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Use of Smartphones and Medical Apps in Dentistry

Saba Rehman[a], Attique ur Rehman[b*], Rizwan Mahmood[c], Iquebal Hasan[d]

[a]Department of Medical Education, Al-Aleem Medical College, Lahore, Pakistan
[b]Assistant Professor and Head, Department of Operative Dentistry, Islam Dental College, Sialkot, Pakistan
[c]School of Dental Sciences, Universiti Sains Malaysia, Kota Bharu, Malaysia
[d]Workman School of Dental Medicine, High Point University, USA

*Corresponding address: *Department of Operative Dentistry, Islam Dental College, 7 KM Pasrur Road, Sialkot, Pakistan*
Email: **attiquedentist@gmail.com**

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ABSTRACT

Objective: To assess the usage patterns, perceptions, and associated factors related to smartphone and medical/dental app use among dentists and dental students in Punjab, Pakistan.
Methods: A cross-sectional, web-based survey was conducted among 900 dentists and dental students from multiple dental institutions in Punjab. Data were collected using a structured, self-administered questionnaire adapted from a previously validated tool, comprising items on demographics, smartphone usage patterns, purposes of app use, and perceptions regarding dental and medical applications. Responses were recorded through Google Forms, and all questions were mandatory. Data were analyzed using SPSS version 24. The Wilcoxon–Mann–Whitney test was applied for two-group comparisons, while the Kruskal–Wallis test was used for analyses involving more than two groups; post hoc tests were conducted where appropriate. Statistical significance was set at $p < 0.05$.
Results: Although smartphone ownership was high, professional use of dental and medical apps was relatively low. Most participants used apps less than once per week, with 79.2% reporting daily use of 1–20 minutes. Diagnostic assistance (38%) and reviewing dental literature (33%) were the most common purposes of use. Participants expressed strong agreement that apps provide useful information (mean = 3.90), are easy to obtain (mean = 3.80), and that they were interested in receiving more apps (mean = 3.88). Mixed perceptions were observed regarding the use of apps to replace textbooks (mean = 2.58). Teaching experience significantly influenced perceived ease of obtaining apps ($H = 7.72$, $p = 0.021$), and qualification level significantly affected learning through apps ($H = 13.27$, $p = 0.010$).
Conclusion: Despite widespread smartphone access and positive perceptions of app usefulness, the use of dental and medical apps remains limited. Enhanced digital integration, faculty and student training, and improved infrastructural support may help increase meaningful adoption of app-based learning and clinical support tools within dental education in Pakistan.

Keywords: Mobile applications; Smartphone; Surveys and questionnaires; Cross-sectional survey; Pakistan; Dentists; Students

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Introduction

The rapid expansion of information technology has transformed patterns of communication, learning, and healthcare delivery worldwide. As smartphones have become increasingly powerful, affordable, and user-friendly, they are progressively replacing traditional personal computers for everyday tasks. Their advantages, including portability, diverse application ecosystems, high-quality multimedia capabilities, and instant internet connectivity, have contributed to unprecedented global adoption. Recent estimates indicate that there are more than 9.14 billion cellphone subscriptions worldwide and 197 million in Pakistan, reflecting widespread accessibility of mobile technologies.[1, 2] Similarly, internet penetration has risen sharply, with more than 5.56 billion global users and approximately 152 million users in Pakistan.[2, 3] Among smartphone platforms, Android dominates with over 70% of the global market share, largely due to its open-source nature, lower device costs, and extensive app availability.[4] Studies also suggest that average daily smartphone usage exceeds two hours, and may be even higher among dental students due to their reliance on digital resources for academic tasks. [5, 6]

The proliferation of mobile applications has generated significant opportunities within medical and dental education. Numerous apps are designed specifically for students and clinicians, supporting activities such as accessing academic content, managing patient information, enhancing communication among colleagues, facilitating clinical skills training, and guiding evidence-based practice.[7] The availability of point-of-care digital resources has been shown to strengthen clinical decision-making, offering timely and reliable information during patient encounters. Younger dental students and practitioners, in particular, increasingly prefer mobile apps over traditional textbooks, valuing the autonomy and flexibility afforded by digital learning tools.[5] Many dentists anticipate that mobile devices and associated applications may eventually supplement or replace certain conventional learning resources.7 Perceived advantages commonly reported in the literature include portability, efficiency, accuracy, time-saving features, and improved coordination in clinical workflows.[7]

