

# Health Behaviors and Outcomes of Mobile Health Apps and Patient Engagement in the USA

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## Abstract

Mobile health applications, or mHealth apps, have gained popularity due to their practical functions and strengthening the connection between patients and healthcare professionals. These apps are designed for managing health and well-being on portable devices, allowing individuals to self-manage their health or healthcare practitioners to enhance patient care. Key features include personalized recommendations, data synchronization with other health devices, and connectivity with healthcare professionals. The research describes how mobile health applications support healthy behaviors, facilitate communication between patients and physicians, and empower individuals in the United States to take charge of their health. This study also examines how adults in the US use mobile health applications, or mHealth apps, on their tablets or smartphones for health-seeking purposes. The information was taken from Cycle 4 of the Health Information National Trends Survey (HINTS 4). The challenges regarding these mobile health apps have also been evaluated with possible remedies. Around 100 university students participated in a cross-sectional study by answering questions on their eating habits, physical activity, lifestyle choices related to health, and use of mobile health apps. The data was then analyzed and concluded as a result. Mobile health applications have brought about a significant shift in the way patients connect with their healthcare providers by providing them with convenient access to health services and information. By keeping track of health markers like diet, exercise, and medication compliance, patients may use these tools to help better manage their chronic

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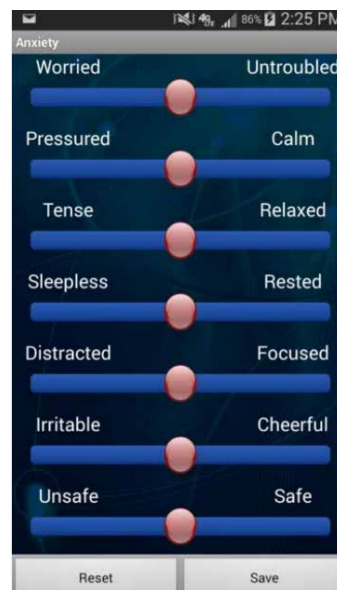
conditions. Mobile health applications can improve patient outcomes and save healthcare costs by empowering patients to take charge of their health. Through the facilitation of communication between patients and healthcare professionals, mobile health apps also offer virtual consultations and remote monitoring.

## Keywords

mHealth App, Self-Management, Patient, MARS, Monitoring

## 1. Introduction

Through the provision of self-management tools, communication channels with healthcare practitioners, and easy access to health information, the way that patients engage with their healthcare has been drastically transformed by mobile health applications, or apps. Involving people in their healthcare decisions and treatment plans, also known as patient engagement, is essential to enhancing overall healthcare quality and health outcomes [1]. Apps for mobile health have become important instruments in contemporary healthcare, providing creative approaches to raise patient participation and improve health results. Users can access a variety of health-related information, resources, and services with the help of these applications, which are made for smartphones and other mobile devices [2]. For example, T2 Mood Tracker helps users monitor symptoms like depression, anxiety, and posttraumatic stress disorder. In **Figure 1**, an app named T2 mood tracker is pictured that indicates the app can track the mental conditions of individual detecting the severity of worries, distraction, pressurized condition of mind etc.



**Figure 1.** T2 mood tracker, US department of defense [2].

The accessibility, affordability, and quality of care presented to the American healthcare system are major obstacles. By giving patients the resources for self-management, mobile health apps might assist in closing gaps by possibly lessening the strain on medical institutions and cutting expenses overall [3]. A large portion of the American population can access mobile health apps due to the high percentage of smartphone owners. The opportunity to use technology to enhance health on a large scale is created by its widespread acceptance [4]. Personalized health information and interventions can be provided through mobile health applications, which is consistent with the trend in the American healthcare system toward more customized and individualized care regimens [5]-[9].

Apps for mobile health are useful for encouraging healthy habits including eating better, exercising more, and maintaining mental well-being. With lifestyle-related health problems becoming more common in the United States, these applications provide a means of helping people change their behavior on a big scale [10]-[14]. Adherence to approved treatment plans is a significant problem for many individuals in the United States when it comes to medication [15]. Health outcomes can be satisfactorily improved by mobile apps through tracking adherence and sending out reminders [5]. The United States has recently implemented policies that seek to standardize the use of digital health technologies. A growing understanding of the benefits of mobile health apps is evident, for instance, in the growth of telehealth services and payment for digital health therapies [16].

