence	0.600**	0.491**	1.000					
Facilitating conditions	0.662**	0.789**	0.625**	1.000				
Perceived reliability	0.581**	0.585**	0.631**	0.681**	1.000			
Price value	0.509**	0.459**	0.515**	0.562**	0.657**	1.000		
Behavioral intention	0.640**	0.647**	0.549**	0.661**	0.632**	0.556**	1.000	
Actual usage behavior	0.651**	0.610**	0.626**	0.656**	0.728**	0.597**	0.752**	1.000

The Cronbach's alpha coefficient measures the reliability of the questionnaire. Table XIII in the appendix shows the results for all variables. The alpha coefficient is appropriate when it is at least 0.70 [93]. The Cronbach's alpha for all factors was between 0.799 and 0.927, and the overall reliability coefficients are 0.965. Therefore, the tool has high stability. The KMO test is performed to measure the suitability of the sample size and achieved a value of 0.954, indicating that the sample size is sufficient because it is above the recommended value of 0.6 [94].

Their results are contradictory to our results giving a different context of the study. For instance, [74] conducted a study in China targeting the elderly population and patients with chronic conditions in 2017, whereas [47] conducted a study in Bangladesh targeting young university students in 2020. Thus, differences in country, culture, targeted group, and duration lead to varying results.

H3 suggests that social influence positively affects behavioral intention to adopt mHealth services, which is empirically verified ($\beta = 0.55$, $p < 0.05$). This result is in line with [2], [52], [70]. Saudi users are influenced by their society through words of mouth, recommendations, and peer reflections of their references groups, such as family and friends, especially with social media revolution.

The research findings show that facilitating conditions are an important factor in adopting mHealth services, thus confirming H4. These results are consistent with previous studies [2], [52], [95] ($\beta = 0.66$, $p < 0.05$) and emphasize that learning role and usage support for mHealth service adoption are vital to different users.

Previous studies have confirmed that perceived reliability influences behavioral intention to adopt mHealth services [2], [26], [32] ($\beta = 0.63$, $p < 0.05$). Our results confirmed the influence of perceived reliability on mHealth adoption (H5). Thus, the results indicate that Saudi users expect thorough and consistent operation of mHealth apps. In contrast, certain studies found that perceived reliability does not significantly influence mHealth adoption [48]. Their results are contradictory due to differences in country, culture, targeted group, and duration, similar to H2.

H6 proposes that price value influences the intention to adopt mHealth services and was confirmed with $\beta = 0.56$ and $p < 0.05$). This result is in line with previous studies [52]. Price value is important to Saudi users because they may have an alternative to paid and free mHealth apps, such as those provided by MOH. In contrast, certain studies found that price value does not significantly influence mHealth adoption, such as [47]. Their results are contradictory due to differences in country, culture, targeted group, and duration, similar to H2.

Finally, behavioral intention and actual use behavior is correlated ($\beta = 0.75$, $p < 0.05$), supporting H7 [2]. Facilitating conditions is the most important factor followed by effort expectancy, performance expectancy, perceived reliability, price value, and social influence. The appendix provides additional details about the simple regression results.

D. T-Test and One-Way ANOVA

Independent-samples T-test is used to measure the significant differences between the mean of the responses of the study sample according to (gender). One-way ANOVA is used to measure the significant differences between the mean of the responses of study sample according to age, education level, experience in using mobile phones, experience in using mHealth, "Have you used Sehhaty app issued by the Ministry of Health?," and "Have you used mHealth services for a hospital you previously dealt with?"

The T-test and one-way ANOVA results showed that the mean of the responses according to gender, age, education level, and experience in using a mobile phone had no statistically significant differences at the level of significance of 0.05 or less. In contrast, experience in using mHealth, "Have you used Sehhaty app issued by the Ministry of Health?," and "Have you used mHealth services for a hospital you dealt with previously" have opposite result. The appendix shows the details of the statistical analyses of the T-test and one-way ANOVA.

