A Review Of Mobile Health Application Rating Scales

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Abstract

Nowadays, mobile devices have evolved to solve almost every problem and have become an indispensable part of our daily lives. According to statistics, users spend an average of three to five hours on their smartphones each day, and approximately ninety percent of this time is spent on applications. As in other sectors, mobile health applications (mHealth apps.) are increasingly utilized. The high demand in this regard naturally causes the rapid proliferation of mHealth applications, and it is becoming more and more challenging for both patients and healthcare professionals to identify superior applications due to the vast selection available in stores, varying in quality, reliability, and adherence to best practices in healthcare. In this context, various surveys and frameworks such as MARS, uMARS, ORCHA-24, ENLIGHT, THESIS, and ACCU^{3}RATE have been proposed to provide a systematic and standardized approach. In this study, a review of proposed rating scales will be conducted.

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1. INTRODUCTION

According to statistics, users spend an average of three to five hours per day on their smartphones, and this time increases every year (see Figure 1c). The widespread use of smartphones and mobile devices has contributed to the growing popularity of mobile applications (mobile apps) across various domains, including healthcare. The term "mHealth" (mobile health) emerged in the early 2000s.

Around the mid-2000s, the World Health Organization (WHO) recognized mHealth's potential and started using the term in its reports and initiatives, and by the 2010s, mHealth had become a well-established concept in the healthcare industry. WHO has defined mHealth as “medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices” (Kay et al.,

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2011). mHealth encompasses a wide range of functionalities, such as health monitoring, remote consultations, health education and information, medication adherence**,** disease management, wellness and lifestyle management, and emergency response.

Mobile health applications (mHealth apps) are an integral part of the broader mHealth ecosystem, working in tandem with other mobile health technologies to advance the goals of improving healthcare access, delivery, and outcomes through mobile devices. mHealth apps may contribute to the democratization of healthcare, by improving access to services and empowering individuals to take control of their health and well-being. These apps serve various purposes within the realm of mHealth, including health monitoring, disease management, telemedicine consultations, medication reminders, fitness tracking, and health education. According to a study conducted in the USA in 2023, almost half of the participants stated that they use sleep and weight control applications. Additionally, one-fifth of the participants stated that they use medication management (MM) and mental health applications (see Figure 1a). Especially after the COVID-19 pandemic, people increasingly turned to digital solutions for managing their health and well-being in the face of pandemic-related challenges and restrictions, and this has accelerated the adoption of mHealth applications. The installation rate of mHealth applications has increased by 65 percent worldwide. In fact, according to statistics reports from Statista.com, in some countries, such as South Korea, a significant increase of 135 percent was observed.

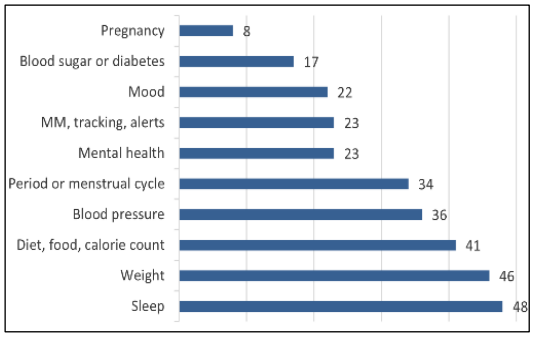

Figure 1a

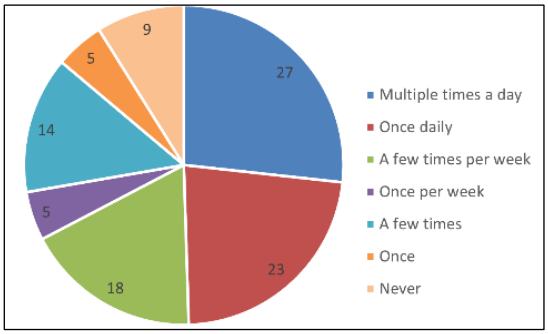

Figure 1b

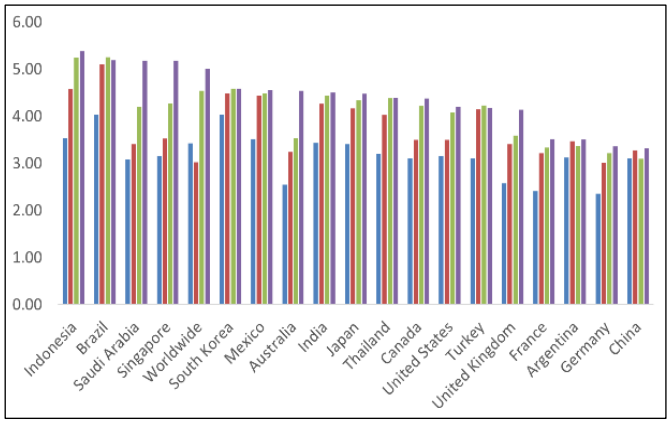

Figure 1c

Figure 1. Some statistics about digital health habits. (a) Adults' percentage in the U.S. who used an mHealth app. to monitor their health as of 2021. (b) Distribution of monthly frequency

