Knowledge, Perception and Practice of Telemedicine among Undergraduate Medical Students at a Tertiary Care Teaching Hospital

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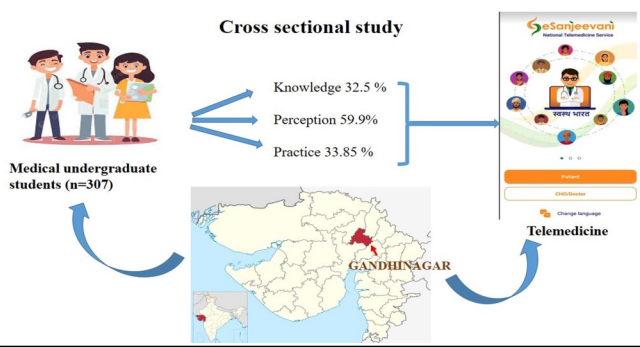
ABSTRACT

Telemedicine is crucial in supporting the healthcare sector in developing countries as it can assist in various scenarios, such as low physician-to-population ratios, lack of access to specialty physicians, and patient and physician needs in remote areas. The study aimed to assess the knowledge, perception, and practice of telemedicine among undergraduate medical students, recognizing the importance of equipping future healthcare professionals with the necessary skills and understanding of this technology. A cross-sectional study was conducted among 307 undergraduate medical students at a tertiary care teaching hospital. A structured questionnaire was used to collect data on demographic information, computer literacy, knowledge, perception, and practice of telemedicine. Data entry and analysis were done using Microsoft Office Excel 2010. The mean, percentage, and standard deviation were calculated to describe the characteristics of respondents. This study found that 75.8% of participants were aware of telemedicine; however, only 18.8% recognized its use for prescribing drugs. Additionally, 59.9% had a low level of perception towards telemedicine. Although 45% agreed to incorporate telemedicine into medical education, 61% preferred traditional hospital visits due to concerns about information, expertise, and technical challenges. The study emphasizes the imperative for telemedicine training to address the existing knowledge gap. It underscores the critical importance of integrating telemedicine education into medical curricula at an early stage.

ABSTRAK

Telemedis sangat penting untuk mengembangkan sektor kesehatan di negara berkembang karena dapat membantu dalam berbagai skenario, seperti rendahnya rasio dokter terhadap populasi, kurangnya akses terhadap dokter spesialis, dan kebutuhan pasien dan dokter di daerah terpencil. Penelitian ini bertujuan untuk menilai pengetahuan, persepsi, dan praktik telemedis di kalangan mahasiswa kedokteran, menyadari pentingnya membekali para profesional kesehatan masa depan dengan keterampilan dan pemahaman yang diperlukan tentang teknologi ini. Sebuah studi cross-sectional dilakukan pada 307 mahasiswa kedokteran sarjana di rumah sakit pendidikan tersier. Kuesioner terstruktur digunakan untuk mengumpulkan data tentang informasi demografis, literasi komputer, pengetahuan, persepsi, dan praktik telemedis. Entri dan analisis data dilakukan dengan menggunakan Microsoft Office Excel 2010. Rata-rata, persentase, dan deviasi standar dihitung untuk menggambarkan karakteristik responden. Studi ini menemukan bahwa 75,8% peserta mengetahui telemedis, hanya 18,8% yang mengetahui penggunaannya dalam peresepan obat. Selain itu, 59,9% memiliki tingkat persepsi yang rendah terhadap telemedis. Meskipun 45% setuju untuk memasukkan telemedis ke dalam pendidikan kedokteran, 61% lebih memilih kunjungan ke rumah sakit tradisional karena kekhawatiran tentang informasi, keahlian, dan tantangan teknis. Studi ini menekankan pentingnya pelatihan telemedis untuk mengatasi kesenjangan pengetahuan yang ada. Hal ini menggarisbawahi pentingnya mengintegrasikan pendidikan telemedis ke dalam kurikulum kedokteran pada tahap awal.

