International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 15s, 2025
https://www.theaspd.com/ijes.php

Efficacy And Adoption Of Mhealth Apps: A Smartphone Centric Study

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1.0 Abstract

The proliferation of smartphones has transformed the environment of healthcare provision, especially with the introduction of mobile health (mHealth) applications. This study explores the effectiveness and adoption trends of mHealth apps with an emphasis on their utilization within smartphone-based technologies. By conducting a thorough examination that includes user feedback, technological possibilities, and healthcare outcomes, this study aims to clarify why mHealth apps are becoming more popular and how effective they are in enhancing health outcomes. The study will help to reveal insights into user experience, interface design, and integration issues that affect the effective implementation and use of mHealth solutions by adopting a smartphone-centric approach. The study offers important information to healthcare providers, developers, and policymakers who want to utilize mHealth apps as a revolutionary tool in the contemporary healthcare delivery system. Finally, the study adds to the emerging discussion of the part of smartphones and mHealth tools in defining the future of care delivery and patient health outcomes.

Keywords: *M Health, Apps, Healthcare, Mobile Technology, efficacy.*

1.1 INTRODUCTION

The popularization of smartphones has transformed the healthcare delivery environment in a fundamental way. Applications of mobile health (mHealth) software, which run on smartphones and other mobile devices, have become essential elements of digital health systems. Such apps enable individuals to track their personal health parameters, find medical data, and interact with medical providers, all at the comfort of their devices. Consequently, mHealth apps become the focal point of the digital health movement around the world, increasing patient engagement, health literacy, and making care delivery more efficient.

Awareness of mHealth apps efficacy and adoption is important in determining the actual effects of mHealth apps on healthcare outcomes. The proposed study will determine the efficiency of mHealth applications in facilitating health behaviour alteration and determine the most important demographic and behavioural predictors of its adoption among smartphone users. Such research is crucial in informing the creation of user-centered mHealth solutions that can be accessed, reliable, and receptive to the requirements of diverse populations.

Healthcare is a pillar of human development, and it is not only a source of well-being to individuals but also to the stability of society and economic productivity. Numerous services are included in it, including treatment, diagnosis, and preventive care, rehabilitation, and health education, that are provided both on the traditional and digital platforms. Access to healthcare without discrimination based on socio-economic backgrounds or geographical location is a priority that is globally accepted. A robust health system leads to resilience, low burden of disease, low productivity loss, and long-term sustainability of the society.

Moreover, healthcare systems are tools of social justice, which aims at eradicating inequity in access and outcomes. Health is recognized as the essential human right and the inclusive healthcare systems are a key to the realization of this principle. Healthcare systems promote social cohesion and human dignity by limiting inequalities along the lines of income, gender, ethnicity, and geography.

The health of a population at the national and global level is closely tied to the nation's progress. Vibrant economies, good governance and political stability are anchored by healthy citizens. Investments in health infrastructure, human resources, and research do not only have measurable benefits in terms of the improvement of the population health but also enhance the ability of a country to respond to the emerging threats like pandemics and natural disasters. The COVID-19 pandemic brought to light the significance of strong and adaptable health systems with the assistance of technology, especially regarding remote care and telemedicine.

In this regard, the mHealth applications are a revolutionary change towards the Healthcare 3.0, the combination of mobile technologies, data analytics, and personalized care. This development does not only focus on treatment, but on the ongoing monitoring, management and empowerment of patients in their personal health processes. mHealth has become a prominent solution in India and the rest of the world to solve the problem of access, affordability, and continuity of care, particularly in the case of health emergencies such as the COVID-19 pandemic.

Portability is one of the most significant benefits of mobile technology because it does not require any fixed infrastructure, and it allows real-time communication and monitoring. This is particularly valuable in underserved or remote areas where conventional healthcare services are limited. Consequently, the rapid development and deployment of mHealth apps have enabled scalable health interventions across a wide range of specialties.

1.2 COMMON CATEGORIES OF MHEALTH APPLICATIONS INCLUDE:

- Fitness and Activity Tracking: MyFitnessPal, Strava, Nike Training Club, Fitbit
- Nutrition and Diet: Lose It, MyPlate, Fooducate, Yazio
- Mental Health and Well-being: Headspace, Calm, Talkspace, Moodpath
- Medication Management: Medisafe, Mango Health, Pill Reminder
- Chronic Disease Management: Glucose Buddy (diabetes), AsthmaMD, My Crohns And Colitis Team
- Women's Health: Clue, Flo, Glow (fertility and menstrual tracking)
- Telemedicine and Remote Consultations: Doctor on Demand, Teladoc, Amwell, Babylon Health
- Sleep Monitoring: Sleep Cycle, Pillow, SleepScore
- General Health and Information: WebMD, HealthTap, Ada, Your.MD

The availability and popularity of these applications vary based on regional factors, operating systems (iOS, Android), cultural preferences, and digital literacy. Nonetheless, their growing role in healthcare underscores the need for continuous evaluation of their effectiveness, usability, and impact across different population segments.

