Mobile Health Applications to Support COVID-19 Self-management: Review and Evaluation

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Abstract

Aim: During the epidemic and with an increase in coronavirus (COVID-19) disease prevalence, emergency care is essential to help people stay informed and undertake self-management measures to protect their health. One of these self-management procedures is the use of mobile apps in health. Mobile health (mHealth) applications include mobile devices in collecting clinical health data, sharing healthcare information for practitioners and patients, real-time monitoring of patient vital signs, and the direct provision of care (via mobile telemedicine). Mobile apps are increasing to improve health, but before healthcare providers can recommend these applications to patients, they need to be sure the apps will help change patients' lifestyles.

Method: A search was conducted systematically using the keywords "Covid-19," "Coronavirus," "Covid-19, and Self-management" at the "Apple App Store". Then we evaluated the apps according to MARS criteria in May 2020.

Results: A total of 145 apps for COVID-19 self-management were identified, but only 32 apps met our inclusion criteria after being assessed. The overall mean MARS score was 2.9 out of 5, and more than half of the apps had a minimum acceptability score (range 2.5-3.9). The "who academy" app received the highest functionality score. Who Academy, Corona-Care and First Responder COVID-19 Guide had the highest scores for behavior change.

Conclusion: Our findings showed that few apps meet the quality, content, and functionality criteria for Covid-19 self-management. Therefore, developers should use evidence-based medical guidelines in creating mobile health applications so that, they can provide comprehensive and complete information to both patients and healthcare provider.

Keywords: Covid-19; Coronavirus; Self-management; Mobile application; Mobile health

COVID-19 is a new respiratory virus that first appeared in Wuhan, China (1). The World Health Organization (WHO) has introduced the COVID-19 as universal health calamity and a pandemic (2). WHO reported 93,194,922 confirmed cases of COVID-19 and 2,014,729 related deaths globally (As of 5 may 2020) (3). Now, the outbreak of COVID-19 disease is increasing. In addition, the disease is more severe in the elderly and those with underlying medical conditions (4). If this disease is not managed and controlled soon, it can affect the society's economy and make daily life difficult (2, 5). Due to the spread of coronavirus in the world, people must have access to accurate health information to prevent the spread of infection (6).

In this situation, Mobile health applications (mHealth apps) as a possible way for self-management, education, access to health information and follow-up of patients with coronavirus are essential, especially people who are in contact with coronavirus patients.

Mobile health (mHealth) is the use of cell-phones software applications and digital technologies to provide healthcare information. Smartphones may be helpful for vulnerable people, especially those exposure to coronavirus (7, 8). The benefits of smartphone applications and mHealth tools in the COVID-19 pandemic include interactive communication between patients and healthcare providers, easily access to information about the disease, promotion of self-management, prevention of infection transmission, reduction of anxiety and depression, and increase of quality of life (9).

Many mobile-based applications have been created to reduce the transmission and prevention of COVID-19(10), but the effectiveness of the majority of them has not been evaluated. Therefore, the design of health-related apps should be based on the approved guidelines and policies of a regulatory body (such as the Food and Drug Administration [FDA]), (7, 11). The Mobile App Rating Scale (MARS) is one of the tools developed to evaluate mHealth apps in mobile stores systematically. MARS has been used in previous studies to evaluate various health-related apps such as Alzheimer's disease (12), infants self-care in the intensive care unit (13), sleep control (14), health behavior change (15), diabetes (16), weight management (17) and pain management (18). This article aims to identify and evaluate existing mHealth apps for self-management and improving coronavirus disease control.