GRAPHICAL ABSTRACT



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INTRODUCTION

Telemedicine has resulted in remarkable advancement in providing medical services (Junaid et al., 2022). In India, the need for healthcare has increased due to the expanding population. Approximately 279,588 beds are in rural hospitals and 431,173 beds are in urban hospitals, with 70% of the population of India still living in rural areas, equating to 1.3 beds per 1000 population. Hence, the availability of beds in government hospitals is low (Malhotra et al., 2020). Another barrier, long geographical distances, may affect the delivery of care, from diagnosis of disease to the beginning of treatment, particularly in rural and hilly areas, which seriously affect the final result of care in emergency situations like acute myocardial infarction, cranial hemorrhages, and injuries due to accidents, etc. (Panagariya, 2014; Parikh et al., 2014). In this context, telemedicine in developing countries can serve as an alternative to provide upgraded services and specialist care, while in developed countries, it may easily deploy an emergency strategy such as sending out a helicopter to rescue the patient and transport them to the nearest hospital in a short time (Combi et al., 2016; Ehteshami et al., 2018; Thong et al., 2021; Zayapragassarazan & Kumar, 2016).

The WHO defines telemedicine as "The delivery of health-care services, where distance is a critical factor, by all health-care professionals using information and communications technologies for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and the continuing education of health-care workers, with the aim of advancing the health of individuals and communities" (WHO, 2010). Telemedicine can also help in e-learning techniques to provide health education to remotely located healthcare professionals and patients, and for expert second opinions or tele-counseling between doctors and patients either through a network or video link. Several programs have been used in a successful way in developed countries like the United Kingdom, Finland, Europe, and Taiwan (Combi et al., 2016; Kong et al., 2020; Venkatesh et al., 2022). In the United Nations, 76% of hospitals connect with patients using forms of telemedicine (Ambade et al., 2022; Combi et al., 2016). Across the European Union, telemedicine is used to monitor patients with hypertension, diabetes mellitus, and bronchial asthma. In Asian countries like Japan and South Korea, it has been used to complement in -person encounters and to follow up on in-person encounters, respectively (Gudi et al., 2021; Stoltzfus et al., 2023). With the Covid-19 pandemic affecting the world, telemedicine has been upgraded as an essential service to mitigate the spread of Covid-19 in patients and to preserve valuable personal protective equipment for healthcare workers (Calton et al., 2020). In Western Australia, another program has been launched which focused mainly on remote medical education (76% of the cases considered) without ignoring other objectives like wound care (55%), psychiatry cases (54%), etc. (Combi et al., 2016).

As the growth of telemedicine expands worldwide, the Government of India also adopted the program "eSanjeevani," the pillar for India's National Telemedicine Service, in 2020 (Goyal et al., 2022), which aims to create a digital health ecosystem for the country to promote universal healthcare and improve health outcomes (Dastidar et al., 2022). The Telemedicine Practice Guidelines were released by the Government of India and the Medical Council of India in 2020 for Registered Medical Practitioners (RMPs). This practical information has been leveraged by RMPs to merge telemedicine into their practice, and since its launch, there have been over thirty million teleconsultations through eSanjeevani. Though a remarkable achievement, it is still a tiny fraction relative to the total need and demand for healthcare services in India, and there is heterogeneity in the acceptance and practice of telemedicine in India across diverse subgroups of the population (Balsari et al., 2018; Dash et al., 2021).

To ensure the effective implementation of telemedicine technology in the healthcare system, updated knowledge, a persistent attitude, and consistent skills of medical undergraduates are much needed, as they are the future of healthcare services (Dey et al., 2016; Ghaddaripouri et al., 2023). There are many studies carried out across the world to explore the perception of students toward telemedicine (Badea et al., 2014; De Silva et al., 2014; Kong et al., 2020; Kunwar et al., 2022), but very few studies are available in our country (Dey et al., 2016; Malhotra et al., 2020) that have shown a lack of knowledge, perception, skill, training, and resistance to adopting telemedicine among healthcare professionals. Hence, this study was planned to evaluate the knowledge, perception, and practice of telemedicine amongst the undergraduate medical students so that improvements can be made through programmatic evaluation and research to guide best practices in the future.