Strict legislation, such as the Health Insurance Portability and Accountability Act (HIPAA), governs data security and privacy in the United States. To fully appreciate the importance of mobile health apps in the healthcare industry, one must grasp how they conform to these requirements [10] [17] [18]. By addressing marginalized groups with limited access to standard healthcare services, they can give access to support, health monitoring, and instructional materials that might not otherwise be available [3] [19] [20]. Studying how well U.S. mobile health apps work might reveal important information about how they affect patient participation and health outcomes.

This evidence can inform best practices and guidelines for app development. An increasing body of research indicates that patients participating actively in their treatment get better, more efficient care. When patients are engaged or active, they work with their healthcare providers, receive information about their treatment, are given dignity and respect, and participate in decision-making [21]. According to two independent reviews commissioned by the Robert Wood Johnson Foundation and the Institute of Medicine, effective care management programs targeting patients with high costs and high needs must prioritize patient engagement and self-management of chronic disease [22]. Reduced hospital utilization, improved quality of life, and functional autonomy are all associated with these tactics. In the context of sickness treatment and prevention, researchers have looked into the viability, functionality, technology, clinical utility, benefits, and risks of using mHealth apps as their use grows [23]. Still, relatively few studies

have examined the characteristics of mHealth app users or the relationship between mHealth app use and users' opinions on the apps' use. It is now increasingly clear that different population segments have varying opportunities to benefit from the potential benefits offered by apps, so it is equally important to study the characteristics of mHealth app users and understand the apps' utility from the users' perspective [23].

Patient engagement is a multifaceted concept that involves patients actively participating in their healthcare journey. It includes behaviors such as seeking health information, participating in treatment decisions, adhering to treatment plans, and managing chronic conditions. Engaged patients are more likely to achieve positive health outcomes, experience higher satisfaction with their care, and incur lower healthcare costs [24]. Mobile health apps are pivotal in promoting patient engagement by equipping patients with tools and resources to manage their health actively. These apps enable patients to track health metrics, monitor progress, and communicate with healthcare providers. By providing access to personalized health information and resources, mobile health apps assist patients in making informed decisions about their health and treatment options [1] [25] [26].

MyFitnessPal is a popular app designed to help users track their diet, exercise, and weight loss goals. It offers personalized advice based on the user's health targets and allows them to track their progress over time. Mango Health assists users with medication management by providing reminders, monitoring adherence, and offering information about potential drug interactions [27]. Fitbit, which includes both a wearable device and an app, tracks physical activity, sleep patterns, and heart rate, giving personalized insights and recommendations for overall health improvement [28]. Ada, an AI-powered app, evaluates symptoms and gives personalized health recommendations, enabling users to track symptoms over time and share this data with healthcare providers. These apps are essential in encouraging patient engagement by offering tools and resources for active health management [29] [30].

Mobile health applications are increasingly used to enhance health by providing access to health information, monitoring tools, and support for behavior change. This review investigates the effects of mobile health applications on health outcomes, the factors that influence their impact, studies showing improved results, and evidence of their efficacy [31]. Several studies have shown that mobile health apps can improve health outcomes for various demographics and medical conditions. Research has demonstrated that these apps can assist with medication adherence, chronic disease management, promoting healthy behaviors, and enhancing communication between patients and providers [28]. For instance, a study published in *JAMA Internal Medicine* found that patients who tracked their blood pressure with a mobile app had lower readings compared to those who did not use the app [32]. Another study in the *Journal of Medical Internet Research* indicated that individuals with diabetes who monitored their blood glucose levels using a mobile app achieved better glycemic control than those who did not use the

app [27]. Many studies have confirmed the positive impact of mobile health apps on health outcomes, such as weight loss and improved glycemic control in those who track their exercise [32].

The study explains how mobile health applications encourage healthy habits, help patients and doctors communicate, and give Americans the confidence to take control of their health. This study also looks at the ways that US consumers utilise mobile health applications, or mHealth apps, to search for health information on their tablets or smartphones. The data came from the Health Information National Trends Survey's fourth cycle. Potential solutions to the problems with these mobile health apps have also been assessed.