III. Conclusion

This study used the UTAUT model to examine Saudi users' acceptance of mHealth technology and the factors that affect their behavior. We integrated perceived reliability and price value as two additional factors the UTAUT model. The model is more effective in technology adoption behavior than other theoretical models, such as TAM and TPB. Hence, this study presented an extended UTAUT model to examine the factors that influence user adoption of mHealth services.

This study assists researchers in Saudi Arabia to understand the factors that influence mHealth adoption. The study result confirms the usability of the theoretical foundation of the UTAUT framework in the healthcare services. Furthermore, effort expectancy, performance expectancy, facilitating conditions, social influence, perceived reliability, and price value are positively related to behavioral intention to adopt mHealth services. Moreover, behavioral intention significantly impacts actual usage behavior. Also, the results demonstrate that the COVID-19 pandemic has significantly increased mHealth adoption in Saudi Arabia. The high rate of mobile phone usage in the country and the COVID-19 pandemic have opened excellent business opportunities to provide reliable mHealth at an affordable price. The results of this study can be used by policymakers, decision-makers, and hospital administrators to increase mHealth adoptions.

This study shows the influence of factors on a single time point. Thus, future research should be conducted over a longitudinal study to show the influence of different factors over time. The proposed model can also be applied to other types of healthcare services, such as electronic health

record, in another context. Future studies may consider user demographic data as a moderating factor to obtain additional insights.

TABLE XIV. HYPOTHESIS OUTCOME OF THE–CONCEPTUAL MODEL EVALUATION.

Influencing Variable	Influenced Variable	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Outcome
		B	Std. Error	Beta			
Performance expectancy	behavioral intention	0.71	0.04	0.64	19.42**	0.00	Positive influence
Effort Expectancy	behavioral intention	0.70	0.04	0.65	19.76**	0.00	Positive influence
Social Influence	behavioral intention	0.52	0.03	0.55	15.31**	0.00	Positive influence
Facilitating Conditions	behavioral intention	0.81	0.04	0.66	20.53**	0.00	Positive influence
Perceived Reliability	behavioral intention	0.67	0.04	0.63	19.01**	0.00	Positive influence
Price Value	behavioral intention	0.58	0.04	0.56	15.57**	0.00	Positive influence
Behavioral Intention	Actual usage behavior	0.68	0.03	0.75	26.56**	0.00	Positive influence
(**) There is a statistically significant influence at the level of significance (0.05) or less							

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Appendix TABLE XV. LIST OF MEASURES

Constructs	Items	Statement	Sources
Performance Expectancy	PE1	I find mHealth useful in my life.	[13], [72]
	PE2	Using mHealth increases my chances of meeting my needs.	
	PE3	Using mHealth helps me in managing my daily healthcare more quickly.	
	PE4	Using mHealth service increases my capability to manage my health.	
Effort Expectancy	EE1	Learning how to use mHealth is easy for me.	[13], [72]
	EE2	My interaction with mHealth is clear and understandable.	
	EE3	I find mHealth easy to use.	
	EE4	It is easy for me to become skillful at using mHealth services.	
Social Influence	SI1	People who are important to me think that I should use mHealth services.	[13], [72]
	SI2	People who influence my behavior think that I should use mHealth.	
	SI3	People whose opinions that I value prefer that I use mHealth.	
	SI4	People in my society who use mHealth service have more prestigious than those who do not.	
Facilitating Conditions	FC1	I have the resources necessary to use mHealth services.	[13], [72], [88]
	FC2	I have the knowledge necessary to use mHealth.	
	FC3	mHealth is compatible with other technologies I use.	
	FC4	I can get help from others when I have difficulties using mHealth services.	
	FC5	Guidance will be available to me in the use of mHealth services.	
Perceived Reliability	PR1	I obtain accurate and error free services from mHealth service providers.	[50], [89], [90]
	PR2	I can rely on the service provided by mHealth service provider.	
	PR3	mHealth service is consistent over the time.	
	PR4	mHealth services maintain standard continuously.	
Price Value	PV1	It enables me to use health services at a reasonable price.	[72]
	PV2	mHealth services is good value for the money.	
	PV3	At the current price, mHealth provides a good value	
Behavioral Intention	BI1	I intend to continue using mHealth in the future	[72], [87]
	BI2	I will always try to use mHealth in my daily life	
	BI3	I plan to continue to use mHealth services Frequently	
Actual Usage Behavior	AU1	mHealth service is a pleasant experience.	[72], [87]
	AU2	I really want to use mHealth services to keep my health safe.	
	AU3	I spend a lot of time on mHealth service.	
	AU4	I use mHealth services on regular basis.	