METHODS

A descriptive, questionnaire-based cross-sectional study was conducted amongst the undergraduate medical students at a medical college and hospital in India for 4 months from April to July 2021. Medical students from the 2nd year, 3rd year, and internship willing to participate in the study were recruited by simple random sampling. Using a single population proportion calculation, a sample size of 384 participants was calculated, accounting for a 50% proportion of the study population, a 5% margin of error, and a 95% confidence range. All study participants were given a predesigned, pretested self-administered questionnaire after obtaining written informed consent. The majority of the questions were formulated from previous studies (Calton et al., 2020). To enhance its validity, the questionnaire was validated by two subject experts. Furthermore, a pilot test involving 20 undergraduate students not involved in the main study was conducted to refine the questionnaire before its administration to the intended participants. The study was initiated after obtaining ethical approval from the Institutional Ethics Committee no. 09/2019 dated 29th May 2019. The questionnaire was administered to students after a brief description and purpose of the study. The questionnaire consists of four sections. Section 1 consists of 8 items regarding demographic details. Section 2 contains 10 items to assess computer access, literacy, and knowledge of telemedicine. Regarding knowledge, four statements have to be answered in the form of "Yes", "No", or "Don't know" responses. A score of "2" for "Yes", "1" for 'Don't know', and "0" for "No" was allotted to each statement. One can score in a range of 0 to 8 in this section. Section 3 (total of 15 items) assesses telemedicine perception, which requires a graded response to each statement on a three-point Likert scale, i.e., "0" for disagree, "1" for undecided, and "2" for agree. One can score in a range of 0 to 30 in section 3. Section 4 contains 6 items regarding the practice of telemedicine. Each statement has to be answered in the form of "Yes" or "No". A score of "1" for "Yes" and "0" for "No" was allotted. One can score in a range of 0 to 6 in section 4.

The raw scores were calculated for all the statements of knowledge and attitude. The mean and standard deviation for the subsamples and the range for the overall samples were calculated. Further, the raw scores were converted to percentages. The scores equal to and less than 49% were considered poor/negative, the scores 50% to 70% were considered average/moderate, and the scores equal to and above 71% were considered good/positive with respect to knowledge and perception scores.

Confidentiality of all the data was maintained. After collection, the raw data were entered into Microsoft Office Excel 2010, and all collected data were analyzed using GraphPad Prism 9.4.1 for Windows, GraphPad Software, www.graphpad.com. The relevant statistical test was applied, and the result of the

Table 1
The Characteristics of medical students

Variable	Frequency (n)	Percentage (%)
Gender		
Male	163	53.09
Female	144	46.9
Year of study		
2nd M.B.B.S	130	42.34
3rd M.B.B.S	58	18.89
Final year M.B.B.S	10	3.25
Intern	109	35.5
Domicile		
Urban	237	77.19
Rural	70	22.8
Type of Family		
Joint	85	27.68
Nuclear	222	72.31

study were expressed in mean, percentage, and standard deviation for demographic profile, knowledge, perception, and practice of telemedicine. A statistically significant difference was indicated by a p-value < 0.05. Spearman correlation was used to find out the association between knowledge, attitude, and practice, with a p-value of < 0.001 considered statistically significant.

RESULTS

For the final analysis, a total 307 students participated and response rate was 79.9% in this study. The mean age of participants was 20.8 years (SD=10.22, range 18-22). Out of 307 participants, 53 % (n=163) were males and 46.9 % (n=144) were females (Table 1). The majority of study participants were from 2nd M.B.B.S 42.34% (n=130), residing in urban area 77.1 % (n=237) and from nuclear family 72.3 % (222). The source of information related to telemedicine was by means of Internet use (43.9 %) among the study participants.

