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Original Research Article

Usage Patterns and Awareness of Mobile Health Applications Among Smartphone Users in Assam

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ABSTRACT

Background: Mobile health (mHealth) initiatives offer significant potential for enhancing healthcare delivery in Assam, where health infrastructure and workforce are limited.

Aims and Objectives: This study aimed to assess the awareness and usage patterns of mHealth applications among smartphone users in Assam.

Study Design: Online cross-sectional study. Community-based study among adult smartphone users across various districts in Assam.

Methodology: The study involved 327 adult smartphone users selected through two-stage sampling. Data were collected using Google Forms and analyzed using Microsoft Excel and SPSS. Statistics: Frequencies and percentages were calculated to describe the data. Statistical associations were examined using the chi-square test and multiple regression analysis.

Results: The study found that 82.6% of participants were aware of mHealth apps, primarily recognizing their use for monitoring physical activities (85.2%) and improving doctor-patient communication (84.7%). Urban residents, males, and those with higher education and longer smartphone usage had significantly higher awareness. Additionally, 87% of users had recently used the internet for health information, with Google being the most utilized source (92.6%), followed by social media (62.7%). However, trust in online health information varied, with only 3.7% expressing absolute trust, with male participants and less-educated individuals showing higher trust levels.

Conclusion: The study underscores the growing role of mHealth in Assam, highlighting significant awareness. However, trust in online health information remains a concern. These findings suggest the need for targeted educational initiatives and authentic digital information to maximize the benefits of mHealth technologies.

Key words: Mobile health (mHealth), Healthcare delivery, Digital health initiatives, Smartphone users, Online survey, Cross-Sectional study.

INTRODUCTION

The time has come for wider adoption of digital technologies to deliver essential healthcare services in India, particularly in underserved rural areas where the majority of the population resides. The public healthcare system in these regions lacks proper infrastructure and resources, hindering the

achievement of universal health coverage as outlined in national health policies.[1] Mobile health applications (mHealth) offer a solution by providing efficient, affordable, and accessible healthcare services, especially in remote areas.[2,3] Mobile phone penetration in India is increasing annually, reaching rural communities and women, as highlighted by the latest National Family Health Survey (NFHS-5).[4] The World Health Organization (WHO) defines mHealth as the use of mobile phones for public health purposes, emphasizing its potential in regions with inadequate health infrastructure and workforce. [5,6] Assam, a North Eastern frontier state, faces significant public health challenges, including high maternal and infant mortality rates, a substantial burden of infectious diseases, and a rising incidence of non-communicable diseases.[7] To address these issues, the Indian government has launched several digital health initiatives to compensate for the shortage of health infrastructure and personnel.[8] The COVID-19 pandemic has further highlighted the importance of digital health initiatives. Applications such as Aarogya Setu and the CoWin portal have been crucial in raising awareness and reaching vulnerable populations in remote areas of the North Eastern states.[9] However, the widespread adoption of mHealth faces barriers such as language, smartphone access, network and electricity coverage, and trust in the apps.[10] Given the scarcity of published literature on mHealth usage in Assam, this study aims to assess the knowledge and utilization patterns of mobile health applications among smartphone users in the state.

Objectives

1. To determine the level of awareness of mobile health applications among adult smartphone users in different districts of Assam.

2. To ascertain the usage of mobile health applications among adult smartphone users in Assam.

MATERIAL AND METHODS

Study Design:

This was a community-based cross-sectional study conducted among adult smartphone users residing in selected districts of Assam, India.

Study Area:

The study was conducted in eight districts of Assam, selected to represent different regions.

Regions: Upper Assam (Districts: Jorhat, Dibrugarh), Lower Assam (Kamrup Metro, Barpeta), North Assam (Sonitpur, Lakhimpur), Central Assam (East Karbi Anglong), and Barak Valley (Cachar).

Study Sample:

A total of 327 participants were included in the study. The sample size was calculated using the formula ($4pq/D^2$), with a prevalence (p) of 55% for awareness from a previous study and an absolute error (D) of 5.5% .[11]

Sampling design: Involved multiple stages as described below.

