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Perceptions of Using Mobile Health Apps (mHealth) During Covid-19 Pandemic In Saudi Arabia: A Cross-Sectional Study

Abdullah Almufarij[1], Abeer Alharbi[2]*

[1] King Saud University, Riyadh, Saudi Arabia.

[2] Health Administration Department, Business Administration College, King Saud University, Riyadh, Saudi Arabia.

Abstract

Background: In Saudi Arabia, the Ministry of Health has developed many mhealth apps to control the spread of COVID-19 and to provide healthcare services during the pandemic. This study aimed to assess the users' awareness, use, and perceptions toward mhealth apps during the COVID-19 pandemic.

Methods: An online questionnaire was used to collect data from users of mhealth apps. A convenience sampling method was used and consisted of a sample of 900 individuals. One-sample Wilcoxon signed-rank test, spearman's rho correlation, Mann-Whitney, and Kruskal-Wallis tests were used to answer the research questions.

Results: A total of 878 respondents completed the survey questionnaire. The most well-known and used app was Tawakklna (96%) followed by Tabaud (68.6%), Seha (64.2%), Mawid (61.4%), and Tataman (56.4%). Social media networking and the MOH website were the most reported methods for gaining knowledge of the mhealth apps. Almost all the respondents used Tawakklna (96%), and less than half of them used the other four apps. Most respondents recognized the purposes of these apps, perceived their benefits, were satisfied with them, and did not face any technical difficulties in their use ($p< 0.001$). There were significant relationships between the users' perceptions about the purpose of mhealth, the benefits, satisfaction level, and the perceived technical difficulties in its use ($p< 0.01$). Married, employed, and older users had a higher understanding of the purpose and had positive perceptions around usefulness of the mhealth apps. Male and users who earn less than 10 thousand SAR perceive higher technical problems with the apps.

Conclusion: Majority of the mhealth users had positive perceptions in terms of purpose, benefits, satisfaction, and technical difficulties. With the increasing number of services on mhealth apps, further research is needed to evaluate these apps.

Keywords: Mobile Health, Smartphones, Mhealth apps, COVID-19, Saudi Arabia

*Abeer Alharbi-Health Administration Department, Business Administration College, King Saud University, Riyadh, Saudi Arabia; Email: aalharbi15@ksu.edu.sa .

1. Introduction

With the ever-growing number of smartphones users, mobile applications have increased rapidly worldwide. The total number of mobile applications on Google Play and Apple Apps, the two biggest app stores, was 5.7 million in the first quarter of 2021 [1]. These mobile applications have been developed for different fields, including health. The health apps category is known as mobile health apps or, in short, as mhealth apps. The total number of mhealth apps from Google Play and Apple apps stores was 107,000 in the first quarter of 2021 [1], constituting 2% of the total mobile apps. Mhealth refers to the use of mobile devices, such as mobile phones, tablets, wearable devices, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices to deliver healthcare services through apps developed for these purposes [2,3]. There are numerous functions, uses, and applications of mhealth in different medical specialities and disciplines such as medication management, chronic care management, women's health, personal health record, healthcare and fitness, nutrition and diet, and patient education apps [4,5]. Functions of mhealth apps include providing distance healthcare services through virtual visits via text, audio and video conversations, personal monitoring and tracking, population health education, epidemic tracking, and making appointments [6–8]. These apps provide the users with the necessary information, record and save the user's data, provide medical guidance, facilitate diagnosis and consultation, and alert the user when needed.

