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ORIGINAL ARTICLE

**Penetration of M-Health Apps and Devices among Undergraduate Medical Students in Puducherry: A Cross-Sectional Study**

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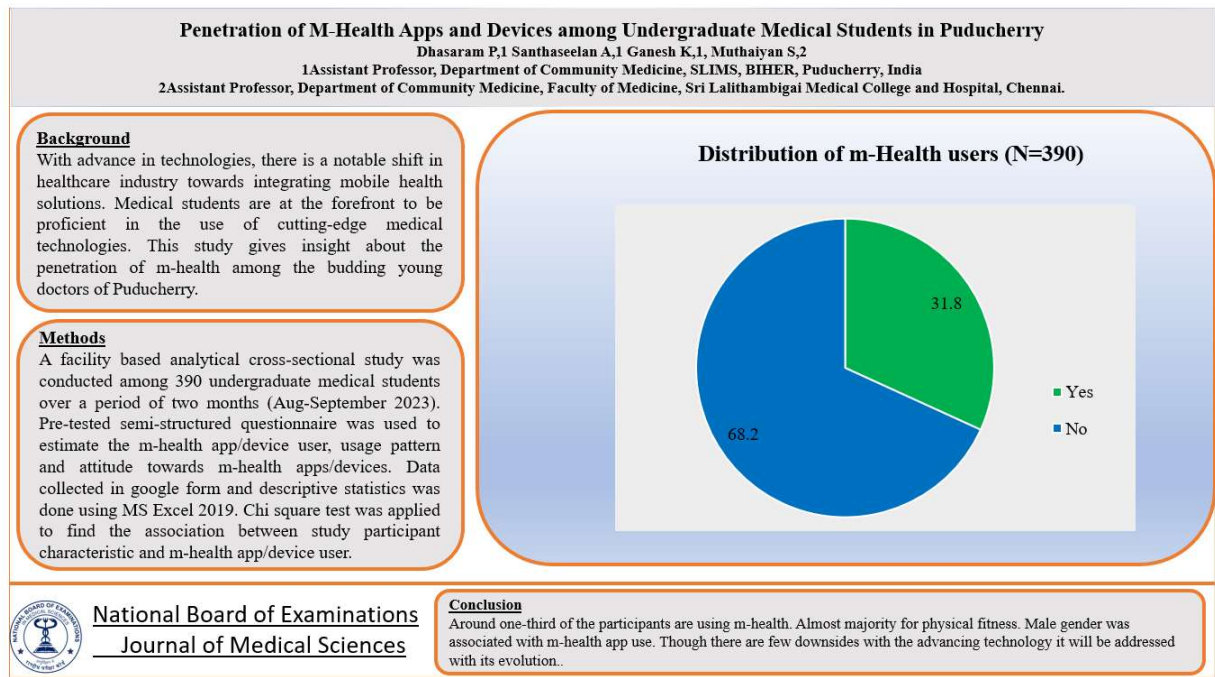
**Abstract**

**Background:** With advance in technologies, there is a notable shift in healthcare industry towards integrating mobile health solutions. Medical students are at the forefront to be proficient in the use of cutting-edge medical technologies. This study gives insight about the penetration of m-health among the budding young doctors of Puducherry. **Materials and Methods:** A facility based analytical cross-sectional study was conducted among 390 undergraduate medical students over a period of two months (Aug-September 2023). Pre-tested semi-structured questionnaire was used to estimate the m-health app/device user, usage pattern and attitude towards m-health apps/devices. Data collected in google form and descriptive statistics was done using MS Excel 2019. Chi square test was applied to find the association between study participant characteristic and m-health app/device user. **Results:** Proportion of the participants using m-health app was 31.8%. The M-health devices used by the participants were smartphone (100.0%), smartwatch (54%), wrist band (32.2%), blood pressure monitoring device (13.7%). They were using for physical fitness (85.5%), clinical training (32.3%) and disease monitoring (26.6%). Around half 46% of the participants were using it for at least once in a day. Majority (91.1%) were highly confident and confident on the results provided by m-health apps/devices. Proportion of male participants using were higher compared to the female participants. **Conclusion:** Around one-third of the participants are using m-health. Almost majority for physical fitness. Male gender was associated with m-health app use. Though there are few downsides with the advancing technology it will be addressed with its evolution.