Following the COVID-19 pandemic, the shift toward online and blended learning strategies further accelerated the integration of smartphones and mobile applications into health professions education. E-learning platforms and mobile-assisted learning played critical roles in ensuring educational continuity, particularly in resource-limited settings. Despite this global trend, there is limited published research on how dental students and dentists in Pakistan, especially within Punjab, utilize smartphones and dental apps for educational and clinical purposes.[8] Existing studies from other countries, such as India, China, and various Middle Eastern contexts, highlight growing reliance on mHealth solutions among dental professionals; however, the applicability of these findings to Pakistan remains uncertain due to differences in educational infrastructure, technology access, and clinical training environments.

The Technology Acceptance Model (TAM) provides a useful conceptual framework for examining technology adoption in healthcare and education. According to TAM, perceived usefulness and perceived ease of use are key determinants of individuals' willingness to adopt and integrate new technologies into their routine practice.[9] Applying this framework allows for a structured understanding of how dental students and practicing dentists evaluate mobile applications, and how these perceptions shape their behavior. Yet, to date, no published study has explored smartphone usage and dental app adoption among dentists and dental students in Pakistan in the post-COVID context, representing a significant knowledge gap. Understanding local patterns of adoption is essential for informing curricular design, guiding institutional decision-making, and supporting the development of contextually relevant digital tools by both national and international software developers.

Given this background, the present study aims to investigate the use of smartphones and medical/dental mobile applications among dental students and practicing dentists in Punjab, Pakistan. Specifically, it examines their perceptions regarding these apps, the purposes and patterns of their usage, and the extent to which demographic factors are associated with usage behaviors and perceptions.

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Materials and Methods

Study Design and Setting

This study employed a cross-sectional, web-based survey design to assess the use of smartphones and medical/dental mobile applications among dentists and dental students in Punjab, Pakistan. The survey targeted individuals affiliated with multiple dental institutions across the province.

Participants and Sampling

Participants included dentists and dental students who owned a smartphone and were willing to complete an online questionnaire. A convenience sampling strategy was used, and the survey link was disseminated through institutional WhatsApp groups and email lists. Participation was voluntary, and no personal identifying information was collected.

Questionnaire Development and Content

The questionnaire was adapted from a previously used instrument developed by Zhang et al.10 To ensure contextual relevance to dental education and practice in Pakistan, the tool was reviewed by two medical educationists and three dental clinical specialists. The final instrument comprised 25 items across four sections: (1) demographic information; (2) smartphone usage patterns; (3) purposes for using smartphones; and (4) perceptions regarding smartphone and app use. The first three sections included multiple-choice items, while the perception section used a 5-point Likert scale ranging from “Strongly Disagree” to “Strongly Agree.”

Pilot Testing and Instrument Validation

A pilot check was conducted to ensure clarity, comprehensibility, and internal consistency of the adapted questionnaire. Although no formal reliability coefficients were calculated due to the small pilot sample, feedback confirmed that items were well-understood and required no substantial revisions.

Sample Size Calculation

The minimum required sample size was calculated using the OpenEpi sample size calculator, based on an assumed outcome frequency of 25%, confidence level of 80%, and a margin of error of 5%. This yielded a target sample size of 105 participants. The final dataset exceeded this threshold.

Data Collection Procedures

The finalized questionnaire was uploaded to Google Forms, and the survey link was distributed to eligible participants via WhatsApp and email. Data collection occurred from August 2022 to January 2023, and respondents were permitted to review and modify their responses until 28 February 2023. All survey items were mandatory, ensuring complete datasets without missing values. To prevent duplicate entries, participants were required to sign in using a Google account, limiting responses to one per individual. Only the principal investigator had access to the response data, and confidentiality was strictly maintained throughout.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of Islam Dental College (Ref. no IDC/09-05/171; Dated: May 09, 2023). Informed consent was obtained electronically at the beginning of the survey. All procedures adhered to ethical guidelines for human participant research.