Method

This study was conducted in three phases as follow:

1- Search strategy and apps extraction

In May 2020, a search was conducted systematically in Apple iTunes (IOS) to identify all available apps for COVID-19 self-care. The following search terms were used to identify relevant apps: "Covid-19," "Coronavirus," and "Covid-19 and Self-management". Inclusion criteria for the apps were as follows; focused on covid-19 self-management; to be currently available on the public market; to be in English-language; to be a free app; and to be classified as "Health & Fitness," "Medical," or "Lifestyle." In the first round of screening, applications that were purchasable, entertaining, unrelated to Covid-19, and used at the conference, education, reference purposes, business, and news were removed. In the second round, we used exclusion criteria that included none English apps, none functioning apps for any reason, similar versions of the same app, apps with a user star rating of less than 2.5, and none patient-centered apps (see figure 1 flowchart). Then, team members evaluated the programs that met the inclusion and exclusion criteria. Any discrepancies in inclusion and exclusion criteria ratings between the team members were discussed until consensus was reached. The remaining apps were downloaded, reviewed (IOS 13.4.1 on iPhone 6), rated, and evaluated by two reviewers (SKH, EGH). Finally, reviewers extracted the following details from the programs: the app name, user star rating, language, category, version, developer, and last update.

2- Mobile App Rating Scale (MARS)

The Mobile App Rating Scale (MARS) tool has been developed to assess mHealth apps' quality systematically. It contains 23 items in 3 sections of classification, quality, and satisfaction. The classification section provides descriptive information about the apps (such as price, platform, rating, version, developer), health information (including physical health, mental health, behavior change, happiness), theoretical strategies (such as assessment, information,

monitoring, skills training), technical aspects (such as log-in, password-protection, send reminders, sharing capabilities), and age group. The quality section contains 19 items, which are divided into four subscales, including engagement (5 items), functionality (4 items), aesthetics (3 items), and information quality (7 items). This study first calculated the mean score for four subscales of engagement, functionality, aesthetics, and information separately. Then, we add the scores obtained from four subscales (engagement, functionality, aesthetics, and information), and in the next step, we divide the obtained scores by four and get its average, which is the same as the overall MARS score. The overall score between the range 2.5-5 as good quality and the range of 1.3-2.2 as poor quality is classified.

The subjective quality of MARS, which evaluated the user's satisfaction, includes four questions of app recommendation, the number of times the app has been used, pay for the app, and star rating. These questions are rated are rated with a 5-point Likert (1 = inadequate, 2 = poor, 3 = acceptable, 4 = good, and 5 = excellent). We add scores together and divide by 4; the average obtained is the same as the app's subjective quality (satisfaction).

Behavior change is used to assess the impact of the apps on the user's Awareness, Knowledge, attitudes, intention to change, help to seek, and actual change in the health behavior. Supplementary Table 1 shows the MARS scales and subscales. The MARS showed excellent internal consistency (alpha = 0.90) and good reliability correlation (ICC = 0.79) (19).

3- Data Analysis

Two reviewers installed the apps independently, used each app for a minimum of 30 minutes, and then rated the content and quality of the apps. Descriptive statistics were used to assess the apps' characteristics and contents.