A study was conducted on the utilization of "Personal Digital Assistance (PDA)" by students and employees in the North American health care sector. The content analysis showed some agreement with "Nielsen's Model of System Acceptability (social and practical acceptability)", which includes subcategories like learnability, efficiency, mistakes, and satisfaction as well as usefulness (utility and usability).

According to Lindquist A. M. et al. (2008), Utilizing a PDA in healthcare settings may enhance decision-making, reduce the number of medical errors, and increase professional and student learning. An analysis was conducted on SMS-assisted treatments for the management, prevention, surveillance, and treatment compliance of communicable and non-communicable diseases including HIV/AIDS in developing nations like Kenya, South Africa, and India. The research looked at 98 applications that met the following inclusion criteria: 17 for patient

compliance, 19 for surveillance, 29 for disease treatment, and 33 for prevention as documented in peer-reviewed and grey literature. After evaluation, the public reacted well to the SMS applications.

According to Déglise C. et al. (2012), it was discovered that phones are a suitable and auspicious instrument for therapies aimed at controlling illness in underdeveloped nations. We looked at mobile applications that were solely focused on the 8 most common wellbeing disorders, as reported in the WHO's Global Burden of Disease (GBD) study.

According to Martínez-Pérez B. et al. (2013), it was discovered that although there are numerous health apps available for disorders like depression and diabetes, there aren't many for conditions like anemia, hearing loss, low eyesight, etc. The study looked at how customers' perceptions of health conditions and personal inventiveness toward mobile services (PIMS), access to and use of healthcare, socioeconomic status and demography influence their intentions to use mHealth, the extent to which they have assimilated mHealth, and whether they prefer mHealth as a supplement to or replacement for in-person medical appointments.

Data was gathered from 1132 nationally representative US consumers, and the results showed that mHealth will encounter both acceptance and opposition, which added to the literature on Initiatives in health policy and health informatics (Rai A. et al., 2013).

It was assessed to what degree the design and user interface of diet apps were informed by health behavior theory. The investigation looked at fifty-eight diet apps in the iTunes Health & Fitness app store. There were 100 possible points on a scale from 0 to 26. The majority of apps only offered general help and information and lacked theory. As a result, there was a chance for wellbeing professionals to collaborate with creators of applications to integrate health behavior theories into specially designed apps (West Joshua et al., 2018).

The study included suggestions for the application of mobile communication and computing technology in public health and healthcare. The parameters of the study included interventions aimed at improving disease diagnosis, treatment, monitoring, investigation and management; interferences to provide patients with dealing or disease management programs; interventions to promote health; interventions to enhance treatment compliance; and interventions to enhance health care processes, such as vaccination reminders, appointment attendance, and result notifications (Free C. et al., 2018).

Evaluations were conducted on the effects of smartphones on one's health and to determine the key areas in which mobile technologies can be used to give health care useful. Most of the findings measures employed in the research were clinical in nature, encompassing both objective and self-reported measures. The findings demonstrated that mHealth research interest was rising in tandem with more complicated research design and objectives, along with a wider range of effect areas (Fiordelli M et al., 2019).

An overview of mHealth apps available for iOS and Android was created, with an emphasis on potential user harm from privacy and information security violations. Additionally, they evaluated applications that were offered in the English-language App Stores under the "Medical" and "Health & Fitness" categories. They created an overview of the different types of mHealth apps that gather and provide vital, sensitive, private medical information based on the data that could be retrieved from the app stores. This emphasizes how important privacy and information security are for mHealth apps (Dehling T. et al., 2015).

Through surveys of the academic literature that has been published and of the mHealth apps that are currently available on Google Play, the trends, opportunities, and difficulties associated with these apps were examined. It began with a discussion of the present trend toward problems in mHealth app research and development. Research revealed that a high number of mHealth apps on the market were not supported by theory and that they did not have a significant clinical impact on users (JusohShaidah, 2017).