Statistical Analysis

Data were exported from Google Forms into Microsoft Excel and subsequently analyzed using SPSS version 24 (SPSS Inc., Chicago, IL, USA). The primary outcome variables included frequency of app use, daily duration of use, perceptions of smartphone apps, and perceived impact on clinical and educational activities. Independent variables included gender, age, workplace, qualification, and years of experience. Group differences were assessed using the Wilcoxon–Mann–Whitney test for two-group comparisons and the Kruskal–Wallis test for comparisons involving more than two groups. For significant Kruskal–Wallis results, post hoc comparisons were conducted to identify subgroup differences. A p-value < 0.05 was considered statistically significant.

Results

Participants Characteristics

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A total of 900 respondents completed the survey. Most participants were younger than 30 years (74%) and female (86%). Respondents represented a diverse range of workplaces, teaching experience levels, and qualifications (Table 1).

Table 1: Workplace, Experience, and Qualification of Participants (n = 900)

Workplace	**n**	**%**
Private Clinic	68	7.5%
Public/Trust Hospital	112	12.5%
Teaching Institute – Clinical Department	585	65.0%
Teaching Institute – Non-Clinical Department	135	15.0%
Total	900	100%
Teaching Experience	**n**	**%**
None	555	61.7%
1–3 years	210	23.3%
4+ years	135	15.0%
Total	900	100%
Qualification	**n**	**%**
Undergraduate Student	308	34.2%
BDS	248	27.5%
BDS + Certificate/Diploma	97	10.8%
Masters / MPhil / MSc	112	12.5%
Fellowship or Equivalent	135	15.0%
Total	900	100%

Smartphone Ownership and Operating System

Most respondents owned smartphones running Android, with Samsung, Huawei, Xiaomi, Vivo, Oppo, Infinix, and Realme collectively representing the majority of devices. Approximately one-third (33.3%) reported using iPhones, indicating iOS as the second most common operating system. Overall, Android accounted for more than 65% of devices among participants.

Patterns of App Use

The frequency of dental and medical app use and daily usage patterns are presented in Table 2. Most participants used apps less than once per week, and 79.2% reported daily usage of 1–20 minutes.

Table 2: Frequency and Average Daily Use of Dental/Medical Apps (n = 900)

Frequency of App Use	**n**	**%**
Never	270	30.0%
At least once per month	195	21.7%
At least once per week	225	25.0%
At least once per day	210	23.3%
Total	900	100%
Average Daily Usage	n	%
1–20 minutes	712	79.2%
20–40 minutes	105	11.7%
>40 minutes	83	9.2%
Total	900	100%

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Types of Apps Used

Most respondents reported using a range of dental and medical applications, with *Dental Study*, *Dental Lite*, and *Dental Clinical Mastery* being the most frequently selected dental apps, and *PharmaGuide*, *Medscape*, and *Wikimed* being the most common medical apps. A substantial proportion of participants, however, indicated that they did not use any dental or medical apps. (Table 3).

Purpose of App Use

The primary reasons for app use are shown in Table 4. Diagnostic assistance was the most frequently reported purpose.

Table 3: Most Common Medical and Dental Apps used

Dental Apps		
App Name	**Frequency (n)**	**Percentage (%)**
Dental Study	324	36%
Dental Lite	171	19%
Dental Clinical Mastery	135	15%
Onceph	63	7%
Dental Box	9	1%
Denticalc	9	1%
Easy Dentistry	9	1%
Instacare	9	1%
None	306	34%
Medical Apps		
App Name	**Frequency (n)**	**Percentage (%)**
PharmaGuide	225	25%
Medscape	216	24%
Wikimed	144	16%
ClinicalSense	81	9%
Pharmapedia	18	2%
Oladoc	9	1%
Marham	9	1%
PharmaPlus	9	1%
PubMed	9	1%
Instacare	9	1%
None	333	37%

Table 4: Purpose of Using Dental and Medical Apps (n = 900)

Purpose	**n**	**%**
Assisting diagnosis	342	38%
Reading news/journals & reviewing dental knowledge	297	33%
Communicating with patients/marketing	180	20%
Never used	18	2%

Perceptions of Smartphone and App Use

Participants showed strong agreement that dental apps provide useful information for patient care (mean = 3.90), are easy to obtain (mean = 3.80), and expressed a desire to obtain more apps (mean = 3.88). Moderate agreement was recorded for the usefulness of apps compared to books (mean = 3.22) and for learning primarily through apps (mean = 3.01). Responses were mixed regarding

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whether apps could replace textbooks (mean = 2.58).