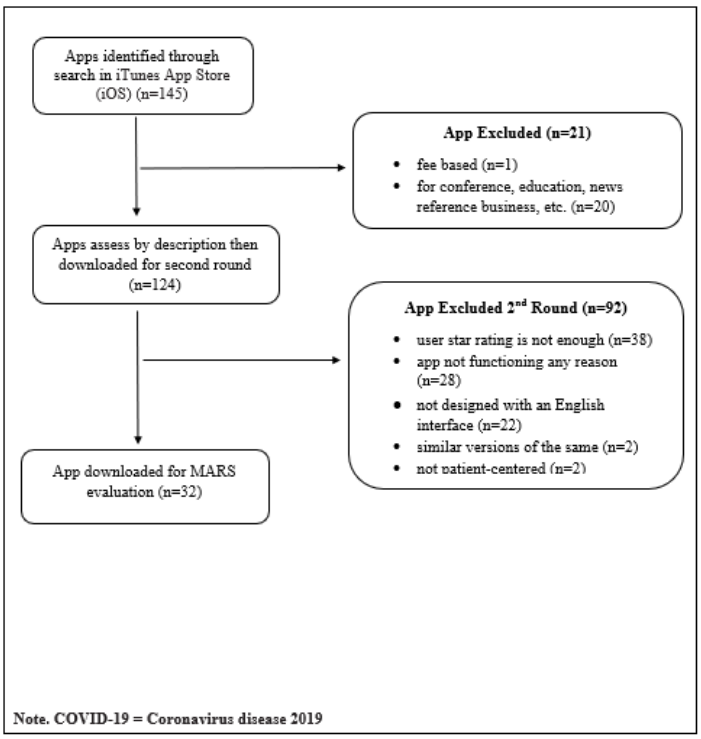

Figure 1: Flowchart of the COVID 19-related app

Table 1: MARS items and subscales criteria

App Quality Scoring Criteria	Subscales
1. Engagement	1.1 Entertainment 1.2 Interest 1.3 Customization 1.4 Interactivity 1.5 Target group
2. Functionality	2.1 Performance 2.2 Ease of use 2.3 Navigation 2.4 Gestural design
3. Aesthetics	3.1 Layout 3.2 Graphics 3.3 Visual appeal
4. Information	4.1 Accuracy of app description 4.2 Goals 4.3 Quality of information 4.4 Quantity of information 4.5 Visual information 4.6 Credibility 4.7 Evidence base
5. Subjective quality (Satisfaction)	5.1 Would you recommend this app? 5.2 How many times do you think you would use this app? 5.3 Would you pay for this app? 5.4 What is your overall star rating of the app

Results

The findings of this study are categorized into sections as follows:

- ***Screening Process***

The flow diagram (Figure 1) presents the details of the inclusion and exclusion criteria. In search strategy, 145 Apple Store apps (iOS) were found, of which 32 apps met the inclusion criteria. Most of the apps were excluded for the following reasons: (1) user star rating was not satisfactory (n = 38), (2) app did not function for any reason (n = 28), (3) the app was not in English (n = 22), and (4) the app was used for conference, education, reference business, news, etc. (n=20).

- ***Descriptive characteristics of the apps***

Table 1 shows the extracted apps and their specifications. All apps were free to download, and only in Healthlynked COVID-19 Tracker and COVID-19, and applications, the users had to pay a subscription fee to access more app features and capabilities. The average user star rating of the remaining 32 apps was 4.4 out of 5, with a range of 2.5 to 5. The privacy policy was seen in more than 50% of the apps, which covered collecting, using, disclosing, transferring, and storing personal information. Eighty-one percent of the apps evaluated required an Internet connection to perform their function, and to access the available information, seven applications needed user account and password. Approximately in 34.3% of apps (n=11), users could share their health status information through email and social media, and 21.8% of the apps (n=7) had a reminder function. The majority of apps were developed by commercial providers (n=12), followed by government agencies (n=11), non-profit organizations (n=3), universities (n=3), hospitals (n=2), and other types of providers (n=1). Ninety percent (29 from 32 apps) of the apps had been updated in the past month.

Seven apps (e.g., *Sentinel Monitor, JamCOVID19*) were using dashboard mapping tools to show the prevalence of Covid-19, while three apps (*COVID-19, COVID-19 UAE, Healthlynked COVID-19 Tracker*) had chatbot and voice/video calls capabilities that could facilitate conversation between human and computer. Only the *Corona-Care* app provided a virtual appointment feature to call healthcare providers if needed. Some apps (6 from 32 apps, 18.75%) used GPS features, enabling users to find nearby hospitals, pharmacies, and approved covid-19 labs. According to the MARS theoretical strategies criterion, the purpose of apps was for self-assessment (n=20) and to show updated information on COVID-19 disease (n=17). Covid-19-related apps were classified as medical (53.1%) and health & fitness (43.7%), and only *Rakning c-19* app was classified as a

lifestyle app. Twenty apps (44.8%) included symptom tracking options, which help users screen and self-assess their covid-19-related symptoms. *Corona-Care* could sync with various fitness apps (e.g., Health kit, Withings, Fitbit, Kardia). Also, most programs (25%) were based in the United States.