## 2. Literature Review

Patient engagement is a crucial element of healthcare delivery, enabling patients to take an active role in managing their health. Engaged patients tend to adhere to treatment plans and adopt healthier habits, leading to better health outcomes [28]. Mobile health apps play a significant role in promoting patient engagement by allowing users to track health metrics, access personalized health information, and communicate with healthcare providers. These apps are particularly beneficial for high-need, high-cost patients, empowering them to manage their own care [28]. In the United States, around two-thirds of the population owns a smartphone, and this number is increasing among older adults (27%) and those with lower household incomes (50%). Community clinics and health centers are increasingly recognizing mobile health technologies as ideal tools for engaging patients in managing chronic illnesses [28]. This issue brief outlines standards for evaluating mobile apps to enhance patient participation and improve quality and safety for high-need, high-cost populations. It also discusses the results of efforts to assess and refine these standards using various apps available on the Apple iOS and Android platforms [33].

Mobile health applications have revolutionized patient interaction with healthcare by providing self-management tools, communication channels with healthcare professionals, and easy access to health information [32]. Patient engagement, involving individuals in their healthcare decisions and treatment plans, is vital for improving overall healthcare quality and health outcomes. This review explores how mobile health apps can boost patient engagement, detailing their benefits and showcasing examples of such apps [32]. The development of mobile health apps has evolved significantly, enhancing patient participation and health outcomes. Early mobile health apps in the 2000s focused on basic functions like symptom tracking and medication reminder [27]. The rise of smartphones in the late 2000s revolutionized the market, enabling more sophisticated health apps through platforms like Google Play and the Apple App Store [28]. The 2010s saw a surge in health and fitness apps, covering a range of activities such as sleep, exercise, and nutrition tracking [31]. A review of twenty randomized controlled trials (RCTs) found that seventeen showed positive impacts on health-related behaviors,

suggesting that mobile health apps can effectively enhance user outcomes [28]. However, three studies did not show positive effects [31].

The study analyzed data from the Health Information National Trends Survey to examine the prevalence and effectiveness of mHealth apps on smartphones and tablets. Among respondents with these devices, 35.9% reported using a mHealth app [34]. A study by Krebs and Duncan (2015) found that 58.2% of mobile phone users had downloaded a health-related app at some point, with 45.7% discontinuing use of some apps. The most common uses were tracking physical activity (52.8%), diet (47.6%), and weight loss (46.8%), while fewer than 10% used apps for scheduling doctor appointments or communicating with doctors. This indicates significant potential for increased and diversified mHealth app usage among smartphone and tablet owners. Eleven interventions utilized SMS and the Internet, while eighteen combined these with other tactics. Intervention durations ranged from four weeks to a year, with 59% of the twenty interventions showing statistically significant changes in health-related behavior. Monitoring the impact of mHealth interventions on behavior change is crucial for health education and behavior authorities [33].

Advancements in technology have made mobile health apps a promising tool for modern health interventions, yet their impact on college-aged populations remains underexplored [35]. This study assessed differences in eating behaviors, physical activity, and health-related lifestyle choices between users and non-users of mobile health apps and examined the link between demographic factors and app usage. Users of mobile health apps reported significantly higher EBI scores, indicating better eating behaviors compared to non-users. While mobile health app use was associated with increased lifestyle scores, the relationship was not statistically significant. These results align with other studies showing improvements in lifestyle and eating behaviors among app users [28]. Users also reported feeling healthier, identifying as athletes, and motivating others to engage in healthful activities. Two studies demonstrated that incorporating mobile-based apps into weight loss programs led to greater compliance and more weight loss compared to traditional methods [27]. The study revealed that participants using multiple mobile health apps had significantly higher EBI scores, highlighting the importance of diverse app features in effective health interventions [33]. Preferences for physical activity apps among college students included coaching, personalized feedback, and competitive elements with friends. Apps that were free, user-friendly, and featured visual and auditory cues were most popular, especially those aligning with specific health goals [35]. Tailoring mobile apps to individual health and lifestyle needs could enhance their effectiveness.