**Keywords:** m-Health applications, Smartphones. Medical students

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## Graphical Abstract



## Introduction

M-health has evolved due to uprising development in the information and technology causing a great impact on the different fields of health system. Programmatic Integration, financial support, electronic linkages to health system remains as the sustainable solutions of m-health. The World Health Organization (WHO) has defined m-health as “medical and public health practice supported by mobile device such as mobile phones, patient monitoring devices, personal assistants and other wireless devices” [1]. Innovation in medical technology, rapid expansion of mobile networks, task shifting and other health system needs, unprecedented growth of mobile phone users are the influencing factors for mHealth. M-health applications have gained wide acceptance in the field of medical education by improving the performance and knowledge acquisition of students in medical schools. Smartwatch,

Wristband, smartphones, laptops, Android tablets, iPads are some devices which can be used for M health applications [2,3].

According to recent data from Google, India ranks among the top five countries for search terms like ‘mobile health’, ‘health apps’, ‘medical apps’ and ‘m-Health’. This confirms that the Indian population is interested in M-health [4]. In India, there are 74 approved mhealth websites and apps which were listed in the National health portal (NHP) for mHealth. National health portal India, AIMS–WHO CC ENBC, Health You Card, mhealth basics, Safe Pregnancy and Birth, Mobile-Family Planning tool, TB detect (mobile app and website), iTriage Health, Newborn care are some of the apps in NHP for mHealth [5,6]. Apps like Parkinson mPower study app and Autism & beyond study app helps us to understand further information about the disease [5]. In recent times, apps like UpToDate is used worldwide in improving

quality of care, efficiency and patient safety. It is the world's most used Clinical decision support system at the point of care [6]. Safe Pregnancy and Birth app provides a great information on how to stay healthy during pregnancy, talks about danger signs during pregnancy, birth and after birth. What to do when danger signs arises Instructions for community health workers with step by step explanation such as "How to take blood pressure", "how to treat someone in shock", "how to stop bleeding" [6]. In spite of M-health benefits, there are some shortcomings noted in rural India like poor phone access, lack of reliable power, poor smartphone user rates and poor internet connectivity. This study intends to measure the penetration of m-health in provider centric purview (medical students) to get the insight about its use and shortcomings. The objective of this study is to find the proportion of medical students using m-Health apps and devices in a medical college of Pondicherry.

### **Materials and Methods**

A cross-sectional study was conducted among the undergraduate medical students of South India over a period of 2 months (August-September 2023). The participants were MBBS students enrolled from 2017-2022 were considered as the sampling frame for this study. Considering an assumption that 50% of the study participants will use m-Health apps and m-health devices, with absolute precision of 5%, power 80% the final sample size was calculated to be 390. Of the 950 total students, 390 participants were selected by simple random sampling using computer generated random number table. After obtaining written

informed consent from the study participants the data was collected in self-administrated, pre-tested questionnaire through online platform (Google form). Pre-testing of the questionnaire was conducted among the 20 undergraduate medical students recently graduated from the same institute. Content validity of the questionnaire was obtained from the subject experts of Community Medicine of Professor level. Questionnaire comprised on general information about study participants and specific questions related to m-health. The study variable includes name, gender, age, year of MBBS, recent exam grade and the outcome measures were proportion of m-health apps, device users, duration of usage and attitude towards m-health. Data were collected in MS EXCEL 2019, checked for error and coding was done for the variables. SPSS statistics 16.0, Chicago, USA was used to analyze the data. Quantitative variables were expressed in mean standard deviation and qualitative variables were expressed in proportions. Chi-square test was applied to test the association between general characteristics of study participants and m-health users.

### **Results**

In our study, total number of participants recruited were 390. Out of which 171 are male and 219 are female participants. Majority 56.4% are females. Out of 390 participants, majority, 58.2% i.e. 225 members are of more than 20 years of age and 165 are less than or equal to 20 years. The distribution of class of study indicates 87 are first year students, 78 second year, 102 third year, 65 final year and 65 are CRMI (Table 1).