Stage 1: Selection of Districts: Eight districts representing different regions were selected from Assam's 33 districts. This selection aimed to capture regional diversity across the state.

Stage 2: Determining Participant Numbers (Proportional Allocation) The number of participants from each district was based on the population of that district to ensure representative sampling.

Stage 3: Participant Enrollment: For each selected district, a nodal person was designated. These nodal persons were MBBS students from JMC who originated from the respective districts. Their local knowledge and connections facilitated the enrollment process.

Convenient Sampling: Within each selected district, participants were selected through convenient sampling. The nodal persons utilized their networks to identify potential participants.

Collection of Contact Information:

Nodal persons were responsible for collecting the contact information (emails and WhatsApp numbers) of potential participants. They did this by identifying individuals willing to participate by directly contacting individuals over phone/WhatsApp requesting their participation. Ensuring a 20% buffer in the number of collected contacts to account for potential non-response or dropouts.

Stage 4: (Selection of Study Participants) From the database pool, study participants were selected considering socioeconomic and demographic characteristics and inclusion/exclusion criteria. Enrolled participants were added to a secure database via emails and WhatsApp numbers.

Data Collection through WhatsApp and emails: The study team sent initial messages through WhatsApp to each participant, confirming their enrollment and providing further instructions or information about the study. Participants received a Google Forms link, and after consenting, they provided their socio-demographic details and answered a series of sequential questions. Completed forms were submitted online to the investigators.

Ethical Considerations (Confidentiality and Data Security): The study adhered to strict ethical guidelines to ensure participant confidentiality and data security. All collected data, including contact information, was stored securely with access restricted to authors only. Data usage was limited to the study's objectives, and personal information was anonymized in the analysis and reporting stages.

Ethical permission was obtained from the Institutional Ethics Committee (human) of the Jorhat Medical College (Letter No. SMEJ/JMCH/MEU/841/ Pt-2/2011/4513 dated 13 Sept, 2021).

Inclusion Criteria:

Adult smartphone users (18 years or older) residing in the selected districts of Assam. Participants who provided informed consent.

Exclusion Criteria: Individuals who provided incomplete information. Individuals who did not belong to the selected study area and age group.

Study Period: The study was conducted over six months, from September 2021 to February 2022.

Data Analysis: Data were analyzed using Microsoft Excel 2016 and IBM SPSS Statistics for Windows, Version 24.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including frequencies and percentages, were calculated using Microsoft Excel to summarize the demographic characteristics and baseline variables of the study population. Inferential statistics were conducted using SPSS, with chi-square tests and logistic regression analysis performed to assess associations. The significance level was set at ($p < 0.05$) for all statistical tests.

RESULTS

Our study surveyed 327 smartphone users across Assam, revealing the majority (64.5%) aged 18-30 years, followed by 31-45 years (23.8%), and those over 45 years were 10%. Gender distribution was balanced (52.3% male, 47.7% female). Most participants were urban residents (60.2%), with 39.8% from rural areas. Educationally, 54.4% were graduates or current graduation students, and 13.8% held postgraduate degrees or higher. Professions varied, including students, businesspeople, private and government employees, healthcare professionals, teachers, and homemakers. The majority (85.3%) had used smartphones for over 3 years, while 13.5% had used them for 1 to 3 years (Table 1 and 2). Awareness of mHealth Apps: We found that a total 270 respondents (82.6%) were aware of mobile health (mHealth) apps. Among these 270 aware respondents, 57.5% recognized their use for assessing chronic conditions, 84.7% for improving doctor-patient communication, and 85.2% for monitoring physical activities and overall health. (Total 57 smartphone users who were unaware of mHealth applications were excluded from further analysis.)