Male participants scored higher on lifestyle and physical activity measures, while females scored higher on eating behaviors. There was no significant difference in mobile health app usage between genders [34]. Further gender-specific research on health behaviors and mobile health interventions could lead to substantial improvements. Ethnic minority college women, who are particularly

susceptible to high rates of overweight and obesity, were examined in terms of race/ethnicity and BMI. No significant differences in app usage were found between white and non-white participants, though white participants reported higher physical activity scores. Rodgers *et al.* found that adherence to healthy eating apps decreased over time among ethnic minority college women [36]. Participants with higher BMI reported lower satisfaction with the technology, though those with higher body dissatisfaction had the highest adherence. This study did not find a higher frequency of app usage among overweight and obese individuals compared to those of normal weight [31]. Conversely, [32] found that obese respondents were 3.2 times more likely to use apps for achieving health behavior goals. Effective strategies to address high obesity rates are crucial for reducing chronic diseases. The variety of mobile health apps used and the reliance on surveys rather than direct measurement of health outcomes highlight the need for further research. Future studies should develop apps based on behavior change theory to enhance health improvements. The sample was predominantly female, limiting generalizability to other institutions, though the gender ratio closely matched the university's overall ratio [31]. While this study did not find significant gender differences in app usage, future research could uncover varying preferences between genders. This study focused on psychological aspects of using apps to track health behaviors, with a 4:1 ratio of positive to negative feedback regarding app use. Future research into specific behavioral responses and factors influencing app use, such as accuracy, legitimacy, security, required effort, and mood impact, could provide additional insights [31]. Negative feelings associated with health monitoring apps, such as obsession with exercise and food intake, anxiety or guilt from unmet goals, and concerns about body image, should also be considered. Gowin found similar negative feelings but noted that users still had positive comments about app use for health and fitness [28]. The relationship between tracking health behaviours and eating disorder symptoms warrants further research. Self-monitoring devices could significantly impact behavioural interventions related to eating habits. Most participants reported feeling healthier, more motivated, and improved self-monitoring due to mobile health apps. Users demonstrated more positive eating behaviors compared to non-users, and using multiple types of apps was associated with better eating habits. Healthy eating and exercise are crucial for health promotion and disease prevention [28]. Social determinants play a vital role in health, but mobile health apps that enhance nutrition and physical activity may improve quality of life and longevity. Innovative health education and promotion programs that incorporate always-available technology could enhance adherence. Certified Health Education Specialists should consider mobile apps as valuable tools for helping individuals improve their health and prevent chronic diseases [28]. Further research through randomized controlled trials exploring various mobile apps and their impact on health outcomes could provide deeper insights into the relationship between improved health and mobile technology [28]. Studies focusing on app usage adherence and preferences

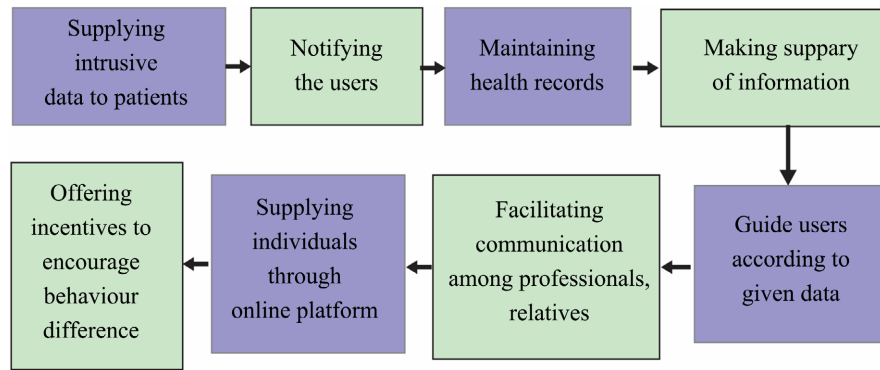
within specific populations are essential for developing effective health education and promotion strategies. Mobile-based technology offers exciting opportunities for addressing chronic disease.

Mobile health applications have transformed healthcare delivery by providing convenient access to health information, monitoring tools, and behavior change support. Emerging trends and opportunities for mobile health apps are set to further enhance patient engagement and health outcomes [36]. This review examines future directions in mobile health app development, focusing on trends, AI and ML integration, and their implications for healthcare policy and practice. Personalized health solutions are a key trend, with developers integrating features for tracking health metrics, personalized recommendations, and healthcare provider connectivity. Apps using wearable devices to monitor physical activity and provide personalized fitness plans are becoming more popular [33]. Gamification, which introduces game-like elements such as rewards and challenges, is another emerging trend to boost user engagement, especially in apps promoting healthy behaviors. AI and ML have the potential to revolutionize mobile health apps by enabling more personalized and accurate health recommendations [28]. A study published in the *American Journal of Preventive Medicine* found that patients who tracked physical activity with a smartphone app improved their cardiovascular fitness and increased their daily step count compared to those who did not use.

