

The Influence of Medical Culture and Key Factors on Mobile Application Usage Frequency and Perceived Effectiveness in Physical Therapy: A Cross-Sectional Study

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The Influence of Medical Culture and Key Factors on Mobile Application Usage Frequency and Perceived Effectiveness in Physical Therapy: A Cross-Sectional Study

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Abstract

Background: Medical culture significantly influences the adoption of technology in healthcare, including mobile health applications, which have the potential to enhance patient care in physical therapy settings. Understanding the role of medical culture and other factors such as app usability and workplace setting in shaping the adoption and perceived effectiveness of mobile applications is essential for promoting their integration into clinical practice.

Objective: The study aimed to assess how medical culture influences healthcare professionals' adoption of mobile applications in clinical settings, particularly in physical therapy interventions, and to examine the relationship between the perceived effectiveness of mobile applications and cultural attitudes toward technology in healthcare teams.

Methods: This cross-sectional study was conducted between April 2023 and March 2024 at a tertiary care hospital specializing in rehabilitation and physical therapy. A total of 456 healthcare professionals, including physical therapists and rehabilitation specialists, were surveyed. Medical culture was measured using a composite scale, while mobile app usage and perceived effectiveness were assessed through structured questionnaires.

Results: Medical culture was strongly associated with mobile app adoption ($r = 0.54$, $p = 0.014$), and multiple linear regression analysis showed that medical culture significantly predicted app usage ($\beta = 0.45$, $p = 0.002$). App usability, in terms of ease of use ($\beta = 0.37$, $p = 0.008$) and patient engagement features ($\beta = 0.28$, $p = 0.021$), also contributed to the perceived effectiveness of mobile applications. Hospitals showed higher adoption and perceived effectiveness compared to private practices and rehabilitation centers. Years of experience ($\beta = 0.32$, $p = 0.014$) and app usage frequency ($\beta = 0.45$, $p = 0.010$) were additional significant predictors.

Conclusions: This study highlights the critical role of medical culture in promoting the adoption and perceived effectiveness of mobile applications in physical therapy. Positive cultural attitudes toward technology, combined with user-friendly app designs, can enhance the integration of mobile health tools in clinical settings. These findings underscore the importance of fostering an innovative medical culture and supporting the development of usable, patient-centered applications to optimize patient care. Clinical Trial: Not Applicable

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Original Manuscript

Original Paper

Title: The Influence of Medical Culture and Key Factors on Mobile Application Usage Frequency and Perceived Effectiveness in Physical Therapy: A Cross-Sectional Study

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Abstract

Background: Medical culture refers to institutional attitudes toward technology usage, innovation, teamwork, and evidence-based practices. Hospitals with strong innovation cultures promote mobile app use, while traditional settings may resist change, relying on conventional methods. Medical culture significantly influences the usage of technology in healthcare, including mobile health applications, which have the potential to enhance patient care in physical therapy settings. Understanding the role of medical culture and other factors such as app usability and workplace setting in shaping the usage and perceived effectiveness of mobile applications is essential for promoting their integration into clinical practice.

Objective: The study aimed to assess how medical culture influences healthcare professionals' usage of mobile applications in clinical settings, particularly in physical therapy interventions, and to examine the relationship between the perceived effectiveness of mobile applications and cultural attitudes toward technology in healthcare teams.

Methods: This cross-sectional study was conducted between April 2023 and March 2024 at a tertiary care hospital specializing in rehabilitation and physical therapy. A total of 456 healthcare professionals, including physical therapists and rehabilitation specialists, were surveyed. Medical culture was measured using a composite scale, while mobile app usage and perceived effectiveness were assessed through structured questionnaires.

Results: Medical culture was strongly associated with mobile app usage frequency ($r = 0.54$, $p = .014$), and multiple linear regression analysis showed that medical culture significantly predicted app usage ($\beta = 0.45$, $p = .002$). App usability, in terms of ease of use ($\beta = 0.37$, $p = .008$) and patient engagement features ($\beta = 0.28$, $p = .021$), also contributed to the perceived effectiveness of mobile

applications. Hospitals showed higher usage and perceived effectiveness compared to private practices and rehabilitation centers. Years of experience ($\beta = 0.32$, $p = 0.014$) and app usage frequency ($\beta = 0.45$, $p = .010$) were additional significant predictors.

Conclusions: This study highlights the critical role of medical culture in promoting the usage and perceived effectiveness of mobile applications in physical therapy. Positive cultural attitudes toward technology, combined with user-friendly app designs, can enhance the integration of mobile health tools in clinical settings. These findings underscore the importance of fostering an innovative medical culture and supporting the development of usable, patient-centered applications to optimize patient care.

Keywords: Medical culture; mobile health applications; physical therapy; app usage; perceived effectiveness.

Introduction

Medical culture plays a fundamental role in shaping the attitudes, behaviors, and practices of healthcare professionals [1]. It encompasses the values, beliefs, and norms that govern how healthcare is delivered within an institution [2]. A positive medical culture, characterized by openness to innovation, collaboration, and evidence-based practice, can significantly influence the effectiveness and efficiency of healthcare delivery [3]. Conversely, a rigid or traditional medical culture can act as a barrier to the usage of new technologies and methods [4]. The role of medical culture extends beyond the attitudes of individual professionals, influencing how teams function and how institutions respond to emerging challenges in healthcare [5]. In recent years, there has been growing recognition of the importance of fostering a medical culture that encourages technological integration, teamwork, and continuous learning to improve patient care and outcomes [6].