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TABLE XVI. PEARSON CORRELATION COEFFICIENTS BETWEEN EACH

Construct	Items	Pearson correlation coefficient	P-Value (Sig)	Pearson correlation coefficient	P-Value (Sig)
Performance Expectancy	PE1	0.858**	0.000	0.805**	0.000
	PE2	0.896**	0.000		
	PE3	0.879**	0.000		
	PE4	0.855**	0.000		
Effort Expectancy	EE1	0.899**	0.000	0.792**	0.000
	EE2	0.893**	0.000		
	EE3	0.912**	0.000		
	EE4	0.861**	0.000		
Social Influence	SI1	0.935**	0.000	0.781**	0.000
	SI2	0.941**	0.000		
	SI3	0.916**	0.000		
Facilitating Conditions	FC1	0.766**	0.000	0.858**	0.000
	FC2	0.808**	0.000		
	FC3	0.844**	0.000		
	FC4	0.789**	0.000		
	FC5	0.816**	0.000		
Perceived Reliability	PR1	0.871**	0.000	0.843**	0.000
	PR2	0.873**	0.000		
	PR3	0.808**	0.000		
	PR4	0.845**	0.000		
Price Value	PV1	0.919**	0.000	0.747**	0.000
	PV2	0.908**	0.000		
Behavioral Intention	BI1	0.926**	0.000	0.835**	0.000
	BI2	0.948**	0.000		
	BI3	0.929**	0.000		
Actual Usage Behavior	AU1	0.771**	0.000	0.861**	0.000
	AU2	0.766**	0.000		
	AU3	0.780**	0.000		
	AU4	0.853**	0.000		
Note: (**) means the correlation statistically significant at)0.01)or less					

STATEMENT AND THE TOTAL DEGREE OF MEASURE ATTITUDE

TABLE XVII. RELIABILITY COEFFICIENTS CRONBACH'S ALPHA

Construct	Items	Coefficients Cronbach's alpha
Performance Expectancy	4	0.892
Effort Expectancy	4	0.914
Social Influence	3	0.923
Facilitating Conditions	5	0.864
Perceived Reliability	4	0.865
Price Value	2	0.801
Behavioral Intention	3	0.927
Actual Usage Behavior	4	0.799
Overall reliability coefficients	29	0.965

TABLE XVIII. RESULTS OF INDEPENDENT-SAMPLES T-TEST ON THE SIGNIFICANT DIFFERENCE BETWEEN RESPONSES OF THE STUDY SAMPLE ACCORDING TO GENDER