Mobile Application Rating Scale Quality Scores

The MARS subscale scores, subjective quality (satisfaction), app-specific health behavior, and the overall quality are shown in Supplementary Table 2. Of the four subscales, functionality had the highest score (3.11), and information had the lowest score (2.8). The average score of the engagement section was 3.04. The *Who Academy* and *NHS24: Covid-19* programs received the highest score for engagement.

The average score of the functionality section with four sub-sections was 3.11. The *Who Academy, Corona-Care, First Responder COVID-19 Guide, NHS24: Covid-19, Apple COVID-19,* and *Healthy together - COVID-19* apps obtained the highest scores in the functionality section. Non-profit organizations' applications had better function scores than for-profit ones. The average score of the esthetics section with three sub-sections was 3.02. *Sentinel Monitor, JamCOVID19,* and *Who Academy* applications obtained the highest score. The average score of the information section with 7 sub-sections was 2.8. The scores ranged from 1.7 to 5.

The *Who Academy* app received the highest score for information (Figure 2). The MARS overall quality average was 2.9 out of 5. More than half of apps (23/32, 71.8%) obtained an acceptable score (ranging from: 2.5-3.9) for the MARS overall quality, and 28% (2/32, 6.2%) obtained a good score (range: 4.0-4.2). Also, only the *Who Academy* app received an excellent score. The *Who Academy* app had the highest average MARS score (5), followed by *Corona-Care* (4.2) and *First Responder COVID-19 Guide* (4.1).

The MARS subjective quality average was 2.2 out of 5. Less than 50% (14/32) of the apps obtained an acceptable score in the subjective quality (ranging from: 2.5-4.5). The *Who Academy* app had the highest average MARS subjective quality score (4.5), followed by *Corona-Care* (4), *COVID-19 UAE* (3.5), and *Sentinel Monitor* (3.5). The *Who Academy* (5), *Corona-Care* (4.3), and *First Responder COVID-19 Guide* (4.1) apps obtained the highest scores for app-specific health behavior change (Figure 3).

Table 2: COVID-19 apps' description

#	Name app	Star rating	Country	Language	Category	Version	developer	Last update
1	Corona Checker	5	unknown	English	medical	1.05	Openmed	May 4, 2020
2	Canada COVID-19	5	Canada	English, French	medical	3.0	Health Canada	Apr 27, 2020
3	NHS24: Covid-19	5	Scotland	English	medical	1.0.3	NHS 24	May 11, 2020
4	Speetar COVID19	5	Libyan	English, Arabic, Urdu	Health & Fitness	1.2	National Centre for Disease Control	May 4, 2020
5	BeWellXcel	5	unknown	English	Health & Fitness	1.0.5	Montefiore Applications, LLC	May 12, 2020
6	COVID AI	5	unknown	English	medical	unknown	AI Biokinetic Technologies	May 14, 2020
7	Covid-19 Wisconsin.connect	5	midwestern united states (Wisconsin)	English	medical	unknown	University of Wisconsin-Madison shared apps	Unknown
8	Coronavirus -Covid19	4.9	Moscow	English, Russian	Health & Fitness	1.3.0	Verbaclinic	May 4, 2020
9	covid control	4.9	unknown	English	medical	2.1	John Hopkins Mobile medicine	May 11, 2020
10	COVID symptom study	4.8	London	English	medical	1.9	Zoe Global Limited	May 11, 2020
11	HowWeFeel	4.8	United States	English	Health & Fitness	1.0.5	The How We Feel Project, Inc.	Apr 27, 2020
12	Apollo COVID-19	4.8	unknown	English, Chinese, Filipino, French, German, Japanese, Korean, Simplified Chinese, Spanish, Tagalog, Traditional Chinese, Vietnamese	Health & Fitness	1.2.8	Gauss Surgical, Inc	Apr 27, 2020
13	Healthy together - COVID-19	4.7	western United States (Utah state)	English, Spanish	medical	1.1.2	Twenty Holdings, Inc	May 11, 2020
14	Who academy	4.7	United states	English, Arabic, French, Portuguese, Russian, Spanish	medical	1.0.1	World health organization	May 1٧, 2020
15	Healthlynked COVID-19 Tracker	4.6	United States	English	medical	1.0.58	HealthLynked Corp	Apr 27, 2020
16	Sentinel Monitor	4.6	unknown	English, Spanish	medical	1.5	Sentinel Healthcare Corp	Apr 27, 2020
17	COVID Coach	4.6	United States	English	Health & Fitness	1.2.1	US Department of Veterans Affairs (VA)	May 11, 2020