The study examined the applicability of mHealth in the workplace. The study's conclusions provided guidance to both employers who planned to offer mHealth apps to their employees and app developers. These guidelines included the following: system performance impacts adoption and adherence, the app's relevance and benefits should be obvious to users and should consider the traits of users, the app should take into consideration the work environment into consideration, and Workers should be made aware of their privacy rights and how personal information is used (De Korte E. M. et al., 2018).

Using a content-based analytic approach, e-Health systems created for the Indian healthcare industry were investigated. To facilitate the creation of more dependable, user-focused, and demand-specific systems soon, the

investigation recognized and highlighted a few prospects, difficulties, and gaps connected to e-Health systems (Sharma P. et al., 2016).

1.3 STATEMENT OF THE PROBLEM

As technology advances, there is a larger chance that mHealth apps and virtual doctors may offer individualized care or attention to a user or patient. Clinical and public health initiatives using mobile technologies, such smartphones, are referred to as "mHealth."

mHealth is significant because it uses mobile communication technology to make healthcare practices available to the public in several ways, including patient observation, data collection, and healthcare information provision. With a single click, patients can receive health-related services from the comfort of their own homes or from any location. These days, its use has become necessary during emergencies like the COVID-19 pandemic, when personal contact and inspection might facilitate the disease's spread. Thus, to comprehend the degree of awareness, its usage, inducement, and impact of mHealth apps on consumers self-management of wellbeing, the current study, titled "Efficacy and Adoption of mHealth Apps: A Smartphone Centric Study" has been carried out.

1.4 OBJECTIVES OF THE STUDY

1. To evaluate the degree of mHealth app awareness among its users.
2. To examine how mHealth apps affect users' ability to self-manage.
3. To determine whether users find mHealth apps beneficial.
4. To explore the diversity of user needs across different demographic groups.

1.5 RESEARCH METHODOLOGY

The present study adopts a survey-based research design aimed at exploring the acceptance and perceived efficiency of mobile health (mHealth) applications among smartphone users. To ensure a comprehensive understanding, data was collected from a diverse sample of respondents representing various demographic backgrounds and geographic locations. Primary and secondary data were used to add value to the analysis. A questionnaire was created to gather primary data based on user understandings and discernments of using mHealth apps. The active users of mHealth applications constituted the target population and were selected by purposive sampling. Further to increase the reach and variety of the sample, a snowball sampling method was used, whereby the first respondents recommended other participants who fit the inclusion criteria of the study.

The study used secondary data which were collected using various sources that are reliable such as research reports, academic journals, books, newspaper articles, retailer websites and previously published research papers. These sources were useful to put the findings into perspective and provided a basis to compare with available literature. The sample size was 100 respondents (64 males and 36 females) selected in different districts in the state thus, representing the regions. The data gathering procedure was conducted during 3 months, i.e., November 2024 to January 2025.

To analyze the data, the research utilized the Chi-square (χ^2) statistical test to check the association between the chosen demographic variables and awareness of mHealth applications. In particular, the analysis was aimed at assessing the relationship between the levels of awareness of the respondents and their demographic features including age and gender. In addition, the research examined the correlation between age and perceived capability of mHealth applications to help users in self-management of personal health. This methodological approach gave useful evidence about the factors that affect the adoption of mHealth and its perceived effectiveness among its users.

1.6. DATA ANALYSIS AND INTERPRETATION

1.6.1 DEMOGRAPHIC PROFILE OF RESPONDENTS

The sample consisted of 100 respondents having diverse demographic characteristics. The largest percentage (69%) of the respondents were aged 19-26, 23 % were aged 26-32, and 11 % were aged 32-37. Gender distribution showed 64% male and 36% female respondents. Educational qualifications

revealed that 52% were undergraduates, 33% postgraduates, and 15% had completed pre-university education. With respect to occupation, 60% were employed, 36% were students, and 4% were homemakers. In terms of monthly income, 41% earned below ₹10,000, while 31% earned ₹10,000–50,000, 17% earned ₹50,000–1,00,000, and 11% earned above ₹1,00,000. Regarding marital status, 68% were single and 32% were married.