Figure 1 shows about 75% of study participants had computer knowledge. In a study questionnaire regarding the use of the internet, about 51.79 % of participants had answered for mail/research and 48.2 % of participants responded for watching news/films. About 47.23 % of study participants answered that they were spending 10-15 hours/week followed by 29.31 % participants were spending 15-20 hours/week on computer.

A detailed assessment of four knowledge questions was provided. The mean score of knowledge regarding telemedicine was 1.95 (SD=0.98) out of 8, with an overall 28% of participants having about fifty percent knowledge score. Our study found a correct rate 32.5% of which shows low level of knowledge in participants. Almost 75.8 % of participants knew about telemedicine but only 18.8 % of participants answered the use of telemedicine for prescribing drugs; about 7.8 % correctly answered questions regarding the use of telemedicine for prescribing narcotic drugs. Most of the participants (34 out of 58) knew the use of telemedicine to prescribe drugs for fever and 14 students responded to the use of telemedicine for prescribing antihistaminic drugs. As shown in Table 2, there was no statistically significant association between knowledge and age, gender, domicile or educational year of M.B.B.S (p>0.05).

A total of 15 questions were asked regarding perception towards telemedicine. Most participants (81%) strongly agreed to expert specialist care from a distance and 69.5% of participants agreed to save time and travelling expenditure. The average perception score was 20.95 (SD, ±5.33) among 59.9 % of participants which showed a low level of perception. More-

Table 2
Demographic characteristics association with knowledge and perception towards telemedicine

Variable	Knowledge					Perception				
	Good	%	Poor	%	P value	Good	%	Poor	%	P value
Gender										
Male	48	29.4	115	70.5	0.552	59	43.3	104	56.7	0.987
Female	38	26.3	106	73.6		52	36.1	92	63.8	
Year of study										
2nd M.B.B.S	36	27.6	94	72.3	0.959	44	33.8	86	66.2	0.102
3rd first M.B.B.S	18	31.3	50	68.9		18	31	40	69	
3rd final M.B.B.S	2	20	8	80		7	70	3	30	
Intern	30	27.5	79	72.4		42	38.5	67	61.5	
Domicile										
Rural	22	31.4	48	68.5	0.469	33	47.1	37	52.8	0.029*
Urban	64	27	173	73		78	32.9	159	67.1	

Note: *p < 0.05 statistically significant. Association tested using Chi-squared test. M.B.B.S = Bachelor of Medicine, Bachelor of Surgery (MBBS)

over, only 36.15% of the study participants' perception scored ≥80% and were categorized as having a positive perception. As shown in Table 2, negative perception was significantly associated with domicile and there was no statistically significant association between perception and age, gender or educational year of M.B.B.S (p>0.05).

About 138 (45%) study participants agreed to the statement regarding the future use of telemedicine to include as a practical component to provide hands-on skills to medical students, about 132 (42.9%) students agreed to the statement regarding telemedicine use for identification and monitoring of adverse drug reactions.