#	Name app	Star rating	Country	Language	Category	Version	developer	Last update
18	COVID-19 UAE	4.4	United Arab Emirates	English, Arabic, Urdu	Health & Fitness	2.0.2	Ministry of health UAE	May 4, 2020
19	Corona-Care	4.3	unknown	English, Dutch, French, German, Italian	medical	1.2.7	PaxeraHealth Corp	May 14, 2020
20	Apple COVID-19	4.3	United States	English, Arabic, Catalan, Chinese (Hong Kong), Croatian, Czech, Danish, Dutch, Finnish, French, German, Greek, Hebrew, Hindi, Hungarian, Indonesian, Italian, Japanese, Korean, Malay, Norwegian, Polish, Portuguese, Romanian, Russian, Simplified Chinese, Slovak, Spanish, Swedish, Thai, Traditional Chinese, Turkish, Ukrainian, Vietnamese	Health & Fitness	3.0	Apple Inc.	May 14, 2020
21	coronaFACTS	4.3	United States	English	medical	1.9	Trusted Medical LLC	May 12, 2020
22	C spire Health	4.3	Mississippi	English	medical	1.2.2	C spire	May 16, 2020
23	JamCOVID19	4.3	Jamaica	English	Health & Fitness	unknown	Government of Jamaica	May 17, 2020
24	NZ COVID Tracer	4.3	New Zealand	English,	Health & Fitness	1.0.1	Ministry of Health (NZ)	May 20, 2020
25	First Responder COVID-19 Guide	4.2	California	English	Health & Fitness	3.2	Stanford University	May 16, 2020
26	COVID-19!	4	Czech Republic	English	medical	0.9.12	Nemocnice Milosrdnych bratri, p.o.	May 11, 2020
27	Crush covid RI	4	Iceland	English, Spanish	Health & Fitness	unknown	RI	Unknown
28	Safedistance: COVID-19 Map	3.7	Minnesota	English,	Medical	1.4	healthPartners	May 20,2020
29	Coronavírus – SUS	3.6	Brasil	English	Health & Fitness	2.0.6	Governo do Brasil	Apr 27, 2020
30	COVID-19	3.4	Vietnam	English	medical	2.2	Electronic health administration, ministry of health Vietnam	Apr 17, 2020
31	Rakning c-19	3.3	Iceland	English,	Lifestyle	1.1.0	Landleaknisembaettid	April, 26,2020
32	PatientSphere for COVID19	3	unknown	English	Health & Fitness	unknown	Open Cancer Network	Unknown