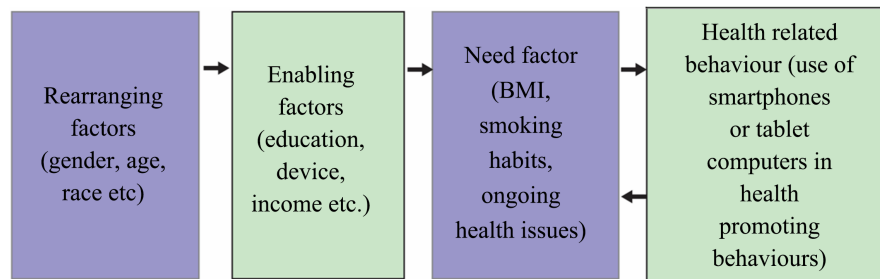
### 3. Methodology

The analysis unit is the person who completed the surveys. The analysis is based on 100 participants for decision input. Using descriptive statistics, weighted percentages of the dependent variables and weighted proportions of the independent factors were assessed for each of the four dependent variables of interest. [31] state that the HINTS database use the Jackknife replicate weights to organize weighting. We calculated multivariate logistic regressions using the jackknife technique to assess the relationships between the four outcome variables of interest and the independent factors, in addition to describing the characteristics of users of tablet and smartphone apps.

The workflow flowchart for analyzing mobile health apps for patients is shown in **Figure 2**. First, users are given the information they need. Patients receive notifications or reminders to upload medical records on a regular basis. The records are compiled once they are available, and users are assisted, guided, and supported. Following their behavioral improvement, the patients receive rewards. The framework is examined in **Figure 3** and involves rearranging the genders, ages, races, and other demographics. Following this, users should be provided with appropriate training and instructions on how to use the apps and other necessary equipment. Next, the medical concerns must be taken into account, and health-related behavior must be observed. The mobile health apps evaluation strategies for patients:



**Figure 2.** Mobile health apps evaluation strategies for patients.



**Figure 3.** Framework for study evaluation.

Data extraction was assessed for the final sets of applications once mobile apps were found using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) framework. Following data extraction using the Mobile Application Rating Scale (MARS), metrics related to patient engagement were examined. Predisposing was the first factor taken into account [34]. Age, the ability to use applications, owning smartphones or tablets, and other enabling characteristics were taken into account. The engagement, health-related behavior, and results were assessed along with a selection of medical concerns. SAS version 9.4 was utilized in the statistical investigations. According to [31] apps were considered successful in this study if they changed health-related behavior in a way that was statistically significant.

## 4. Results and Discussions

**Table 1** shows an overview of the applications for rheumatoid arthritis in the United States, based on the features of mobile health apps and the number of installations. The characteristics and effects of the apps were explored using numerous themes and participants in order to assess their usefulness [28]. Despite the fact that they did not all appropriately adjust their health practices, they expressed high pleasure with these apps. Some apps were very effective; for example, college students were more likely to stick to medicine. Adherence among office personnel was raised to satisfactory levels. RA Healthline and Arthritis Power have 5 k+ installers who are satisfied with 2 and 15 features. TRACT + REACT has the most 10 k+ installs and 13 features.

**Table 1.** Features of US mobile applications for rheumatoid arthritis in terms of operation.

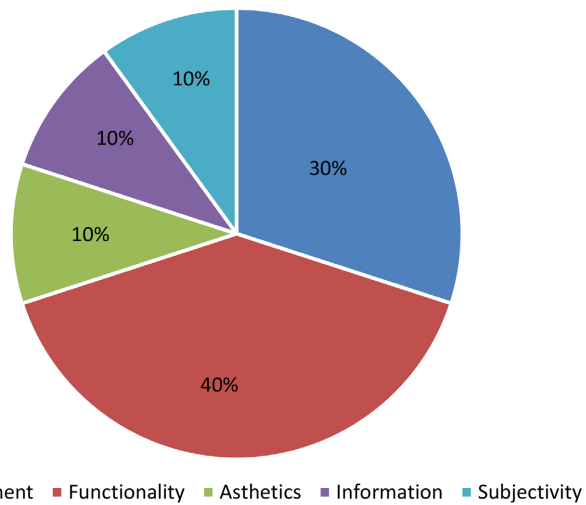
Name of app	Operating System	Total Features	Number of Installs
RA Healthline	iOS, Android	2	5 k+
Your Exercise Solution	iOS, Android	4	1 k+
Arthritis Power	iOS, Android	15	5 k+
My arthritis	iOS, Android	18	1 k+
TRACK+REACT	iOS, Android	13	10 k+
RAISE	iOS, Android	8	500+

RAISE, Your Exercise Solution, and My Arthritis occupy less installers with 4, 18 and 8 features accordingly. In actual words, the popularity and trust with apps depend not only number of features but also on proper service providence and offering new updates.