In Saudi Arabia, the Ministry of Health (MOH), in its vision, states that it strives to deliver best-quality integrated and comprehensive healthcare services to the population [9]. To realize the vision, the MOH has developed a business strategy that depends on eHealth as a primary transformation policy to enhance the provision of healthcare services to meet the growing demand and the increasing costs of these services. Moreover, the MOH has also adopted mhealth to improve access to healthcare services, particularly during the COVID-19 pandemic. To prevent the spread of COVID-19, the Saudi government took necessary measures, including complete and partial curfew, the suspension of mass gatherings like praying in mosques, domestic and international flights, and social and sports events. In addition, all educational institutions were closed. Other prevention measures included the practice of social distancing, mandatory use of masks, and the introduction of awareness campaigns. In line with these measures, the Saudi MOH has developed and launched different mhealth apps to continue the provision of healthcare services, tracking the movement of individuals to ensure social distancing, population education, virus tracking, test result reporting, and tracking infection status. Most of the mhealth apps were developed for the COVID-19 containment and healthcare provision during the pandemic.

Ministry of Health (MOH) mhealth apps

To prevent the spread of the coronavirus and continue providing healthcare services, the MOH has developed and launched various mhealth apps that target healthcare providers, citizens, and patients. MOH has developed eleven mobile apps that serve patients and healthcare clients [10]. The most commonly used apps during the coronavirus pandemic are Tabaud, Tawakkalna Tatamman, Seha, and Mawid [11,12]. The names of the apps are Arabic and mean "Distancing", "We Trust", "Rest assured", "Health", and "Appointment", respectively.

Tabaud

Tabaud app is GPS-based and tracks an individual's movements to ensure that they keep a physical distance of at least one meter from another person to prevent the spread of the coronavirus. The app identifies the individuals who may have physically interacted with individuals infected with the coronavirus. This app sends a notification to those who have interacted with infected individuals to self-isolate for 14 days [13].

Tawakkalna

Tawakkalna is a multi-features app integrated with the main platform of the Ministry of Interior (Absher). The app provides many services that include issuing movement permits during the curfew, Haj and Ummra permits, and booking for vaccination, among other things. In addition, the app indicates the individual's personal information, the status of infection and vaccination. Presently, the use of the app is mandatory for individuals to have access to both public and private organizations, shopping, attending football matches, or any other formal gatherings.

Tatamman

Tatamman app provides services to individuals who have to self-isolate because they are either infected with COVID 19 or suspected COVID 19 cases. The services include a countdown indicator for health isolation and daily health status follow-up.

Seha

Seha app provides virtual healthcare services instead of traditional face-to-face ones. The app allows the users to receive health and preventive care from their homes through medical consultations via text, audio, and video conversations provided by MOH physicians and artificial intelligence technologies.

Mawid

Mawid app enables the users to book, reschedule and cancel their appointments at the primary healthcare centers. The app also chooses the appropriate and nearest primary clinic that provides the necessary medical advice from the medical staff.

Despite the important role that mhealth has played in the containment of the COVID-19 pandemic and the continuation of healthcare services, few studies have been conducted to evaluate the use of these apps in Saudi Arabia. The aim of our study was to evaluate the population's awareness and use of mhealth apps developed by Saudi MOH during the COVID-19 pandemic. The study also aimed to evaluate the apps' perceived purpose, benefits, technical difficulties, and satisfaction levels. In addition, the study explored the relationships between perceptions toward the mhealth apps, and socio-demographic factors associated with the users' evaluations of mhealth apps.

2. Subjects and Methods

2.1 Study design and setting

A cross-sectional study design was used to identify the publics' perceived purpose, benefits, technical difficulties, and satisfaction levels with the MOH mhealth apps. This study design allowed for assessing the users' knowledge of mhealth apps, and the relationship between the users' perceived purpose, benefits, technical difficulties, and satisfaction with the use of MOH mhealth apps. In addition, the design enabled the testing of whether there were differences in the users' evaluations of mhealth apps across the demographic variables.

2.2 Population and sampling

The study population consisted of all the users of the MOH mhealth apps in Saudi Arabia aged 18 years or older. The mhealth apps were Tabaud, Tawakkalna, Tatamman, Seha, and Mawid. Based on the report of the General authority of Statistics (GAS) for the Saudi population and the estimated percent of smartphone users, the total study population was approximately 25.6 million [14]. In the absence of a sampling frame, a convenience sampling method was used to collect the study data from the study population [15]. Other factors that encouraged the researchers to use convenience sampling included its low cost and the quick and easy selection of individuals [16]. A sample of 900 individuals was determined as appropriate for the study according to the guidelines for choosing a sample size using non-probability sampling [17].