Table 1. Characteristics of study participants [N=390]

S. no	Variable		N	%
1	Age	≤20	165	41.8
		>20	225	58.2
2	Gender	Male	171	43.6
		Female	219	56.4
3	Year of MBBS	I	87	22.3
		II	78	20.0
		III	102	26.2
		IV	63	16.2
		CRRI	60	15.3
4	Percentage of Marks obtained in recent University Exam	<60%	43	11.0
		60-75%	197	50.5
		>75%	63	16.2
		Not Applicable*	87	22.3

\*Not appeared in University Examination

Among the 390 participants included in the study 10.8 % have scored <60% in university exams, 50.3% have scored 60-75% and 16.7% above 75% of university marks. Of all participants 87 first year students are not considered in this category as they have

not appeared for exams yet. (Table 1). In our study of the total 390 participants, it was found that around one third (31.79%) of the participants were using M- health apps and around two third (68.2%) were not using M – health apps (Figure 1).

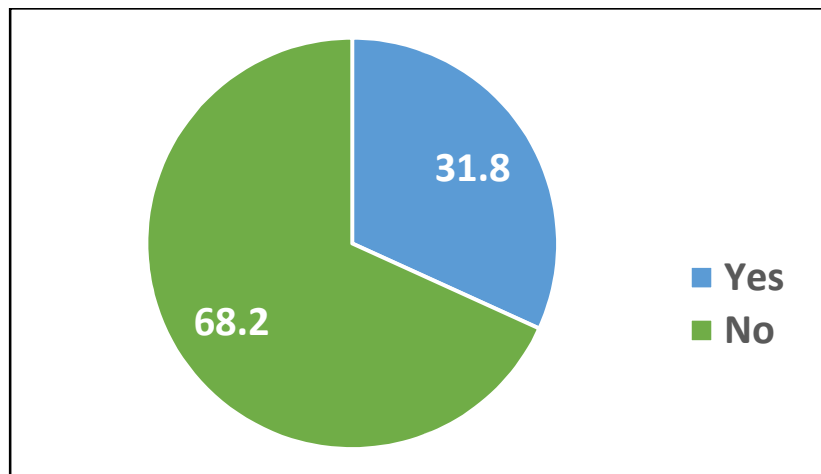


Figure 1. Proportion of participants using mHealth apps (N=390)

Among the 124 m-health app users, all the participants were using smartphones, around half of the participants (54%) are using smart watch, around one third (32.2%) are using wrist band and around one tenth (13.7%) used Blood pressure monitoring devices for fitness, health promotion, disease prevention and disease monitoring.

Of the total 124 m-health app users it was found that more than three-fourth (85.48%) of the participants were using m-health for physical fitness, around one-third (32.25%) of the participants were using m-health for clinical training and around one-fourth (26.61%) were using for disease monitoring (Figure 2).