VARIABLE	CATEGORY	N	MEAN	STD. DEVIATION	T-TEST	DF	P-VALUE
GENDER	MALE	172	3.77	0.81	0.05	543	0.96
	FEMALE	373	3.77	0.75			

TABLE XIX. RESULTS OF ONE-WAY ANOVA ON THE SIGNIFICANT DIFFERENCES IN THE RESPONSES OF THE STUDY SAMPLE

Variable	Sources of variation	Sum of Squares	Df	Mean Square	F	P-Value (Sig.)
Age	Between Groups	4.11	4	1.03	1.75	0.14
	Within Groups	316.35	540	0.59		
	Total	320.46	544			
Educational level	Between Groups	2.99	5	0.60	1.02	0.41
	Within Groups	317.46	539	0.59		
	Total	320.46	544			
Experience in using Mobile phone	Between Groups	1.28	3	0.43	0.73	0.54
	Within Groups	319.17	541	0.59		
	Total	320.46	544			
Experience in Using mHealth	Between Groups	13.42	4	3.36	5.90**	0.00
	Within Groups	307.03	540	0.57		
	Total	320.46	544			
Have you ever used "sehhaty" application issued by ministry of health?	Between Groups	8.73	2	4.36	7.59**	0.00
	Within Groups	311.73	542	0.58		
	Total	320.46	544			
Have you ever used mHealth services for hospital you deal with?	Between Groups	16.75	2	8.37	14.94**	0.00
	Within Groups	303.71	542	0.56		
	Total	320.46	544			

TABLE XX. RESULTS OF THE SHEFFE TEST ON THE SIGNIFICANT DIFFERENCES IN EXPERIENCE IN USING MHEALTH

VARIABLE	EXPERIENCE IN USING MHEALTH	MEAN	LESS THAN 1 YEAR	1 TO 3 YEARS	4 TO 6 YEARS	7 TO 9 YEARS	10+
EXPERIENCE IN USING MHEALTH	LESS THAN 1 YEAR	3.64	-				
	1 TO 3 YEARS	3.85	0.12	-			
	4 TO 6 YEARS	3.80	0.24	0.11	-		
	7 TO 9 YEARS	4.21	0.02*	0.03*	0.02*	-	
	10+	4.62	0.00**	0.00**	0.00**	0.04*	-

Table XXI illustrates that p-values 0.02, 0.03, 0.02, 0.00, 0.00, 0.00, and 0.04 are less than the level of significance at 0.05. Thus, The study sample's experience in using mHealth for 7–9 years and 10 years and above and less than 1 year, 1–3 years, and 4–6 years) is statistically significant at the level of 0.05 or less, which is in favor of the study sample's experience in using mHealth (7–9 years and 10 years and above).

TABLE XXII. RESULTS OF SCHEFFE TEST ON THE SIGNIFICANT DIFFERENCES IN "HAVE YOU EVER USED SEHHATY APP ISSUED BY THE MINISTRY OF HEALTH?"

Variable	Have you ever used "sehhaty" application issued by ministry of health?	Mean	Yes, before Covid-19 pandemic	Yes, during Covid-19 pandemic	No
Have you ever used "sehhaty" application issued by ministry of health?	Yes, before Covid-19 pandemic	3.88	-		
	Yes, during Covid-19 pandemic	3.82	0.12	-	
	No	3.55	0.00**	0.01**	-

Table XXIII illustrates that the p-values 0.00, and 0.01 are less than the level of significance at 0.05. Thus, the study sample's "Have you used Sehhaty app issued by the Ministry of Health?"" ("yes" before the COVID-19 pandemic, "yes" during the COVID-19 pandemic, and "no") is statistically different at the level of significance of 0.05 or less, which is in favor of the study sample's "Have you used Sehhaty app issued by the Ministry of Health?"

TABLE XXIV. RESULTS OF THE SCHEFFE TEST ON THE SIGNIFICANT DIFFERENCES IN "HAVE YOU USED MHEALTH SERVICES FOR A HOSPITAL YOU DEALT WITH BEFORE?"

Variable	Have you ever used mHealth services for hospital you deal with?	Mean	Yes, before Covid-19 pandemic	Yes, during Covid-19 pandemic	No
Have you ever used mHealth services for hospital you deal with?	Yes, before Covid-19 pandemic	3.93	-		
	Yes, during Covid-19 pandemic	3.75	0.03*	-	
	No	3.54	0.00**	0.00**	-

Table XXV illustrates that p-values 0.00 and 0.01 are less than the level of significance at 0.05. Thus, the study sample's "Have you used mHealth services" ("yes" before or during the COVID-19 pandemic and "no") is statistically significant different at the level of significance of 0.05 or less, which is in favor of the study sample's "Have you used mHealth services?"