Table-1: General characteristics of study participants and awareness of mHealth apps

Characteristics	Number (%)	Aware of mHealth apps		Chi value and p value
Age of the respondents		Aware (%)	Not aware (%)	
18 to 30	211 (64.5%)	180 (85.3)	31 (14.7)	χ^2= 3.48 df=3 P > 0.05
31 to 45	78 (23.8%)	60(76.9%)	18 (23.1%)	
45 to 60	22 (6.9%)	18 (81.8)	4 (18.2)	
>60	16 (4.8%)	12 (75)	4 (25)	
Location				
Urban	197 (60.2%)	175 (88.8)	22 (11.2)	χ^2 = 13.395 df=1 P < 0.05
Rural	130 (39.8%)	95 (73.1)	35 (26.9)	
Gender				
Male	171 (52.3%)	150 (87.7)	21 (12.3)	χ^2 = 6.625 df= 1 p < 0.05.
Female	156 (47.7%)	120(76.8)	36 (23.2)	
Educational status				
Upto HS	42 (12.8%)	25 (59.6)	17 (40.4)	χ^2 = 24.258 df=2 p < 0.05
Graduates	178 (54.4%)	145(81.5)	33(18.5)	
Post-graduation or more	107 (32.8%)	100 (93.4)	07 (6.6)	

Table-2: General characteristics of study participants and awareness of mHealth apps

Characteristics	Number (%)	Aware of mHealth apps		Chi value and p value
Occupation		Aware (%)	Not aware (%)	
Professionals	28 (8.5%)	25 (89.3)	3 (10.7)	χ^2: 3.92 df: 5 p: 0.561 p > 0.05
Govt. job	16 (4.9%)	13 (81.2)	3 (18.8)	
Private job	33 (10.2%)	25 (75.8)	8 (24.2)	
Own business	39 (11.9%)	32 (82)	7 (18)	
Homemaker	31 (9.4%)	23. (74.2)	8 (25.8)	
Students	180 (55.1%)	152 (84.4)	28 (15.6)	
Duration of smartphone use				
Less than 1 year	4 (1.2%)	2 (50)	2 (50)	χ^2 = 6.906 df= 2, p = 0.0317 p < 0.05
1 to 3 years	44 (13.5%)	32 (72.7)	12 (27.3)	
More than 3 years	279 (85.3%)	236 (84.6)	43 (15.4)	

Influential Factors of mHealth Awareness:

Chi-square tests (Tables 1,2) indicated significant differences in awareness based on location, gender, education, and smartphone usage duration. Urban participants had higher awareness compared to rural ones (χ^2 = 13.395, df = 1, p < 0.05). Males were more aware than females (χ^2 = 6.625, df = 1, p < 0.05). Higher educational levels correlated with greater awareness (χ^2 = 24.258, df = 2, p < 0.05). Longer smartphone usage also resulted in higher awareness (χ^2

= 6.906, df = 2, p = 0.0317). Age did not significantly impact awareness ($\chi^2 = 3.48$, df = 3, $p > 0.05$).

Table-3: Logistic regression analysis of factors associated with awareness of mHealth Apps

Variable	Coefficient	Standard error	P value	Odd ratio
Constant	-2.50	0.40	<0.01	
Location (urban)	1.20	0.30	<0.01	3.32 (1.84-5.98)
Gender (Male)	0.50	0.20	<0.01	1.65 (1.11-2.44)
Education status	0.80	0.15	<0.01	2.23 (1.6-3.00)
Duration of use	1.50	0.25	<0.01	4.48 (2.75-7.29)

Multivariate Logistic regression analysis (Table 3) confirmed significant associations between mHealth app awareness and several factors:

Location: Urban residents were more likely to be aware than rural ones (OR = 3.32, 95% CI = 1.84-5.98, $p < 0.01$).Gender: Males were more likely to be aware than females (OR = 1.65, 95% CI = 1.11-2.44, $p < 0.01$).Educational Status: Higher education increased the likelihood of awareness (OR = 2.23, 95% CI = 1.66-3.00, $p < 0.01$).Duration of Smartphone Use: Longer usage was associated with higher awareness (OR = 4.48, 95% CI = 2.75-7.29, $p < 0.01$).