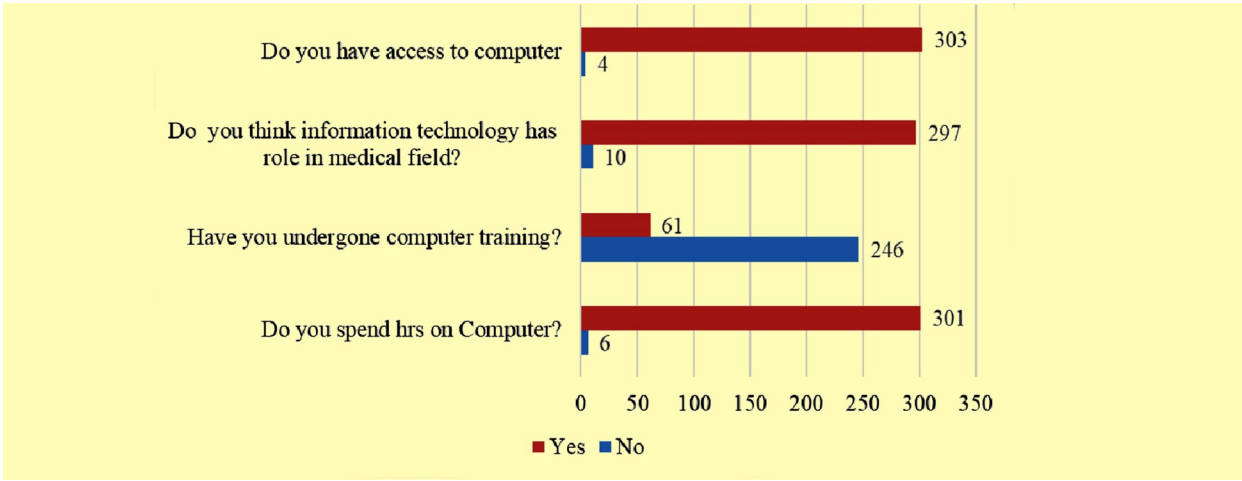
The mean practice score (2.32/6±0.81) with a correct rate of 33.85 % which shows wrong practice toward telemedicine. Although 72.3% of participants were aware of disadvantages of telemedicine only 9.1% used telemedicine and very few participants (2.2%) used telemedicine Apps (Table 3). Only 3 study participants had used antihistaminic drug and 2 participants had used paracetamol through a telemedicine app prescription. Figure 2 shows reasons for not giving preference to telemedicine as compared to traditional hospital visits. Reasons for not preferring telemedicine use were because of lack of information among 39.3% of participants and lack of expertise in 26.4 % of participants.

Our study found small negative correlation between knowledge score v/s perception score (rs=-0.020, p=0.716). This indicates increase knowledge score, decrease in perception score. There was a non significantly small positive correlation between knowledge score v/s practice score (rs=0.068, p<0.05) and perception score v/s practice score (rs =0.275, with p<0.001). It suggests that high perception score is associated with high practice score.

Table 3
Practices related to telemedicine use

Statement	Yes	%	No	%
Have you used telemedicine?	28	9.12	279	90.87
Have you used the medication prescribed by it?	8	2.61	299	97.39
Do you frequently use telemedicine apps?	7	2.29	300	97.71
Are you satisfied with drug use by it?	21	6.84	286	93.15
Have you noticed the disadvantage of it?	222	72.31	85	27.68
Do you prefer telemedicine over hospital visit?	129	41.69	178	57.98

Figure 1
Computer knowledge among medical students



DISCUSSION

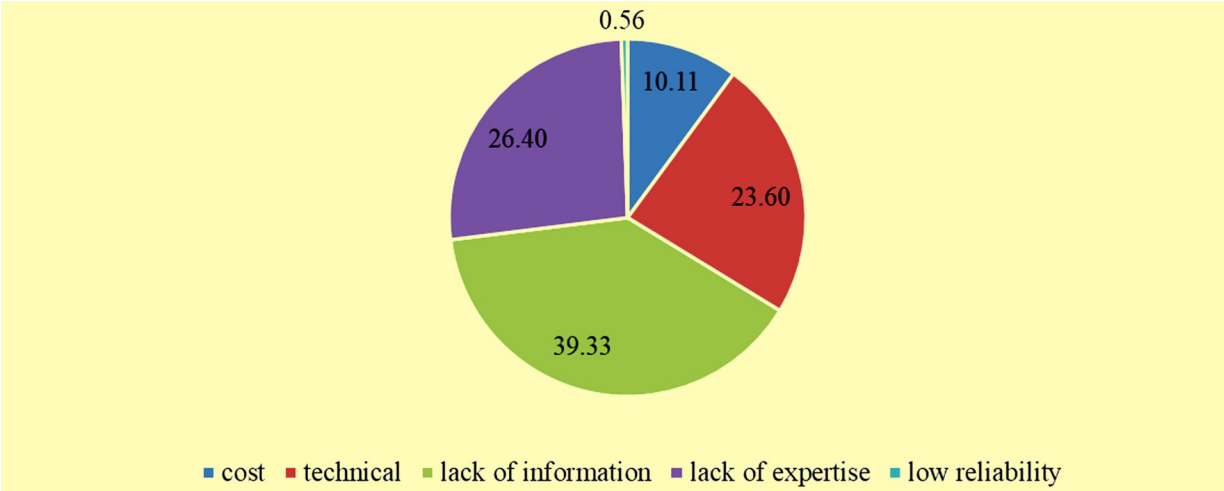
In developing countries, addressing the complex challenges within the healthcare delivery system requires thoughtful and comprehensive solutions. Among these solutions, telemedicine has emerged as a viable tool with the potential to enhance both the quality and efficiency of healthcare services. To ensure the successful integration of this technology and its sustainable adoption, it is crucial to disseminate knowledge, shape perceptions, and promote practical skills related to telemedicine at the grassroots level among healthcare professionals. This proactive approach will pave the way for a more effective and accessible healthcare system that leverages the benefits of technology.