Table 3: Mobile Application Rating Scale Scores

Name app	Engage	Function	Aesthetics	Information	Satisfaction	Behavior change	Overall
Healthlynked COVID-19 Tracker	2.2	2.5	3	2.5	1.7	3.3	2.5
Apple COVID-19	3.4	4	3.6	3.8	3.2	3	3.7
COVID-19!	1.4	1	1.6	1.7	1	2.3	1.3
COVID-19	2.6	3	3.3	3.1	1.7	3.5	3
COVID-19 UAE	3.4	3.5	3	3.7	3.5	3.3	3.4
Corona-Care	4	4.5	5	3.5	4	4.3	4.2
Corona Checker	3	2.2	2	3.1	2.2	3	2.5
Canada COVID-19	3.2	3	2.6	3	2.5	3	2.9
COVID symptom study	2	3	1.6	2.4	1.5	2.3	2.2
Coronavirus -Covid19	2.6	2.2	3	2.2	1.2	2.3	2.5
Healthy together - COVID-19	3	4	2.3	2.4	2	2.3	2.9
Coronavírus – SUS	2.6	2	3	2.4	1.5	2.6	2.5
coronaFACTS	2.2	2	1.6	1.7	1.2	3	1.8
PatientSphere for COVID19	2.4	3	2	2.1	1.2	2.3	2.3
HowWeFeel	3.6	3.5	3.3	3	2.7	2.3	3.3
First Responder COVID-19 Guide	4	4.5	4.3	3.7	3.2	4.1	4.1
Sentinel Monitor	3.4	4	5	3	3.5	3	3.8
Apollo COVID-19	3.4	3	3	2.4	2.7	3	2.9
C spire Health	2.4	2	2.3	2.1	1.5	2.7	2.2
NHS24: Covid-19	4.4	4.5	4	3	2.7	3.6	3.9
Speetar COVID19	3.2	3	3	3.5	2	3.5	3.1
COVID Coach	3	2.7	3	2.2	1.7	2.6	2.7
BeWellXcel	3.2	3	2.6	3	2.7	3	2.9
JamCOVID19	3.4	3.5	5	3.7	3	2.6	3.9
COVID AI	3.2	3	2.6	3	2	2.3	2.9
covid control	3.4	3.5	3.6	3.1	3.2	2.8	3.4
Who Academy	5	5	5	5	4.5	5	5
Covid-19 Wisconsin.connect	3.2	3.5	2.6	3.5	2	3	3.2
Safedistance: COVID-19 Map	2.8	3	2.6	2.2	1.5	2	2.6
Crush covid RI	3	3	3	2.4	2	2.8	2.8
NZ COVID Tracer	2	2	1.3	1.7	1.5	1	1.7
Rakning c-19	2.8	3	3	2.5	2.5	3	2.8
Total	3.04	3.11	3.02	2.8	2.2	3.5	2.9

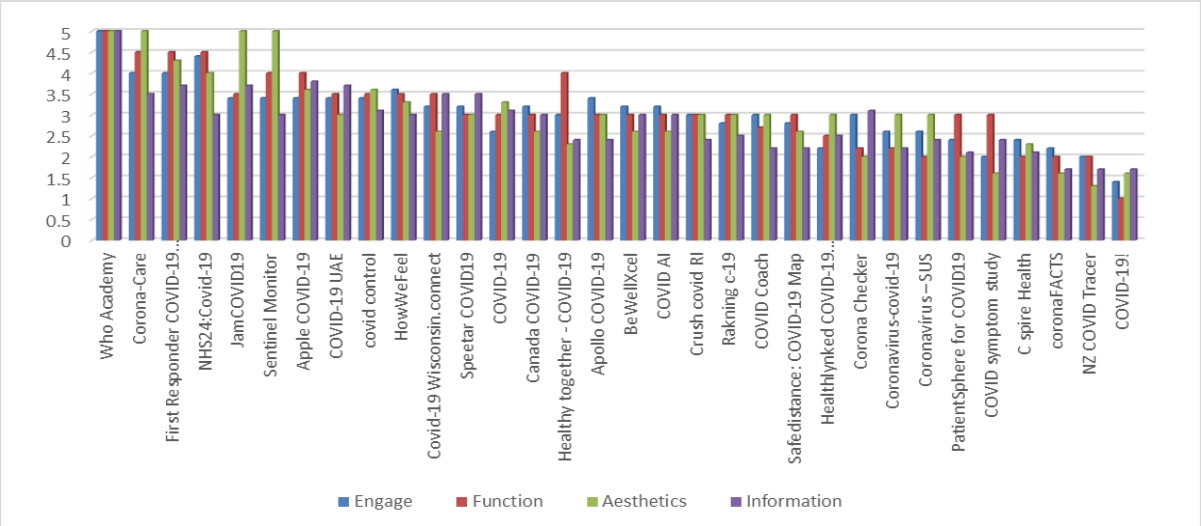

Figure 2: engagement, functionality, aesthetics, and information subscales score average based on MARS in COVID-19 apps