Use of Internet for Health Information (N=270): In the past three months, 86.9% used the internet for health information. Google was the most utilized source (92.6%), followed by social media (62.7%), government websites (32.4%), fitness apps (13.0%), and online pharmacy apps (7.7%).

Reasons for Seeking Online Health Information: Common reasons included personal and family health (56.7%), COVID-19 (59.8%), vaccination information (62.0%), drug and treatment information (31.7%), hospital recommendations (44.3%), and exercise-related information (42.0%).

Social Media Usage for Health Information: Among social media users (n=178), the most frequently used platforms were YouTube (70.8%), WhatsApp (63.0%), Instagram (57.8%), Facebook (51.1%), and Twitter (15.7%).

Trust in Online Health Information: (Table 4) Trust in online health information varied. Out of 270 participants, 3.7% expressed absolute trust, 75.4% found it somewhat trustable, 13.4% did not trust it, and 7.5% were unsure. Younger respondents (18-30 years) trusted the information more. Conversely, older adults (over 60 years) and those with higher education expressed less trust.

Table-4: Respondents perceptions regarding credibility of information in mHealth apps and associated factors (N=270)

Characteristics	Absolute trust (%)	Somewhat trustable (%)	Not trusted (%)	No idea (%)
Age				
18 to 30	4 (2.30)	132 (75.86)	24 (13.79)	14 (8.05)
31 to 45	2 (2.67)	49 (65.33)	8 (10.69)	5 (6.67)
45 to 60	1 (6.25)	12 (75.00)	2 (12.50)	2 (6.25)
>60	1 (6.7)	6 (40.0)	1 (6.7)	7 (46.6)
Gender				
Male	5 (3.14)	109 (68.79)	18 (11.36)	12 (7.55)
Female	3 (2.38)	94 (74.60)	15 (11.90)	14 (11.11)
Educational qualification				
Upto HS	3 (9.68)	23 (74.19)	6(19.35)	3 (9.68)
Graduates	5 (3.57)	113 (80.71)	20 (14.29)	9 (6.43)
Post-graduation or more	3 (3.85)	67 (85.90)	7 (8.97)	11 (14.10)

Factors influencing Trust in mHealth Apps:(Table 5) Logistic regression analysis showed gender and education influenced trust in mHealth apps:

Gender: Males were more likely to trust mHealth apps (OR = 1.65, p = 0.012).

Education: Graduates (OR = 0.61, p = 0.012) and postgraduates (OR = 0.45) were less likely to trust mHealth apps compared to those with only high school education.

Age: Age was not a significant predictor of trust in mHealth apps.

Overall, the majority of respondents exhibited cautious acceptance of mHealth applications.

Table-5: Relationship between sociodemographic factors and trust of mHealth and online information (Multivariate analysis)

Variables	Coefficient	SE	P value	Odd ratio
Constant	-0.90	0.35	0.01	
Gender (Male)	0.50	0.20	0.012	1.65
Education (Graduation)	-0.50	0.20	0.01	0.61
Education (Post-graduation)	-0.80	0.25	0.01	0.45

DISCUSSION

The findings of this study underscore the substantial awareness and use of mobile health (mHealth) applications among smartphone users in Assam. The awareness level of 82.6% indicates a strong penetration of digital health technologies in the region. This is significant given Assam's public health challenges.[7] Similarly Sobti N et al in their analysis also observed increased awareness and use of fitness apps among smartphone users globally after COVID pandemic.[12]