As far as we are aware, this is the first evaluation of mHealth apps designed for RA to assess how well they can accommodate PCC. PCC enables the patient and the doctor to collaborate on decisions at the point of care. Such apps must first promote patient participation and activation in order to enhance collaborative decision-making.

According to the research conducted by [34] there aren't many mobile applications accessible in the United States that have the necessary features to assist patients in taking an active role in their care. Specifically, only two applications came out as having the kind of content that promotes patient activation and the ability to drive patient engagement to a sufficient or good degree, which are two crucial components that support the patient's participation in PCC.

Mobile apps in the US were evaluated using the MARS tool, focusing on five parameters: engagement, functionality, aesthetics, information, and subjective quality. Each app's scores for these parameters, along with the overall MARS score, were analysed and depicted in a pie chart in **Figure 4**. The percentage of apps rated as good (scoring between 4 and 5) varied by parameter: 30% (3 apps) for engagement, 40% (9 apps) for functionality, 10% (4 apps) for aesthetics, and 10% (2 apps) for providing helpful information to patients. Regarding the subjectivity parameter, only 10% (2 apps) scored between 3 and 4, indicating user acceptability and willingness to recommend the app. Only one app achieved an overall MARS score above 4, reflecting a good rating across all five parameters. This study also examined the prevalence and utility of mHealth apps on smartphones and tablets, using the latest data from the Health Information National Trend Survey. These apps were assessed for their effectiveness in helping users reach health behavior goals, assist with medical decision-making, and communicate with doctors or seek second opinions [34]. A key finding was the wide range of factors—predisposing, enabling, and need-based—associated with the use of mHealth apps, depending on the specific application. **Table 2** details user demographics, including age and themes, with results published after analysis.



**Figure 4.** Using the Mobile Application Rating Scale (MARS), patient engagement assessments of rheumatoid arthritis mobile apps.

**Table 2.** Analysis of health behaviors and outcomes of people using mobile health apps in the USA.

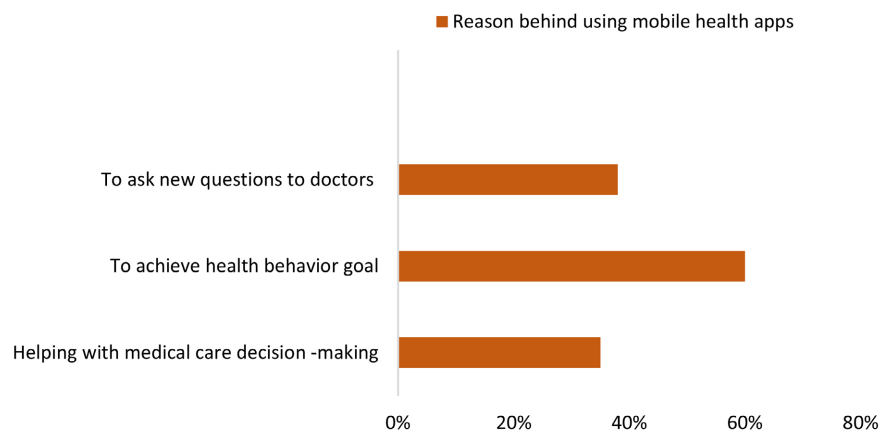
Participants	Themes	Age	Number of people	Features	Outcome measurement	Outcome
Collegegoers who regularly used their smartphones and had an antidepressant prescription	Adherence to medication	20 - 24	35	After entering the recommended dosage information, participants were instructed to use the medication reminder app to reply to the message they got on the app to indicate when they had taken their prescription.	Percent adherence	Adhere to their medication regimen.
Healthy Adults	Dietary Change	30 - 45	15	Received feedback and entered data and education materials.	Satisfaction	Satisfactory frequently
Pregnant mothers	Prenatal education engagement	30 - 50	55	Entering the data (weight, blood pressure etc.)	Recording information frequency	In clinical, interpersonal communication, no differences were seen.
Overweight patients	Weight loss	40 - 55	200	Self-monitoring, feedback	Weight loss at 6 months	No loss in weight but most users reported satisfaction.
Office workers	Neck exercise	40 - 55	20	Neck exercise education	Level of exercise adherence	High adherence
Alcohol dependent people	Alcoholism	30 - 40	180	Education, Counseling	Count the number of days with less danger of drinking.	Less drinking.