of utilization of mHealth apps in the U.S. in 2023. (c) Worldwide mHealth app. usage time from 2019 to 2022, per day, by country (in hours). (Source: Statista, 2024)

The high demand for digital healthcare solutions in this regard naturally causes the rapid proliferation of mHealth applications. Figure 2 shows the number of mHealth applications produced from 2015 to 2022 through the Apple App Store and Google Play Store. As can be seen, there's been a noticeable rise in the number of mHealth applications since 2018, especially in the Play Store. Although having many alternatives seems to be an advantage, finding a high-quality mHealth app can be challenging due to the vast selection available in stores, varying in quality, reliability, and adherence to best practices in healthcare. Additionally, concerns regarding privacy, compatibility, and usability further complicate the process of selecting the most suitable mHealth app that offers accurate information, effective functionality, and robust security measures. Even though the number of downloads and star scores given by previous users are generally considered to evaluate application quality, studies show that the relationship is weak and insufficient (Azad-Khaneghah et al., 2021; Yamamoto et al., 2022). Moreover, star ratings and reviews in stores may be biased or deliberately written to mislead. In this context, various surveys and frameworks such as MARS, uMARS, ORCHA-24, ENLIGHT, THESIS, and ACCU^{3}RATE have been proposed to provide a systematic and standardized approach to determining the quality of mHealth apps. In this study, a review of proposed rating scales will be conducted.

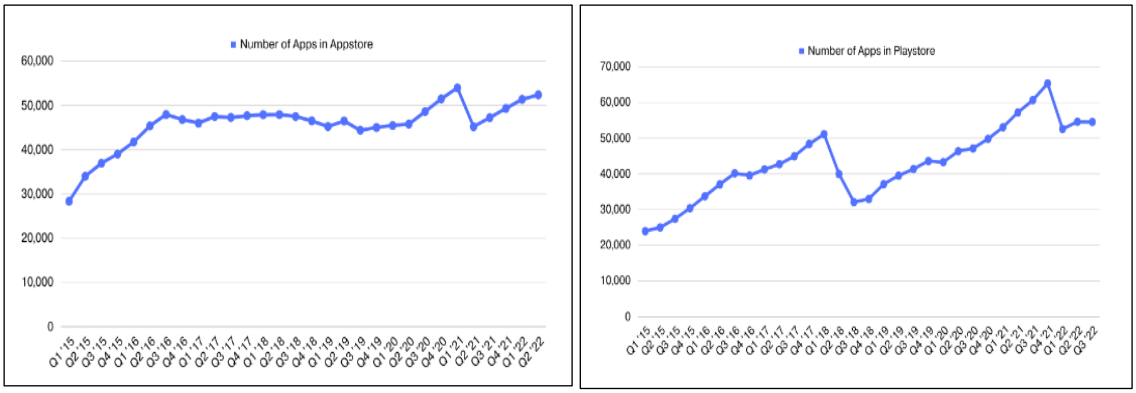

Figure 2. Number of available mHealth applications in the store (Source: Statista, 2024)

2. SCALES FOR MOBILE HEALTH APP EVALUATION

With the rapid proliferation of health-related apps, several scales and frameworks have been proposed to evaluate mHealth applications, aiming to provide a structured and systematic approach to assess their quality, usability, and effectiveness. Stoyanov et al. developed the Mobile Application Rating Scale (MARS) in 2015. The scale is used to systematically evaluate various aspects of mobile apps, including four objective qualities and one subjective quality based on user experience. Subsequently, Stoyanov and his colleagues simplified the language of the scale and proposed an end-user version of MARS known as u-MARS (Stoyanov et al., 2016). It has been developed as an extension of the original MARS framework and enables users to evaluate mobile apps from their perspective, considering factors that are important to their individual preferences and needs. In 2017, Leigh et al. proposed a specialized framework,