This cross-sectional study utilized a questionnaire-based approach to assess the knowledge, perception, and practice of telemedicine among 307 undergraduate medical students. Among the participants, 163 individuals (53%) were male, which aligns with a similar study conducted in Nepal where 83 participants (56.8%) were also male (Kunwar et al., 2022). Notably, 237 participants (77.1%) hailed from urban areas, and 222 students (72.3%) were part of nuclear families. Our study revealed that demographic variables such as age, gender, year of study, and the locality of residence were not found to be statistically significant in association with participants' knowledge level.

In our study, we found that 98.7% of the students had access to computers, while 19.8% had received computer education and training. This trend was consistent with a study conducted in West Bengal, where 96% of postgraduate students were computer literate and had access to computers (Dey & Bhattacharya, 2016). However, a study from Sri Lanka presented contrasting results, indicating that only a small percentage (3%) of students had access to computers, while a significant portion (67%) had undergone formal computer education and training (De Silva et al., 2014). These findings underscore the varying degrees of computer accessibility and education among students in different regions.

In our study, 28% of the participants exhibited approximately fifty percent knowledge scores, a finding akin to a study conducted in Ethiopia. In the Ethiopian study, knowledge was assessed through a set of 10 questions, with only 37.6% of physicians provided correct answers for at least half of them (Biruk & Abetu, 2018). Our study revealed that 75.8% of the participants had knowledge about telemedicine but exhibited limited understanding regarding which drugs could be prescribed through it. In an Indian study displayed that 43% of study participants had insufficient knowledge about telemedicine, while 38% had average and 18.9% had high knowledge about

Figure 2
Percentage of reasons for not giving preference to telemedicine use



telemedicine (Malhotra et al., 2020). Notably, a study involving 287 students in the United States found that only 17.4% of the students had prior exposure to telemedicine (Kong et al., 2020). In contrast, a study conducted in West Bengal reported that an impressive 88.7% of postgraduate students were already familiar with the concept of telemedicine (Dey & Bhattacharya, 2016). A study was carried out in the Northern Province of Iran (Ayatollahi, 2015), where clinicians displayed an overall low level of knowledge regarding telemedicine technology. Another studies conducted in Nigeria, and Uganda (Assaye et al., 2022; Kiberu et al., 2019) revealed that 34.1 % and 41% of healthcare professional had good understanding of telemedicine respectively. On the other hand, study conducted in Libya revealed notably 582 (86.5%) of the physicians had high knowledge of telemedicine (Elhadi et al., 2021). These variations in knowledge across different countries might be attributed to differences in the duration of telemedicine program implementation and functionality in respective regions. Notably, as telemedicine is a relatively new technology and has not been implemented at our institution, the study participants displayed a lower level of knowledge. The average perception score was 20.95 (SD, ± 5.33). Among 59.9 % of participants showed a low level of perception. About 69.5% of participants agreed that telemedicine can save time and travelling expenses. In India, patient from the rural and hilly area has to travel long distance and lose their daily wages for health care service. Telemedicine can be a boon for the delivery of specialist services in remote areas.