2.3 Survey questionnaire and data collection

Based on the related literature, a questionnaire was developed to collect the data from the study population. The questionnaire comprised three parts: demographic characteristics, awareness and use of mhealth apps, and a list of items to evaluate the purpose, benefits, technical difficulties, and satisfaction with the five mhealth apps. The demographic variables included nationality, gender, age, marital status, education, employment status, and monthly income. The second part included questions to assess the level of knowledge of mhealth and the methods by which they came to know about the apps and their use.

The last part asked the respondents to evaluate the perceived purpose (I understand the purpose of the app); benefits (I find the app to be beneficial); technical difficulties (I faced technical difficulties while using the app); and satisfaction (I am satisfied with the app in general) for all MOH mhealth apps by rating the items on a five-point Likert scale ranging from 1=strongly disagree to 5=strongly agree.

An electronic questionnaire was developed using Google Form and then distributed via WhatsApp during March 2021 to the study population. The total received responses were 892, and after cleaning, 878 responses were found valid for analysis, giving a 97.6 % response rate. The questionnaire was tested for both reliability and validity. The values of Cronbach's alpha for the perceived purpose, benefits, technical difficulties, and satisfaction with the mhealth apps were 0.802, 0.843, 0.955 and 0.728, respectively, and these values were above the acceptable threshold level [18]. As for validity, all of the four dimensions' items (purpose, benefits, technical difficulties, and satisfaction) showed significant correlations with their respective total scores ($p \leq 0.05$). Hence, the instrument was considered to be both reliable and valid.

2.4 Data analysis

Descriptive statistics were used for the demographic variables as well as the awareness and knowledge of the mhealth apps. Due to non-normality distributions, a one-sample Wilcoxon signed-rank test was used to determine if the respondents agreed or disagreed with the purpose, benefits, technical difficulties, and satisfaction with mhealth apps. Spearman's rho correlation was used to analyze the relationships between the perceived purpose of mhealth apps, their benefits, the technical difficulties and satisfaction with the use of apps. In addition, Mann-Whitney and Kruskal-Wallis tests were used to assess the differences in perceived purpose, benefits, technical difficulties, and satisfaction with mhealth apps across the demographic variables. Two-sided p-value < 0.05 was set for statistical significance for all statistical tests used.

2.5 Ethical Considerations

Institutional Review Board (IRB) approval for the study was obtained from King Saud University (KSU), reference number KSU-HE-21-169.

3. Results

3.1.Socio-demographic characteristics

The socio-demographic characteristics of the respondents are shown in Table 1. Of the total respondents, 97.7% were Saudi and 53.2% were males. The mean age of the respondents was 35.3 years with a standard deviation of 9.4 years. Most of the respondents were married (66.9%), had graduate or postgraduate degrees (62%), and were employed (58.3%). The mean monthly income of the study

respondents was 8,008 Saudi riyals with a relatively high standard deviation of 5325 Saudi riyals.

Table (1) Sociodemographic characteristics of the respondents

Variable	Frequency (n=878)	Percent (%)
Nationality		
Saudi	858	97.7
Non-Saudi	20	2.3
Gender		
Male	467	53.2
Female	411	46.8
Age (avg = 35.3, SD = 9.4)		
< 18	12	1.4
18-29	290	33.0
30-49	458	52.2
≥ 50	118	13.4
Marital status		
Unmarried	291	33.1
Married	587	66.9
Education level		
Secondary or less	334	38.0
Bachelor	460	52.4
Postgraduate degree	84	9.6
Employment status		
Employed	512	58.3
Unemployed	366	41.7
Monthly income in SAR (avg = 8008, SD = 5325)		
< 5000	146	20.6
5000-10000	184	26.0
10000-15000	239	33.8
≥ 15000	139	19.6

3.2.Awareness of MOH mhealth apps

Table 2 shows that the majority of the respondents were aware of the MOH mhealth apps. The most known app was Tawakklna (96.0%), followed by Tabaud (68.6%), Seha (64.2%), Mawid (61.4%), and Tataman (56.4%).