Inferential Statistics

Kruskal–Wallis analyses revealed significant associations between participants' professional characteristics and their perceptions of dental app use. Respondents with less teaching experience expressed significantly stronger agreement that dental apps are easy to obtain ($H = 7.72$, $p = 0.021$). Similarly, qualification level was significantly associated with the extent to which participants reported learning through dental apps ($H = 13.27$, $p = 0.010$), with the highest agreement observed among BDS holders with certificates or diplomas and the lowest among those with Master's or Fellowships. Post hoc comparisons confirmed the presence of meaningful differences between these groups.

Discussion

This study examined patterns of smartphone and dental/medical app use among dentists and dental students in Punjab, Pakistan, and explored how these patterns related to their perceptions and professional characteristics. Despite near-universal smartphone penetration, reported use of dental and medical apps for professional purposes was modest. Only about one-third of respondents had a medical app installed, the majority used such apps less than once a week, and most reported daily usage of less than 20 minutes. Participants primarily used apps to assist with diagnosis and to read news and journals or review dental knowledge, and they generally perceived apps as useful and easy to obtain, while expressing more reserved views about their ability to replace traditional textbooks.

When compared with existing literature, the relatively low frequency and duration of app use in this sample stand out. Jasti et al. in India reported substantially higher proportions of dentists and medical doctors regularly using medical apps, and a study from nine medical institutes in Islamabad found that 80% of participants used medical apps, often with multiple apps installed on their devices.[11] In those settings, apps were not only more prevalent but also more deeply integrated into daily clinical and educational practice. Our finding that diagnostic assistance and knowledge updating were the predominant purposes of use contrasts with reports from India, where dentists more frequently applied apps for patient education.[12] In Islamabad, medical students emphasized app use for sharing information among peers, taking notes, consulting drug references, and accessing clinical guidelines, whereas an Indian study found relatively few dentists using apps for diagnosis or clinical decision support. Taken together, these comparisons suggest that while our respondents share certain usage patterns with regional peers, particularly in using apps for information and knowledge support, their overall level of engagement remains comparatively limited.[5]

Perceptions of dental and medical apps in the present study were broadly positive and aligned with findings from other contexts. Respondents agreed that apps provide useful information for patient care and reported that apps are easy to obtain, consistent with studies from India and China, where participants endorsed the usefulness of apps as supplements to learning and patient care and expressed interest in acquiring additional apps.[11] Participants in those studies similarly viewed apps as a valuable adjunct to traditional resources. At the same time, both our study and prior work from India and China reported more cautious attitudes regarding the superiority of apps over textbooks, and ambivalence about whether apps could replace books altogether.[12] These convergent findings suggest a pattern in which dental and medical professionals recognize the value of apps but continue to regard conventional texts as a central component of learning.[11]

The Technology Acceptance Model (TAM) offers a useful lens through which to interpret this apparent discrepancy between positive perceptions and relatively low levels of actual use. According to TAM, adoption of new technologies is shaped by perceived usefulness and perceived ease of use. [11] In our sample, participants rated apps as useful and easy to obtain, indicating favorable perceptions on both constructs. However, lower usage compared with studies from India and China may reflect contextual barriers that constrain the translation of positive attitudes into sustained use. Existing text from this study points to limited digital literacy in segments of the dental community, inadequate institutional support, minimal integration of app-based learning into undergraduate and postgraduate curricula, and challenges related to internet connectivity as plausible impediments. In this sense, perceived usefulness and ease of use may be necessary but not sufficient conditions for adoption; structural and curricular factors appear likely to

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influence whether apps become embedded in everyday clinical and educational practice.[13,10]

Professional seniority emerged as another important factor in shaping app-related perceptions. Dentists with greater experience were more likely to report difficulty in obtaining apps compared to their younger colleagues, echoing findings from previous work showing that younger learners tend to prefer modern learning methods, while older faculty members express concern that mobile technology may undermine the perceived value of traditional resources and advocate for blended approaches.[10, 13]