The study found that healthy adults, pregnant mothers, college students, and office workers generally provided satisfactory feedback, although not all goals were met. For example, alcohol-dependent individuals reported reduced drinking after using the apps, but overweight individuals did not show significant weight loss.

**Table 3** presents descriptive data for each participant in the HINTS 4 Cycle 4 sample, along with statistics for four outcome variables and key independent variables. The findings indicate that about 35% of US adults with smartphones or tablets also have a mHealth app. Furthermore, an estimated 60% of these adults use mHealth apps to achieve health behavior goals, and 38% use them to consult physicians or seek second opinions. The percentages of the USA users based on the causes of use are plotted in a bar diagram that is pictured in **Figure 5**.

**Table 3.** Statistics of adults in the USA using mobile health apps.

The reason behind using mobile health apps	Percentage of USA users
Helping with medical care decision-making	35%
To achieve health behavior goals	60%
To ask new questions to doctors	38%



**Figure 5.** The reasons why people use mobile health apps.

The study also highlights the negative emotions associated with health monitoring apps. Participants reported issues such as obsession with diet and exercise, anxiety or guilt over unmet goals, disruption of daily activities and social lives, and body image concerns [34]. Similar findings were reported in a study by [35], where users experienced guilt, avoidance, shame, and fixation, though they also acknowledged positive aspects of using health and fitness apps. Additionally, there is a connection between health behavior monitoring and eating disorder symptoms, warranting further research in this area [34]. Bias in survey responses may have occurred during data collection, with respondents potentially misremembering details or misunderstanding the self-administered questionnaire. For example,

human immunodeficiency virus (HIV) infection is classified differently across various health organisations, such as the World Health Organization and the Centers for Disease Control and Prevention. These classification differences might have influenced sample selection and the overall interpretation of the results.

## 5. Conclusions

The findings of the present investigation indicate that self-monitoring tools may have a significant influence on behavioural therapies intended to enhance eating behaviours. Most participants associated using mobile health apps with better motivation, self-monitoring, and general health. It was shown that using a variety of mobile health app types significantly improved eating behaviours and that app users generally engaged in healthier eating practices than nonusers. A balanced diet and regular exercise are crucial to improve health and prevent chronic diseases. Programs that use mobile health apps to enhance nutrition and activity levels may lengthen life and improve quality of life, even though socioeconomic determinants of health still play a significant role. Innovative approaches and broadly accessible technologies are required for health promotion and education programs. In this modern era of technology, mobile applications are one of the most significant advancements. There are numerous benefits to using smartphone apps for health promotion initiatives since most members of minority and low-income groups and over 90% of Americans own cell phones.

This population is optimal for executing health promotion programs to prevent chronic illnesses and reduce medical costs. In order to reduce health disparities and advance the goals of “the future healthy people”, it is imperative that technology-based health education initiatives focus on these populations. More public participation, raising people’s awareness of health and medical issues, and developing more skilled and capable mobile health developers can all help reduce the inappropriateness of mobile health apps. Children, young individuals, and elderly people in the USA will smile due to these apps’ greatly reduced constraints. Although this paper lacks to discuss backlogs and negative consequences of using mhealth apps, it discusses the positive impacts of mHealth apps on our lives. The future of mobile health (mHealth) apps seems bright, thanks to technological advancements, growing smartphone penetration, and increased demand for quickly accessible healthcare. Among the intriguing features are apps that provide virtual counseling, mindfulness exercises, and cognitive behavioral therapy. Additional encouraging developments include the rising acceptance of telemedicine platforms, which let patients consult with doctors from a distance; AI-powered applications that utilize user data to anticipate health problems and send out alerts; and seamless integration with electronic health records (EHR) to facilitate thorough patient data access.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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