Table (2) Respondents who had heard or knew MOH apps (n=878)

MOH apps	Frequency (n)	Percent of total respondents (%)
Tawakklna	843	96.0
Tabuad	602	68.6
Seha	564	64.2
Mawid	539	61.4
Tataman	495	56.4

Regarding how they came to know about the apps, Table 3 shows that social media networking

(46.5%) was the most stated method. More than 30% of the respondents had heard or knew about MOH mhealth apps through the MOH website and accounts. Other methods of awareness included relatives and friends, the internet, and other methods, which fell below 11%.

Table (3) Distribution of respondents with respect to methods of mhealth apps knowledge

Method of mhealth apps knowledge	Frequency (n)	Percent (%)
Social media	408	46.5
MOH website and accounts	268	30.5
Relatives and friends	97	11.0
Internet	90	10.3
Other methods	15	1.7
Total	878	100

3.3.Use of MOH mhealth apps

Table 4 shows the distribution of the study respondents with respect to use of the MOH mhealth apps. Almost all the respondents used Tawakalna app (96%) which could, perhaps be attributed to the linkage of the app's use with the provision of most government services. Currently, its use is mandatory to enter shopping centers, stadiums, and public and private institutions and some other places. On the other hand, the Tatamman (34.2%) was the least used app.

Table (4) Users of MOH mhealth apps

MOH apps	Number of users (n)	Percent of total respondents (%)
Tawakklna	859	97.8
Seha	438	49.9
Mawid	419	47.7
Tabuad	397	45.2
Tataman	300	34.2

3.4.Technical difficulties

Respondents were asked whether they faced any technical difficulties in using MOH apps by ranking the items (I faced technical difficulties while using the app) on a 5-point Likert scale, 1 (strongly disagree) to 5 (strongly agree). Table 5 shows the respondent median and mean scores of their responses to each MOH app. The median of technical difficulties is 3 for all apps. Whereas the mean score varies between 2.8 to 3.2 which indicate that most respondents faced little technical difficulties while using the apps.

Table (5) Technical difficulties in using MOH apps

I faced technical difficulties while using the app	Descriptive statistics		
	Median	Mean	Std. Deviation
Tabuad	3	2.8	1.18
Tawakklna	3	3.2	1.35
Tataman	3	2.8	1.18
Seha	3	2.9	1.23
Mawid	3	2.8	1.22

3.5.Evaluation of the MOH mhealth apps

a. Perception of purpose

The respondents were asked to indicate their understanding of the purpose of each of the five MOH apps by ranking the items (I understand the purpose of the app) on a five-point Likert scale. The results are summarized in Table 6. The high values of median, mean and the significant p-value of Wilcoxon-signed rank test revealed that most respondents recognized the purpose of these apps which were mainly developed to curtail the spread of the coronavirus.

Table (6) Respondents' responses about their understanding the purpose of MOH apps

I understand the purpose of the app	Descriptive statistics			One-sample Wilcoxon signed rank test	
	Median	Mean	Std. Deviation	Wilcoxon statistic	P-value
Tabuad	5	4.3	0.96	106845.0	<0.001
Tawakklna	5	4.7	0.61	225060.0	<0.001
Tataman	5	4.3	0.95	102612.0	<0.001
Seha	5	4.4	0.93	126864.5	<0.001
Mawid	5	4.4	0.93	138880.0	<0.001

b. Perception of benefits

The respondents were asked to rate their perceived benefits of MOH apps by ranking the items (I find the app to be beneficial) on a 5-point Likert scale. Table 7 presents the values of median, mean and respondents' score. The high median and mean scores and the significant p-value of Wilcoxon-signed rank test showed that the respondents perceived the benefits of all mhealth apps.