About 138 (45%) study participants agreed for telemedicine to be included as a practical component to provide hands-on skills to medical students. Another study from Sri Lanka (Kong et al., 2020) to provide hands-on skills (De Silva et al., 2014). In a study from Nepal, 52.7% of students agreed to include telemedicine in medical curriculum (Kunwar et al., 2022). In a study from the United States only 28 (25.9%) students thought telemedicine should be part of the medical curriculum (Kong et al., 2020). This study finding confirms that the medical students at our institute are bared of acquiring any sort of formal telemedicine education before they are thrust into their clinical practice. Early implementation of telemedicine courses to the curriculum can aid in transforming attitude of medical students for future clinical practice.

About 39% of the study participants expressed a preference for telemedicine over traditional hospital visits. However, the majority of participants still leaned towards face-to-face hospital visits, citing the potential benefits of enhanced patient compliance and satisfac-

tion through physical examinations conducted by doctors. The study revealed that factors such as lack of information, limited expertise, cost implications, and technical challenges stood as prominent deterrents to adopting telemedicine services, echoing findings from a similar study conducted in West Bengal (Dey & Bhattacharya, 2016). It's worth noting that a deficiency in telemedicine training might have influenced medical students to lean towards favoring the traditional hospital visit approach. To bridge this gap, concerted efforts are essential to incorporate telemedicine into medical curricula, fostering a more comprehensive understanding and acceptance among medical students. For the effective integration of modern technology into healthcare delivery, the active engagement of specialists is imperative. This becomes particularly crucial in a country like India, where the barriers of large population and diverse geographical distribution pose significant challenges to healthcare accessibility. Telemedicine emerges as a promising solution to extend healthcare services to underprivileged and remote areas, thereby not only saving time and costs for patients, but also potentially addressing the scarcity of specialist doctors to cater broader population's needs.

The limitation of the study is that we had small sample size and the study participants were drawn from a specific institution, which might not be fully representative of the entire population of medical students in the region. This could introduce sampling bias and limit the generalizability of the findings to a broader context. Another study can be carried out to compare knowledge, attitudes, and practices regarding telemedicine among medical students from different educational institution.

CONCLUSIONS

This study sheds light on the multifaceted landscape of telemedicine adoption among undergraduate medical students. The findings underscore the necessity of early integration of telemedicine education within medical curriculum, as the majority of participants lacked formal exposure to this transformative technology. While a considerable proportion expressed a preference for telemedicine, the prevailing preference for face-to-face interactions emphasizes the value of physical examinations and patient satisfaction. Challenges such as limited knowledge, expertise, and technical barriers highlight the need for targeted training and support. To harness the full potential of telemedicine, concerted efforts are required to bridge these gaps and foster a comprehensive understanding among medical students. By doing so, we can pave the way for a healthcare system that leverages technology to overcome geographical barriers and enhance accessibility while addressing the scarcity of specialized medical services.

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AUTHORS' CONTRIBUTIONS

Ami Vithalani designed the study, wrote the manuscript, enrolled participants, and performed the field work. Preksha Barot and Apexa Shukla designed the study, formulated the concept, wrote the manuscript, reviewed the manuscript, collected and analyzed the data, revised the manuscript, read and approved the final manuscript. Hitesh Patel wrote the manuscript, reviewed the manuscript and analyzed the data. Darshan Dave revised the manuscript, read and approved the final manuscript.

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COMPETING INTERESTS

The authors confirm that all of the text, figures, and tables in the submitted manuscript work are original work created by the authors and that there are no competing professional, financial, or personal interests from other parties.

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