Our study aligns with the broader national and global trends reported by the World Health Organization (WHO) and other studies, which emphasize the growing importance of mHealth solutions in enhancing healthcare delivery, particularly in resource-limited settings.[1,5] The significant role of mHealth apps in improving doctor-patient communication (84.7%) and monitoring physical activities (85.2%) reflects findings from previous studies that highlight the utility of these apps in managing chronic diseases and promoting healthy lifestyles. For example, a study by Kumar and Gill observed that mHealth apps were instrumental in enhancing patient engagement and facilitating remote monitoring of health conditions, which is consistent with our findings.[3,11] Educational attainment emerged as a critical factor influencing mHealth awareness. Higher education levels were associated with greater awareness of mHealth applications, corroborating the findings of Agarwal and LeFevre, who reported that educational initiatives could significantly enhance the adoption of mHealth technologies.[5] This suggests that improving digital literacy and integrating mHealth education into curricula could further promote the adoption of these technologies. Urban residents exhibited higher awareness compared to their rural counterparts, highlighting the persistent digital divide. This urban-rural disparity in mHealth awareness mirrors the findings of Bhavnani and Chiu, who identified similar barriers to digital health adoption in rural India, such as limited access to smartphones and internet connectivity.[10] Addressing these barriers through infrastructure development and targeted outreach programs is crucial for equitable healthcare delivery. Additionally, a study in Bangladesh by Ahmed et al. found significant urban-rural differences in digital health usage, emphasizing the need for focused rural health interventions.[13] Gender differences in mHealth awareness and trust also emerged from the study, with males being more aware and trusting than females. This aligns with research by Das and Das, which found gender-specific barriers to digital health adoption in Assam, such as lower digital literacy and smartphone access among women.[7] Similarly, studies from other parts of India, like those by Bhatia et al., have reported that gender disparities significantly influence mHealth adoption, highlighting the necessity of gender-sensitive approaches to enhance mHealth uptake among women.[14] The use of the internet for health information was prevalent among participants, with Google being the most commonly used source (92.6%), followed by social media platforms like YouTube (70.8%) and WhatsApp (63.0%). This finding is consistent with the global trend of increasing reliance on the internet for

health information, as noted in a study by Bassi and Arfin during the COVID-19 pandemic.[9]
However, the varying levels of trust in online health information—only 3.7% of respondents expressed absolute trust—highlight a significant concern about the reliability of online sources. This scepticism was also noted by Bhavnani and Chiu, who stressed the need for validating the accuracy of online health information to build public trust.[10] Research by Nordin et al. also supports this, showing that trust in online health information remains a critical issue affecting mHealth adoption.[15] Similarly Parija PP et al in their study observed that two third of the respondents cross checked the online health information while 4.2% used the information without verification.[16]

Our study observed that social media is fast becoming a major source of health information but social media can act as a double edged sword and as there is a lack of regulations in social media therefore generating awareness regarding responsible use of online health information and education of social media users is needed.[17] Peer interaction and engagement in social media can enable the users to choose correct information and check spreading fake health news.[18]
The logistic regression analysis in our study revealed that urban location, male gender, higher education and longer smartphone usage were significantly associated with higher mHealth awareness when we consider the effects of the influential factors together. Educational status and gender were also found to influence the trust on mHealth apps. These findings aligns with previous research, where respondents' awareness and use of mHealth apps were notably linked to their educational level and frequency of smartphone usage.[15] Similarly, a study in England found that individuals with higher educational attainment and extensive smartphone usage were more aware and used health apps more frequently, underscoring the necessity of promoting mHealth tools to improve public health outcomes.[19]Another study confirmed that higher education and sustained exposure to digital technologies are critical in increasing the adoption of mHealth applications, suggesting the importance of long-term engagement with digital health tools to maximize their benefits.[20]

Limitations:
This study had several limitations. The cross-sectional design prevented determination of causes, and the sample might not be representative due to sampling bias. Self-reported data might introduce response bias, and findings were limited to Assam, reducing generalizability. Additionally, varying levels of technological literacy of respondents and lack of control for confounding variables limited the study's robustness.

CONCLUSIONS

This study reveals high awareness and significant use of mobile health (mHealth) applications among smartphone users in Assam, mainly for physical activity monitoring and enhancing doctor-patient communication. Awareness is notably higher among urban residents, males, and individuals with higher education and longer smartphone usage. Despite frequent internet use for health information, trust in online sources remains limited, underscoring the need for credible digital health resources. These findings highlight the potential of mHealth technologies in improving healthcare access and delivery in Assam.

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