Table (7) Respondents' responses about the benefits of MOH apps

I find the app to be beneficial	Descriptive statistics			One-sample Wilcoxon signed rank test	
	Median	Mean	Std. Deviation	Wilcoxon statistic	P-value
Tabuad	5	4.2	1.08	90465.0	<0.001
Tawakklna	5	4.7	0.68	213658.0	<0.001
Tataman	5	4.2	0.96	79623.5	<0.001
Seha	5	4.4	0.89	108499.5	<0.001
Mawid	5	4.4	0.96	119290.5	<0.001

c. Satisfaction

Respondents were asked to rate their overall satisfaction with MOH mhealth apps by ranking the items (I am satisfied with the app in general) on a 5-point Likert scale. Table 8 shows that the satisfaction levels were very high. The median value of the satisfaction rating is 5, whereas the median value varies between 4.3 and 4.6; both values reveal that levels of satisfaction with the five apps were very high. Moreover, the one-sample Wilcoxon signed rank test results also show that the respondents were satisfied with mhealth, with all p-values less than 0.05.

Table (8) Respondents' satisfaction with the use of MOH apps.

I am satisfied with the app in general	Descriptive statistics			One-sample Wilcoxon signed rank test	
	Median	Mean	Std. Deviation	Wilcoxon statistic	P-value
Tabuad	5	4.3	0.94	104346.0	<0.001
Tawakklna	5	4.6	0.75	174155.0	<0.001
Tataman	5	4.3	0.89	90951.0	<0.001
Seha	5	4.4	0.84	114405.0	<0.001
Mawid	5	4.4	0.93	108730.0	<0.001

3.6.Correlation between the satisfaction with the MOH mhealth apps and the perceived purpose, benefits, and technical difficulties

Table 9 presents spearman's rho correlation analysis between the satisfaction with the MOH mhealth apps and the perceived purpose, benefits, and technical difficulties. The results show a significant positive correlation between the users' perceived benefits of MOH mhealth apps with their satisfaction levels. The results also show a significant positive relationship between the perceived purpose of MOH mhealth apps with their perceived benefits and satisfaction with these apps. This implies that the app users who understood MOH mhealth apps' purpose perceived their benefits and had high satisfaction levels with them. Furthermore, there was a weak negative and significant correlation between perceived technical difficulties of using MOH apps with their satisfaction with the apps. This shows that the app users with high satisfaction levels perceived less technical difficulties when using MOH apps.

Table (9) Spearman's rho correlation between the perceived purpose, perceived benefits, perceived technical difficulties, and satisfaction with the use of MOH mhealth apps

Dimension	Perceived purpose	Perceived benefits	Perceived technical difficulties
Satisfaction	0.597^{***}	0.637^{***}	-0.204^{**}
Perceived technical difficulties	-0.139^{***}	-0.103^{**}	-
Perceived benefits	0.735^{***}	-	-

*** p< 0.001; ** p<0.01; *p<0.05

3.7.Demographic factors associated with the users' evaluations of the MOH mhealth apps

Table 10 shows the results of Mann-Whitney tests of perceived purpose, benefits, technical difficulties, and satisfaction with the MOH mhealth apps with respect to gender, age, income, education, nationality, marital status, and employment status. Regarding the purposes of mhealth apps, the results show there were significant differences in the users' perceptions with respect to marital status, employment status and age (p-value < 0.05), with married, employed, and older users having higher understanding of the purpose of mhealth apps. However, there were no significant differences in the perceived purposes of mhealth apps with respect to gender, nationality, education, and monthly income (p-value > 0.05). In terms of benefits, the findings revealed significant differences in the perceived benefits of mhealth apps with respect to marital status, employment status and age (p-value < 0.05), with married, employed, and older users having higher perceptions of usefulness of the mhealth apps. Other demographic variables had no significant effect on users' perceptions related to the benefits of the apps. As for technical problems with using the apps, the results showed that there were significant differences in perceived technical difficulties with respect to gender and income (p-value < 0.05), with male and users' who earned less than 10 thousand SAR monthly having perceived higher technical problems with the mhealth apps. The study revealed significant differences in the users' perceived satisfaction with respect to marital status, age, and income (p-value < 0.05), with married, older, and users with higher income being more satisfied. However, gender, nationality and education had no significant effect on the perceived satisfaction (p-value < 0.05).