Our data also showed that dentists with BDS plus additional certificates or diplomas reported the highest agreement with learning primarily through dental apps, whereas those with Master's or Fellowships were least likely to endorse this view. Although direct comparisons with similar qualification-based analyses are scarce, an Indonesian study found no significant association between dentists' qualification and their perceptions of tele-dentistry, suggesting that the influence of seniority and educational level on digital adoption may be context dependent. These patterns are consistent with a scenario in which early- and mid-career practitioners at intermediate qualification levels are more open to incorporating apps into their learning, while more senior clinicians may adopt a more cautious stance.

The relatively low level of app usage observed in this study can also be understood in light of reported limitations in the broader literature, including concerns about internet accessibility, limited awareness of available resources, small screen size, privacy and data protection, and the challenges of integrating apps into existing workplace routines and educational structures.[5] These issues may be particularly salient in settings where institutional digital infrastructure is uneven, where curricular frameworks have not yet fully incorporated mobile learning, and where clear guidelines for the use of digital tools in clinical practice are still evolving. Within such a context, it is plausible that many dentists and dental students recognize the potential benefits of apps yet remain hesitant to rely on them heavily for learning or patient care.

Several methodological considerations should be taken into account when interpreting these findings. The study employed convenience sampling, which may have introduced selection bias and limited the extent to which the results can be generalized beyond the participating institutions. The focus on a single province (Punjab) further constrains external validity, as patterns of technology access and curricular implementation may differ across regions in Pakistan.[9] The cross-sectional design precludes any causal inferences regarding the directionality of associations between professional characteristics and app-related perceptions, and reliance on self-reported data introduces the possibility of recall and social desirability biases. Nonetheless, the study benefits from a sizeable sample and a structured, contextually adapted questionnaire, providing a useful snapshot of current practices and perceptions among dentists and dental students in this setting.[10]

Within these constraints, the findings suggest several implications for dental education, clinical practice, and policy. The combination of high smartphone penetration, positive perceptions of usefulness, and low app usage points to an opportunity for more deliberate integration of dental and medical apps into curricula, particularly in areas such as diagnostic reasoning, evidence-based decision-making, and continuous professional development.[5] Efforts to promote digital literacy for both students and faculty may help address generational differences in comfort with technology and support more consistent, pedagogically sound use of apps. Institutional investment in reliable internet connectivity and clear guidelines for the ethical and secure use of mobile technologies in clinical environments may further lower practical barriers. For developers, the findings underscore the value of creating apps that are aligned with local curricular requirements, culturally relevant, and linguistically accessible, including options that are easy to navigate for users whose primary language is not English.[14] Integrating app-based learning into the dental curricula of Pakistan and promoting digital literacy can enhance the adoption of smartphones for e-learning among students and clinicians. Dental education institutions should incorporate mobile learning strategies and provide training for faculty in app-based teaching methods. Policymakers can support these initiatives by improving digital infrastructure and access. Additionally, developers should create dental apps that are relevant to local contexts and compatible with Urdu to enhance accessibility.

Conclusion

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This study shows that although smartphone ownership among dentists and dental students in Punjab is high, the professional use of dental and medical apps remains relatively limited, with most participants using them infrequently and for short daily durations. Diagnostic assistance and knowledge updating emerged as the primary purposes of use, and perceptions of usefulness and ease of access were generally positive, though participants expressed mixed views about apps replacing traditional textbooks. Significant associations were found between qualification level and learning through apps, as well as between teaching experience and perceived ease of obtaining apps. Overall, these findings suggest that while dental apps are valued and hold considerable potential to enhance learning and clinical practice, their uptake remains constrained by contextual and institutional barriers, underscoring the need for improved digital integration, targeted training, and supportive infrastructure within dental education in Pakistan.

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None.

Author Contribution

SR and AR conceived and designed the study, collected and transcribed the data, and drafted the manuscript. Data analysis and interpretation were carried out by SR, AR, RM, and IH. RM and IH critically revised the manuscript for important intellectual content. All authors approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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Conflict of Interest

The author has no conflicts of interest to disclose

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