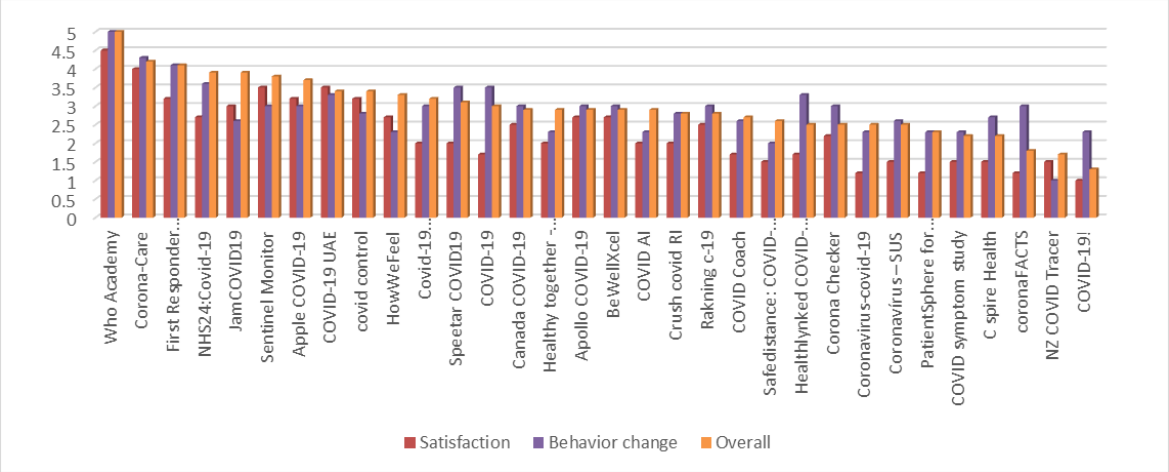

Figure 3: satisfaction, behavior change, the overall mean score in COVID-19 related apps

Discussion

This study is the first to evaluate mobile applications for tracking and self-management of COVID-19 symptoms using validated tools such as MARS. Our research showed that few apps on the smartphone for the Covid-19 self-management have average quality, content, and functionality. Overall, more than half of the apps had good quality (range 2.5-5), and less than a quarter of apps had poor quality (range 1.3-2.2). We classified Who Academy, Corona-Care, First Responder COVID-19 Guide, NHS24: Covid-19, JamCOVID19, Sentinel Monitor, and Apple COVID-19, Sentinel Monitor apps as high-quality applications in Engagement, functionality, aesthetics, and information section. The most common functionality in 32 apps was patient daily self-assessment and information about the disease to fight the coronavirus. Davalbhakta et al. showed that telephone health applications play an important role in disease information dissemination, contact tracing, symptom self-assessment, and improving care (20). Also, some applications provide up-to-date information on the COVID-19 symptoms and disease to reduce and control the prevalence of the virus to users (21). Patient self-assessment and screening based on travel

information can reduce the outbreak of coronavirus. Taiwan has used a special approach to identify cases of coronavirus quickly. Taiwan combined its national insurance database with a customs database to create a "big data" source based on clinical symptoms and travel history to quickly diagnosis Covid-19 patients (22). Some countries use screening devices for the early detection and tracking of high-risk patients. During the outbreak of severe acute respiratory syndrome (SARS), Korea used infrared thermal scanning as a surveillance system at international airports to monitor passengers' signs, especially body temperature and fever (23). Sun et al. (24) in Japan reported that using a radio-wave-based system could be important for monitoring patients' symptoms with suspected infectious diseases.

Meanwhile, Honghu used a mobile-based hybrid system to monitor the infected people. This system included reports, diagnostic tests, medical records, and social media (25). A short message service-based contact tracing strategy has controlled previous epidemic diseases such as Ebola in Western Africa (26).