namely ORCHA-24, focused specifically on evaluating the quality of health apps, with a particular emphasis on healthcare-related criteria and standards (Leigh et al., 2017). ORCHA-24 evaluates mHealth apps across 24 key domains, including usability, functionality, safety, and clinical effectiveness. Unlike MARS, ORCHA-24 is tailored specifically for the healthcare context. Baumel et al. proposed a new scale, ENLIGHT, which is specifically designed for digital mental health interventions, focusing on aspects such as content quality, therapeutic approach, and data security (Baumel et al., 2017). The scale evaluates various dimensions of digital mental health programs, including content quality, user engagement, therapeutic approach, usability, and data security. In 2021, Biswass et al. proposed a scale, namely ACCU^{3}RATE, based on user reviews (Biswas et al., 2021). Like ENLIGHT, ACCU^{3}RATE is intended exclusively to evaluate mHealth apps. Quite different from other studies, text mining by artificial intelligence was used for the first time on this scale.

Related scales, their main dimensions, and the validity tests performed are listed in Table 1. Of course, all these proposed scales have different advantages over each other. Nonetheless, among the proposed mHealth application evaluation scales, MARS is the most used one up to the present; therefore, the MARS scale will be analyzed in more detail in the continuation of the study.

Table 1. Dimensions and performance metrics for well-known rating scales

Scale	Dimensions	Performance Metric
MARS	Engagement, functionality, esthetics, information, quality	ICC
uMARS	Engagement, functionality, esthetics, information, quality	ICC
ORCHA-24	Data governance, clinical efficacy and assurance, user experience and engagement	IR, ICC
ENLIGHT	Usability, visual design, user engagement, content, therapeutic persuasiveness, therapeutic alliance	ICC
THESIS	Usability, security/privacy, technical and health content, transparency	IR, ICC
ACCU^{3}RATE	User star rating, user text review, UI design, functionality, security and privacy, clinical approval	ICC

*ICC: Intra-class Corelation Coefficient, IR: Interrater reliability

3. MOBILE APPLICATION RATING SCALE (MARS)

Stoyanov et al. proposed the MARS scale, which consists of five main clusters, including four objective dimensions such as engagement, functionality, aesthetics, and information quality, and one subjective dimension based on user experience. They created a survey, which consisted of 23 items in total. For each survey question, the reviewer used a 5-point scale (such as 1: inadequate, 2: poor, 3: acceptable, 4: good, 5: excellent). The average score of subscales has been accepted as the score of each dimension, and the average score of dimensions has been accepted as the overall score of the relevant application. The scale was first tested in mental

health applications, then validity tests were completed in many areas, and good inter-rater reliability results were obtained (Stoyanov et al., 2015).

3.1. Adapted Version of MARS And UMARS For Different Countries

In recent years, the MARS scale has been adopted and translated into multiple languages, including Turkish. While the original English version of MARS provides a robust framework worldwide, its effectiveness is limited when evaluators and users are not proficient in English. Considering Turkey as an example, according to the English Proficiency Index (EPI), Turkey ranks 66th out of 113 countries in 2023, and its proficiency is categorized as low (EPI, 2023). Establishing a national-level framework will be effective in preventing reduced usage due to low English proficiency levels. In this context, many countries have chosen to adapt the scale to their national languages. Translating MARS into other languages enhances its efficiency, accessibility, and relevance, allowing non-English-speaking researchers, healthcare professionals, and app developers to utilize the tool effectively. Additionally, the translations help capture culturally specific nuances and preferences in app use and engagement, leading to more accurate and contextually relevant assessments. For example, in the Japanese adaptation, the authors stated that there is no Japanese word to express the concept of "engagement" (Yamamoto et al., 2022). Creating national versions of the MARS scale is important to prevent such language-related logical confusion. The expansion of MARS into multiple languages ensures that the evaluation of mHealth apps is consistent and reliable globally, addressing the diverse needs of users across various regions. Also, this ultimately contributes to the global standardization of mHealth app evaluations, promoting high-quality health interventions worldwide. In most of these studies, validity and reliability tests were also conducted for national applications, and high scores were obtained. Related studies are listed in Table 2.