Table (10) Results of Mann-Whitney test of MOH apps users' evaluation of purpose, benefits, technical difficulties, and satisfaction with the apps with respect to socio-demographic variables

Variable	Purpose (Median)	Benefits (Median)	Technical difficulties (Median)	satisfaction (Median)
Gender:				
Male	4.8	5.0	2.3	4.6
Female	4.6	4.5	2.0	4.8
Z	-0.9	-1.8	-2.2	-0.3
p-value	0.390	0.073	0.028	0.763
Nationality:				
Saudi	4.6	4.8	2.0	4.6
Non-Saudi	4.9	5.0	2.1	5.0
Z	-0.5	-0.7	-0.5	-0.8
p-value	0.600	0.470	0.647	0.418
Marital status:				
Unmarried	4.4	4.2	2.4	4.2
Married	4.8	5.0	2.0	5.0
Z	-3.4	-5.3	-0.8	-5.3
p-value	0.00	0.00	0.432	0.00
Employment status:				

Employed	4.8	5.0	2.0	4.8
Unemployed	4.6	4.6	2.0	4.6
Z	-2.5	-2.2	-0.2	-0.8
p-value	0.013	0.031	0.870	0.424
Age (years):				
< 30	4.4	4.2	2.4	4.2
30+	4.8	5.0	2.0	5.0
Z	-3.4	-5.2	-0.2	-4.5
p-value	0.001	0.000	0.856	0.000
Education:				
Secondary	4.8	5.0	2.1	5.0
University degree	4.6	4.7	2.0	4.6
Z	-1.9	-1.3	-2.6	-1.3
p-value	0.060	0.206	0.009	0.197
Monthly income (Saudi riyals)				
< 10000	4.7	5.0	2.4	5.0
10000+	4.6	4.8	2.0	4.6
Z	-0.5	-0.5	-3.3	-2
p-value	0.604	0.610	0.001	0.048

4. Discussion

In Saudi Arabia, the adoption of mhealth applications has become a priority for improving healthcare services, particularly during pandemics. To contain the spread of the COVID-19 pandemic, the Saudi MOH has developed and launched many mhealth apps. This study aimed to evaluate the users' awareness, use, and perceptions toward the leading mhealth apps, i.e., Tabaud, Tawakkalna, Tatamman, Seha, and Mawid. In addition, the study assessed the inter-relationships in users' perceptions and tested the differences in the users' evaluations across the demographic variables. The study findings revealed that most of the Saudi population used the mhealth apps, particularly the Tawakalna app. The results show that the most known app was Tawakklna, followed by Tabaud, Seha, Mawid, and Tataman. Tawakklna was also the highest app used by respondents. These findings are similar to a study that found that the Tawakklna app is the most used among MOH apps [11]. Another study conducted on pharmacy interns in Saudi Arabia found that almost all interns knew the Tawakkalna app [19]. The high knowledge and use of the Tawakklna app could be attributed to a large number of services it provides and its mandatory use to get services from private and public organizations. Moreover, the study results show that social media networking and the MOH website were the most reported methods for knowledge of mhealth apps. Social media today play a significant role in raising public awareness, particularly in Saudi Arabia, where 79.25% of the population were active social media users at the time of the study [20].