Some mobile apps that use Bluetooth and Global Positioning System (GPS) features can be helpful in Covid-19 contact tracing (27). One of the apps is currently being used in the United States, which is called: "Healthy Together - COVID-19". This app uses Bluetooth tracking technology to identify people who have been in contact with Covid-19 patients. In addition, the Nigerian government uses global positioning data for contact tracing of confirmed cases, quarantine enforcement, and the rapid stop of Covid-19 disease (28). Also, a new electronic reporting tool has been developed with the name of "Surveillance and Outbreak Response Management System (SORMAS)," which is both a web-based and mobile-based application to prevent and control the Ebola virus in Africa (29, 30).

The study of Yasaka et al. (31) showed that tracking contact could effectively reduce the transmission of coronavirus among individuals. During the pandemic, access to evidence-based medicine (EBM) information can lead to the training of individuals and the reduction of transmission of coronavirus infection. Therefore, mHealth plays an important role in reducing the spread of Covid-19 and disseminating appropriate information. In a study in Switzerland, Zamberg et al. (32) created the "HeadToToe" mobile application, which helps healthcare providers' access medical information and guidelines related to COVID-19 disease. The WHO academy app was developed by the WHO and provides a comprehensive source of information on Covid-19 to healthcare professionals and the public. Hernández-García and Giménez-Júlvez (33) evaluated COVID-19 information on various websites, and their finding is somewhat consistent with our study. Also, their evaluation shows that few of webpages have complied with WHO guidelines but do not provide complete treatment recommendations to prevent COVID-19.

In our search, the number of COVID-19 applications had high functionality. There are key requirements that developers must pay attention to when creating mobile phone applications. Therefore, mobile health apps should be developed according to the Food and Drug Administration (FDA) rules and regulations or standards and must be approved by them (34, 35). The apps' content review showed that guidelines were used in some applications. Privacy policy and security are important concerns in the field of mHealth. Privacy is defined as access to health information by authorized persons (36, 37). However, in our study, only 56% of COVID-19 self-care applications provided data privacy and security. One of the essential issues of developers in creating health applications is user-interface design. Designers and

programmers must consider the technical capabilities, customization, usability, visual appeal, color scheme, and style in the user interface. Therefore, developers should consider patients and healthcare providers in the development process of Covid-19 related applications for better functionality.

Conclusion

Covid-19 belongs to the large family of viruses that cause acute respiratory infections. New digital health interventions such as mobile phone apps can have an important role in increasing information, self-care, and reducing coronavirus transmission. There are many covid-19 self-management apps in the market, but they do not have good quality and cannot affect the users. In our study, 32 apps were reviewed that could be helpful in Covid-19 self-care. On the other hand, most of these covid-19 programs have not been developed according to valid guidelines like the Food and Drug Administration guidelines [FDA]. FDA regulations show that features such as user-friendliness, simplicity, attractiveness, aesthetics, and users' needs should be considered in designing health-related applications. However, qualitative assessment and FDA regulations are essential for mobile phone health-related application security. Therefore, patient participation is one of the fundamental requirements in the design of mobile phone health-related applications. The MARS tool can be helpful in the quality assessment of mobile phone apps.

Limitations

One of the limitations of this study is its reliance on English apps. Some MHealth applications are designed for indigenous people in one country who speak their language. So, these apps could not be available for users all over the world. The second limitation is that mobile apps will be removed from the Apple Store after a specified time. The third limitation is that the deadline for the evaluation was May 2020, while many apps may have been designed and launched in recent weeks. Finally, some COVID-19 related apps might have been deleted and ignored according to our inclusion and exclusion criteria.

Disclaimer statements

- **Conflicts of Interests:** None.
- **Financial interests:** None.
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- **Authors' contributions:** S.Kh.'s contribution included methodology, writing, original draft preparation, application and data collections, Apps assessment. E.Gh.S.'s contribution included methodology, application and data collections, Apps assessment. L.Sh.'s contribution included conceptualization, supervision of methodology, validation, writing, and edition of the manuscript.

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