Table 2. MARS and adaptations for different countries

Year	Country	Reference	Year	Country	Reference
2015	Original	Stoyanov et al., 2015	2022	Japan	Yamamoto et al., 2022
2016	Italy	Domnich et al., 2016	2022	Persia	Barzegari et al., 2022
2019	Spain	Payo et al., 2019	2022	Korea	Hee Ko et al., 2022
2020	Arabia	Bardus et al., 2020	2022	Turkey	Mendi et al., 2022
2020	Germany	Messner et al., 2020			

Besides, like MARS, uMARS has been adapted to some countries, such as Australia (Stoyanov et al., 2016), Spanish (Ruben, et al.), Japan (Mendi et al., 2022), Greece (Shinohara et al., 2022), and Turkey (Calik et al., 2022).

3.2. Applications of The MARS

MARS framework has found widespread application to evaluate a diverse range of mHealth apps across various health conditions and diseases, providing a standardized framework. Studies have applied MARS to assess apps designed for mental health, such as those targeting depression, anxiety, and stress management, highlighting its effectiveness in evaluating therapeutic engagement and content quality in psychological interventions. Additionally,

MARS has been used to evaluate apps for chronic disease management, ensuring that these apps provide reliable and user-friendly tools for monitoring and managing these conditions. Fitness and wellness apps, focusing on exercise, diet, and overall well-being, have also been evaluated using the MARS framework, underscoring its versatility in assessing a broad spectrum of health-related applications. Related studies are listed in Table 3.

Table 3. Healthcare fields where MARS is used in application quality assessment.

Content	Reference	Content	Reference
Well-being apps	Stoyanov et al., 2015	COVID19	Davalbhakta et al., 2020
Mindfullness	Mani et al., 2015	Weight management	Bardus et al., 2020
Heart failure	Creber et al., 2016	Anxiety	Messner et al., 2020
Back pain	Machado et al., 2016	Chronic health conditions	Miro et al., 2021
Weight management	Bardus et al., 2016	COVID19	Martin et al., 2021
Rheumatoid Arthritis	Grainger et al., 2017	Smartphone addiction	Barzegari et al., 2022
Smoking cessation	Thornton et al., 2017	Pregnancy tracking	Mendi et al., 2022
Chronic pain	Salazar et al., 2018	Lung transplant	Shinohara et al., 2022
Health and fitness	Payo et al., 2019	Mental health	Yamamoto et al., 2022
Rheumatology	Knitza et al., 2019	Abortion	Stifani et al., 2023
Genitourinary tumors	Amor et al., 2020		

4. MHEALTH APPLICATION STUDIES IN TURKEY

Studies evaluating mHealth apps in Turkey have been growing, reflecting the global trend of incorporating digital health tools into healthcare practices. Although the original MARS scale is globally applicable, all articles describing MARS and uMARS adaptations emphasize the need for cultural and language-specific mHealth app rating scales. Recently, Mendi et al. (2022) adapted MARS for Turkey and completed the validity tests, Calik et al. (2022) adapted uMARS for Turkey and completed the validity tests, aiming to ensure they meet the specific needs and preferences of Turkish users. Both studies show that national scales are reliable and valid. Additionally, MARS has been used to evaluate some mHealth applications such as mindfulness (Duman et al., 2022), digital parenting (Aydoğdu et al., 2023), and pregnancy tracking (Mendi et al., 2022). Furthermore, the MARS scale was employed by Uslu and Arıkan to assess the ESİM mobile application, which is intended for people with hearing impairments.

5. CONCLUSION

The increasing usage of smartphones and the exponential growth of mobile applications have revolutionized the healthcare landscape, and the term "mHealth" emerged. mHealth applications, designed to improve health outcomes and facilitate healthcare access, have become integral tools for all stakeholders in the healthcare system. In this situation, the quality of mHealth applications plays a pivotal role in ensuring their effectiveness, user satisfaction, and overall impact on healthcare delivery. Despite the Food and Drug Administration's efforts, there is no globally accepted standard yet. However, several surveys and frameworks, such as MARS, uMARS, ORCHA-24, ENLIGHT, THESIS, and ACCU^{3}RATE, have been proposed in recent years. Proposed scales are essential tools in the rapidly evolving field of digital health for both healthcare providers and users. They help in identifying which apps are likely to be

beneficial for users and which ones need improvement. Also, by setting high standards and providing transparent evaluations, they contribute significantly to the overall quality and credibility of mobile health technologies.

CONFLICTS OF INTEREST

The authors declared that there is no conflict of interest.

CONTRIBUTION OF AUTHORS

This study is based on Melda Kevser Akgün's doctoral thesis. Prof. Dr. Servet Soygüder is the thesis supervisor.

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