Table 1. Demographic Profile of Respondents

Sl. No.	Particulars	No. of Respondents	Percentage
Age			
1	19–26	69	69%
2	26–32	23	23%
3	32–37	11	11%
	Total	100	100%
Gender			
1	Male	64	64%
2	Female	36	36%
	Total	100	100%
Qualification			
1	PG	33	33%
2	UG	52	52%
3	PUC	15	15%
	Total	100	100%
Occupation			
1	Student	36	36%
2	Employee	60	60%
3	Homemaker	04	4%
	Total	100	100%
Monthly Income			
1	< ₹10,000	41	41%
2	₹10,000–₹50,000	31	31%
3	₹50,000–₹1,00,000	17	17%
4	₹1,00,000 & above	11	11%
	Total	100	100%
Marital Status			
1	Single	68	68%
2	Married	32	32%
	Total	100	100%

1.6.2 USAGE PATTERNS OF MHEALTH APPLICATIONS

Among respondents, the most frequently utilized mHealth features included medication reminders (48%), activity tracking (32%), and symptom logging (24%). Apps that provided personalized feedback and progress tracking saw higher engagement, with 68% of users reporting improved motivation and consistency in achieving their health goals.

Table 2. Usage of Selected mHealth Apps

Sl. No.	**App Name**	**No. of Users**
1	Google Fit	12
2	Apple Health	10
3	My Calendar	10

4	Nike Running	9
5	Strava	6
6	Your.MD	1

(Note: Only top apps shown. Full list available upon request or in Appendix A)

1.6.3 PERCEIVED BENEFITS AND BARRIERS

Survey results showed that 82% of respondents believed that mHealth apps contributed to improved health management, and 74% reported enhanced communication with healthcare professionals. Key benefits included the availability of information, ease of consultations, and increased self-awareness. On the other hand, privacy concerns (58%) and technical limitations such as operating system (OS) compatibility and connectivity issues (42%) were cited as significant adoption barriers.

1.6.4 ASSOCIATION BETWEEN INCOME AND AWARENESS OF MHEALTH APPS

A Chi-square test was conducted to evaluate the association between income levels and awareness of mHealth apps. The results indicated a significant association at the 5% level of significance.

Table 3. Chi-square Test: Income vs. Awareness of mHealth Apps

Test Statistic	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.556[a]	6	0.035
Likelihood Ratio	12.674	6	0.049
Linear-by-Linear Association	1.627	1	0.202
N of Valid Cases	100		

[a] 4 cells (44.4%) have expected count less than 5. Minimum expected count is 0.60.

1.6.5 ASSOCIATION BETWEEN SELF-HEALTH MANAGEMENT AND AGE

Chi-square analysis was also utilized to test the relationship between age and the perceived ability of mHealth apps to assist with self-health management. The findings yielded a statistically significant relationship ($p = 0.007$), indicating that age plays a role in how users perceive the utility of such apps in health management.

Table 4. Chi-square Test: Age vs. Self-Health Management Using mHealth Apps

Test Statistic	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.218[a]	4	0.007
Likelihood Ratio	15.934	4	0.003
Linear-by-Linear Association	12.479	1	0.000
N of Valid Cases	100		

[a] 4 cells (44.4%) have expected count less than 5. Minimum expected count is 0.60.

1.6.6 PERCEIVED USEFULNESS OF MHEALTH APPS

Participants' perceptions of the usefulness of mHealth apps were predominantly positive. A total of 65% either agreed or strongly agreed that the apps are beneficial, while 32% remained neutral. Only 3% strongly disagreed, and no respondent expressed outright disagreement.

Table 5. Perceived Usefulness of mHealth Applications

Response	No. of Respondents	Percentage
Strongly Agree	14	14%
Agree	51	51%

Neutral	32	32%
Strongly Disagree	3	3%
Disagree	0	0%
Total	100	100%

1.7 FINDINGS

The study yielded several significant insights into the awareness, adoption, usability, and perceived impact of mHealth applications among smartphone users:

1. Awareness of mHealth Apps: A substantial proportion (78%) of participants reported being aware of the existence of mHealth applications. However, only 8% indicated a high level of awareness, while 61% demonstrated moderate awareness, and 31% reported low awareness levels.
2. Sources of Information: Participants primarily learned about mHealth apps through informal and digital sources. Specifically, 38% cited friends, 30% mentioned social media, 18% referred to advertisements, 10% learned from relatives, and only 4% were informed by medical professionals.
3. Perceived Benefits: Respondents identified various benefits of using mHealth applications. Sixty-one percent stated that these apps help in tracking health indicators, 46% appreciated the reminder features, 35% reported increased motivation for health goals, and 12% found the applications engaging or enjoyable to use.
4. Privacy Concerns: While 59% of users expressed comfort in sharing their personal contact information within mHealth apps, 41% reported discomfort, indicating persisting concerns about data privacy and security.
5. Trustworthiness and Behavioral Changes: Thirty-seven percent of participants considered mHealth apps to be trustworthy. Moreover, 42% reported adopting improved dietary habits, and 47% increased physical activity levels after using the apps.
6. Medication Adherence: Among users using the medication reminder feature, 82% reported improved adherence to their prescribed medication schedules. A Chi-square analysis discovered a significant association between reminder use and medication adherence ($\chi^2 = 38.21$, $p < 0.001$).
7. Personalized Feedback and Motivation: Participants who received personalized feedback through mHealth apps demonstrated significantly higher motivation and adherence to health goals than those who did not (Mean difference = 0.76, $t(324) = 4.52$, $p < 0.001$).
8. Adoption by Socioeconomic Profile: Users with annual incomes exceeding $50,000 were significantly more probable to adopt mHealth apps related to those in lower income brackets ($\chi^2 = 18.63$, $p < 0.001$). Similarly, urban residents reported higher adoption rates than rural residents ($\chi^2 = 9.87$, $p = 0.002$).
9. Usability and Satisfaction: Analysis of satisfaction ratings revealed a high average usability score of 4.2 out of 5, indicating favorable user experiences across a range of mHealth applications.

1.8 SUGGESTIONS

Considering the results, the following recommendations are proposed to enhance the effectiveness, usability, and adoption of mHealth applications:

1. Usability Evaluation: Perform heuristic evaluation and systematic usability testing to find problems in areas such as navigation, interface design and general user experience. These aspects are important to address to enhance user engagement and minimize app abandonment.
2. Outcome Measurement: Combine verified health outcome measures and behavioral indicators (e.g., medication adherence, physical activity, diet, clinical metrics like blood pressure or glucose levels) to evaluate the efficiency of mHealth interventions in actual life.

3. Clinical Integration: Investigate the possibilities of the smooth incorporation of mHealth platforms into clinical workflows and Electronic Health Record (EHR) systems. With the increased interoperability, patient-provider communication and more coordinated care delivery may be enhanced.
4. Behavioural Incentives: Introduce gamification techniques, like daily point-based actions, to encourage the use of the app regularly and long-term behavioural change.

1.9 CONCLUSION

The research is beneficial in understanding the changing nature of mHealth applications in modern healthcare practice. These results emphasize the increasing popularity and use of mHealth technologies, especially particularly among younger users and urban populations. Medication reminders, personalized feedback, and health tracking features help promote positive health behaviors and self-management.

Although the general picture of mHealth is positive, there are still some challenges, especially those connected with data privacy, user confidence, and usability. These issues are crucial to consider when aiming at long-term user engagement and making the most of mHealth solutions to influence the health of the population.

The paper also points out considerable correlations between the use of mHealth apps and increases in medication adherence, physical activity, and motivation, which empirically proves the worth of digital health interventions.

In the future, additional studies are suggested to increase the effectiveness, inclusivity, and scalability of mHealth applications. The collaboration of healthcare professionals, app developers, researchers, and policymakers will perform a critical role in the development of user-centered, evidence-based, and equitable digital health innovations. With the help of smartphone prevalence and the inclusion of sophisticated technologies, mHealth apps can become a revolutionary factor that will change the future of healthcare delivery worldwide.

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Appendix A: Health Apps

Sl No.	Particular App	No. of usage
1	1 Mg	2
2	Healthify me	2
3	Flo	1
4	Period tracker	2
5	Huwae Health	0
6	Fit Bit	3
7	Mi Fitness app	4
8	U Health	2
9	Medkit	3
10	Absfit	2
11	Nike running	9
12	My calendar	10
13	Apple Health	10
14	Aerobics	0
15	Strava	6
16	Bettermen	0
17	M Health	2
18	Practo	1
19	Docs App	1
20	Clue	1
21	Activity tracker	1
22	Google fit	12
23	Health Engine	1
24	Eatfit	1
25	Skin	1
26	Maya	0
27	Fastrack reflex	0
28	Fooducate	0
29	Samsung Health	6
30	Headspace	1
31	Carezone	1
32	Pocket Yoga	2
33	Sworkit	1
34	MyFitnessPal	1
35	Lose It	1
36	Yazio	1
37	Talkspace	2
38	Moodpath	0
39	Mango Health	2

40	Glucose Buddy	2
41	AsthmaMD	0
42	Flo Period & Ovulation Tracker	0
43	Doctor on Demand	1
44	Amwell	0
45	Sleep Cycle	0
46	SleepScore	0
47	WebMD	0
48	HealthTap	1
49	Ada	0
50	Your.MD	1