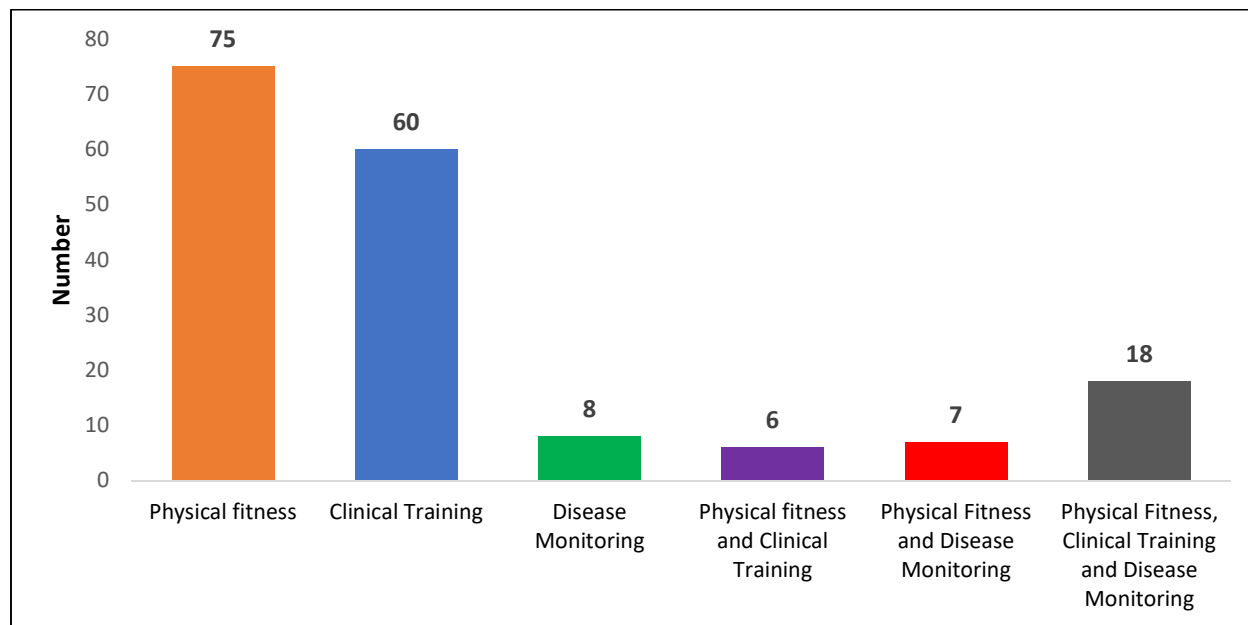


Figure 2. Domains of m-health apps preferred among users (N=124)

Table 2: Usage pattern of M- health apps/ devices among the users

SL No	Variable	Duration	n	%
1.	Duration of use in a day (average)	<30mins	83	66.93
		30mins to 1 hour	33	26.61
		1-3 hours	7	5.64
		>3hours	1	0.8
2.	Duration of use in a week	Several times a day	28	22.58
		Once or twice a day	30	24.19
		2-3 times a week	39	31.45
		Once a week	27	21.77

The usage pattern of m-health apps and devices among our study participants is depicted in Table 2. Of the total 124 m-health users it was found two- third 83 (66.93%) of the participants are using m-health apps for less than 30 minutes. Around half of the participants 58 (46.77%) were using this app/device at least once in a day.

The participants are assessed for their trust and privacy in the results provided by the m-health apps. 17 (13.7%) of the participants are highly confident, 96 (77.42%) are confident and 11 (8.9%) are less confident in the results provided by the m-health apps. Around half of the participants 70 (56.4%) are also aware of the security policy and chances of security breach in the data captured. But none were aware about the reporting mechanism in the occurrence of security threat.

The main driving factor for m-health apps are easy accessibility (55.6%), to get the

knowledge in less time (45.16%) and accuracy (39.5%). The barriers in m-health apps/devices are internet connectivity, high data consumption, electricity power shortage for charging, customer support, increase in screen time.

The attitude of the study participants towards the m-health apps/devices shows that they consider this as a new revolution in healthcare (93.5%). It is seen that majority (91.1%) are ready to share and motivate their friends to use m-health apps or devices in future.

The proportion of male participants using m-health was higher compared to the female participants (38.6% vs 26.5%). This difference was found to be statistically significant. No other characteristic of the study participant had significant association with the m-health use (Table 3).

Table 3. Association between m-health use and characteristics of participants (N=390)

Variable		m-health apps/devices user		pValue
		User (n=124)	Non-user (n=266)	
Age	≤20	49 (29.7)	116 (70.3)	0.446
	>20	75 (33.3)	150 (66.7)	
Gender	Male	66 (38.6)	105 (61.4)	0.010
	Female	58 (26.5)	161 (73.5)	
Year of MBBS	≤ II MBBS	51 (30.9)	114 (69.1)	0.747
	>II MBBS	73 (32.4)	152 (67.6)	

## Discussion

Mobile health apps and other modes of m-health are emerging field in aspects of delivering early healthcare intervention. They help in easy identification and screening of at-risk individuals. Currently available m-health apps are stand alone. They do not require continuous monitoring by medical professionals. Although M-health apps are aimed at, “at risk” population, our study participants are medics students. The aim of our study is to find proportions of Medical students in a medical college of Puducherry using these apps for their own health fitness and other purposes. In our study among 390 participants inclusive of all years of MBBS students it was found that 31.7% students are using m health apps and again 31% are using mm-health devices. It is a facility-based study when participants are selected through simple random sampling.