The study findings showed that most users understood the purposes of the MOH mhealth apps, perceived their benefits, were satisfied with these apps, and did not face any technical difficulties in using them. This is consistent with a previous study conducted in Saudi Arabia which provided evidence that

the users of Seha app were satisfied with its functions and services [21]. Another recent study conducted among physicians in Saudi Arabia found that most respondents were satisfied with the Seha app in delivering healthcare to their patients [22]. Our study findings on mhealth apps are also consistent with the results of two previous studies conducted in Dubai, which found that most users of Dubai Health Authority apps, Sehhaty and MyChart, perceived the apps to be useful, were satisfied with them, and found them easy to use [23,24]. Also, our findings are consistent with study results conducted in USA, which show that most patients were highly satisfied with the healthcare services they received from the community mobile health clinic [25]. Prior studies on mhealth apps have shown that well-designed apps help patients adhere to medical advice and the medications prescribed by the health providers [26]. This study found that most users did not face difficulties in using the five MOH apps. These findings are also consistent with the prior study conducted in Saudi Arabia that found that the Seha app users had faced fewer technical problems associated with using the app [21].

This study also indicated that the users of the app who understood the purpose of MOH mhealth apps perceived their benefits and had high satisfaction levels with them. Additionally, the app users who had high satisfaction levels perceived less technical difficulties using MOH apps. These results align with the findings of a study carried out in Saudi Arabia, which found a significant association between technical problems and low satisfaction with Seha app [21]. Although most users had not faced technical problems, reducing the technical problems with the mhealth apps would enhance the satisfaction level and improve the delivery of healthcare services.

Some demographic factors had a significant association with the users' evaluations of mhealth apps. The users had differences in their perceptions in terms of apps' perceived benefit and purpose with respect to marital status, employment status and age, with married, employed, and older users having higher perceived usefulness and higher understanding of the purpose of mhealth apps. These findings are consistent with those of a similar study carried out in the United Arab Emirates which found that the higher the age, the more the users perceive the apps to be beneficial [23]. Also, the study found that gender and income had an association with perceived technical difficulties, with male and users' who earn less than 10 thousand SAR monthly have perceived greater technical problems with the mhealth apps. This reveals that policymakers need to consider the Saudi population segments with respect to gender and income in future public awareness campaigns for the use of mhealth apps. The study also revealed significant differences in the users' perceived satisfaction with respect to marital status, age, and income, with married, older and users with higher income being more satisfied. However, gender, nationality and education had no significant effect on the perceived satisfaction. These findings were differed partly from

those of AlSuwaidi and Moonesar who found that age and nationality had significant effects on perceived satisfaction, whereas gender and education had no significant effects.

In this study, a convenience sample was used, which may not be fully representative of the study population. Hence, we could not generalize the findings from this study to the whole population. Therefore, there is the need for future studies to be done with a more representative sample of the population in terms of nationality, region, education, income, age, among other factors.

5. Conclusion

Overall, the study respondents were aware of all five apps - Tabuad, Tawakklna, Tataman, Seha, and Mawid. Moreover, the majority of the users had positive perceptions about the purposes and benefits of the mhealth apps, and they were satisfied with them. They did not face technical problems while using these apps. Additionally, the differences in users' evaluations of mhealth apps with respect to demographic variables showed that gender, age, marital status, employment status, and income are important factors affecting the evaluation of health apps. This reveals that there were some areas for improvement to enhance users' satisfaction with mhealth apps developed by the Saudi MOH. This includes the need to consider the population segment with respect to demographic variables in future public awareness campaigns for the use mhealth apps. With the increasing number of services on mhealth apps, further research is needed to evaluate these apps.

6. Declarations

6.1 Conflict of Interest Statement

The authors have no conflict of interests to declare.

6.2 Funding Disclosure

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

6.3 Ethical Considerations

The study was reviewed and approved by the Ethics Committee of Scientific Research at the Deanship of Scientific Research that supports the King Saud University Institutional Review Board (KSU IRB). The committee, on behalf of the Institutional Review Board, approved the research (reference number KSU-HE-21-169). Informed consent was obtained from all subjects or, if subjects were under 18, from a parent and/or legal guardian. All methods were performed in accordance with the relevant guidelines and regulations.

6.4 Author's Contribution:

Abdullah Almufarij contributed to the research conceptualization, methodology, formal analysis, literature review, and writing. Abeer Alharbi contributed to the research conceptualization,

methodology, and writing – review & editing.

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