When compared to our study, Gajendra Singh et al conducted a cross-sectional study in Bangalore and it was found that 59% of undergraduate students were using m health apps [13]. Thus difference may be due to low sample size (n=120) of the study including only 2<sup>nd</sup> and 3<sup>rd</sup> year students. The results of the study by Ventola CL identifies the purpose for which HCP use such apps and devices. Searching for accurate and clinically significant data was one among the most popular causes [14].

In our study 85% i.e. majority were using m-health apps/devices for physical fitness in contrast to study done by Gajendra Singh et.al. [13] (2019) where it was found that around half of the participants were using it for fitness. The usage has increased as per our study which is conducted in ongoing

COVID pandemic scenario after three waves of which have taken a toll on us. The pandemic has made individuals aware of the famous saying, “health is wealth.”

According to the Ventola CL [14] 85% medical students use such apps and devices for clinical purposes or information’s once in a day. In comparison to our study only one-fourth of the users are using such apps and devices once in a day. The difference could be due to geographical difference in conduct of the study.

According to a descriptive study conducted in Saudi Arabia by Mishael Alhusseini et al. (2021) on students’ perceptions towards m-health applications for education in medical colleges, around 22.2% uses it for around an hour a day [8]. Similarly around 1/4<sup>th</sup> of the participants included in our study spend at least an hour a day. These similar results could be due to inclusion of medical students as study population in both the studies.

In contrast to our study which shows about 1/5<sup>th</sup> of users uses such apps and devices for all purposes like clinical training, learning, physical fitness monitoring, the study conducted by Mishael Alhusseini et al. showed that 14.5% of users use it for all purposes and 39.8% for only learning [8]. In comparison to our study it was found that majority 85.48% are using them for only physical fitness monitoring which could be attributed to the increased awareness of healthy body in the current scenario of the pandemic [11].

In our study the main barriers for m-health penetration were security issues, privacy in data captured, internet connectivity, high data consumption and

electricity power for charging the devices. Similarly, in a study by Jembai et al. [15] among medical students of Malaysia, it was highlighted that around one-third of the participants reported privacy as a hindering factor for acceptance. 21.3% were not confident on the results provided by m-health technology. But in our study, it was reported 8.9% were not confident on the results. This difference might be because of geographical variation. The updates provided by the apps to fix the bugs also could have contributed in reliability of the results [15].

India is currently undergoing urbanization. And there is a steady population growth going on. Amid such evolving situations along with the ongoing pandemic HCP and health care facilities are unable to meet the demands of the country due to considerable gap between demand and supply, due to inadequate doctor patient ratio. "Doctor patient ratio for India – the reality" an article written by Madhav Deo et.al states that in India, the overall doctor population ratio is 1:1800, which is lower than that the ratio of 1:1000 suggested by 'High Level Expert Group (HLEG) for Universal Health Coverage' constituted by the Planning Commission, and endorsed by WHO. In order to narrow down this gap, amidst the current situation of evolving pandemic m-health applications can act as bridge [4,12,13]. In current scenarios of pandemic where maintaining social distance has become a key step in prevention of spread, m-health technology can impact substantially on health outcomes of the forever increasing demand for better health care curated to perfection. The underserved health care due to financial deficits and other difficulties

when dealt with easily available and cost-effective apps and devices could act revolutionary in the developing countries like India [9,13]. Among our study participants 93.5% holds same view that it could be revolutionary in health care.

### **Conclusion**

From our study it is evident that around one-third of the medical students are using m-health apps and devices and almost majority for physical fitness and around one-fourth for clinical training and disease monitoring. Amongst the users this evolving platform is considered as potentially beneficial tool though few downsides like security breach and network connection are well known. More the penetration of the m-health apps and devices through sharing of its benefits by its users to the non-users will improve the coverage and avoid the human error in diagnostics and health promotion. Further research is needed to address the barriers in expansion of m-health.

### **Statements and Declarations**

#### **Conflict of Interest**

The authors declares that they do not have conflict of interest.

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No funding was received for conducting this study.

#### **Author's contributions**

All the authors participated in the process of concept building, literature search, presentation and approval of initial design, data collection, analysis, report writing,



editing, reviewing and approving the final manuscript.

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