As technology continues to transform healthcare, mobile applications have become essential tools for healthcare professionals, offering new ways to manage patient care, monitor health outcomes, and streamline clinical workflows [7]. However, the usage of these mobile applications is not uniform across clinical settings, with medical culture playing a pivotal role in determining the rate and success of their integration [8]. In clinical environments where innovation and technology are embraced, healthcare professionals are more likely to adopt mobile applications as part of their practice [9]. This is particularly relevant in physical therapy, where mobile apps can aid in exercise prescription, patient monitoring, and rehabilitation management. The usage of mobile health applications in physical therapy has the potential to enhance patient outcomes by providing real-time feedback, improving adherence to treatment plans, and increasing patient engagement [10]. Despite their benefits, the successful integration of these tools largely depends on the prevailing medical culture within the institution [10, 11].

The perceived effectiveness of mobile health applications is another critical factor that influences their usage and sustained use by healthcare professionals [12]. Cultural attitudes toward technology, both at the individual and institutional levels, play a significant role in shaping perceptions of the value of mobile applications in clinical practice [13]. In physical therapy, where patient engagement and adherence to treatment are essential for successful outcomes, healthcare professionals are more likely to perceive mobile applications as effective tools if they work in environments that promote technological innovation and value patient-centered care [14]. A supportive medical culture that encourages the use of technology can enhance healthcare professionals' perceptions of the utility and effectiveness of mobile applications, leading to more widespread usage [15]. However, in environments where there is resistance to change or skepticism about new technologies, healthcare professionals may be less likely to view mobile apps as beneficial, even if they have the potential to improve patient outcomes [16].

Despite the recognized benefits of mobile applications in clinical practice, there remains a significant gap in the literature regarding the role of medical culture in influencing their usage and perceived effectiveness, particularly in physical therapy [17]. While some studies have explored the broader factors that influence technology usage in healthcare, few have specifically examined the intersection of medical culture, mobile app usage, and perceived effectiveness in physical therapy settings [18]. Additionally, most research has focused on larger healthcare systems or other clinical specialties, leaving a gap in understanding how mobile apps are adopted and used in physical therapy environments, where the dynamics of patient care and the nature of interventions may differ from other areas of healthcare [18]. Moreover, while usability factors such as ease of use and patient engagement features are known to influence the usage of technology, there is limited research on

how these factors interact with medical culture to shape the perceived effectiveness of mobile applications [19].

The composite scale for assessing medical culture was adapted from the Organizational Culture Assessment Instrument (OCAI), which has been widely used in healthcare settings to evaluate openness to innovation, teamwork, and technology integration [20]. Mobile app usability was assessed using the System Usability Scale (SUS) [21], which evaluates ease of use, and the Patient Engagement Scale (PES) [22] to measure patient-centered app features. Perceived effectiveness of mobile applications was measured using the Mobile App Rating Scale (MARS), which assesses user experience and clinical impact [23].

This study seeks to address these gaps by examining the influence of medical culture on the usage of mobile applications in physical therapy and investigating the relationship between the perceived effectiveness of these applications and cultural attitudes toward technology. The study is particularly relevant given the growing importance of mobile health technologies in enhancing patient outcomes and improving clinical workflows in physical therapy. By focusing on the role of medical culture, this study aims to provide insights into how healthcare institutions can foster environments that promote the integration of mobile applications, thereby maximizing their potential to improve patient care [24]. Furthermore, understanding the factors that influence the perceived effectiveness of mobile applications can help healthcare professionals make informed decisions about their use and guide developers in designing tools that meet the needs of clinicians and patients alike [24].

The specific objectives of this study are twofold: first, to assess how medical culture influences healthcare professionals' usage of mobile applications in clinical settings, with a focus on their use in physical therapy interventions, and second, to examine the relationship between the perceived effectiveness of mobile applications in physical therapy and the cultural attitudes toward technology in healthcare teams. We hypothesize that a positive medical culture, characterized by openness to innovation and collaboration, will be significantly associated with higher mobile app usage frequency rates and more favorable perceptions of app effectiveness in physical therapy. Additionally, we hypothesize that usability factors such as ease of use and patient engagement features will moderate the relationship between medical culture and the perceived effectiveness of mobile applications.

Methods

Design and setting

This observational cross-sectional study was conducted between April 2023 and March 2024 at the medical rehabilitation and physical therapy clinics affiliated with King Khalid University, Abha, Aseer Region, KSA. Data were collected from healthcare professionals working in the physical therapy department, including therapists and rehabilitation specialists, using structured electronic surveys distributed through institutional email lists and departmental announcements.

Ethical Considerations

This study was approved by the institutional review board of the hospital (REC#764-2023) on March 23rd, 2023, in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants before survey distribution, and participation was voluntary, with the ability to opt out at any stage. All collected data were anonymized to maintain confidentiality and prevent identification of individual participants. No financial or other compensation was provided to participants.

Participants

Participants in this study were healthcare professionals actively involved in patient care and the use of mobile health applications. Eligible participants had a minimum of one year of clinical experience in physical therapy and were either currently using or considering the use of mobile applications in their daily practice. Exclusion criteria included professionals not involved in direct patient care or those with limited exposure to mobile health technologies. A total of 612 invitations were sent, with 456 professionals ultimately participating. Participation was voluntary, with no incentives offered, and written informed consent was obtained before survey distribution. A convenience sampling method was used, selecting participants based on their active involvement in physical therapy and mobile health applications. Researchers accessed potential participants through institutional email lists and internal departmental communication channels, ensuring that invitations were sent directly to eligible professionals within the affiliated healthcare institutions.

Variables

The primary variables of interest in this study were medical culture, mobile app usage frequency, and the perceived effectiveness of mobile applications. In this study, the primary outcomes were mobile app usage frequency, assessed by the frequency of app usage for patient care, and perceived effectiveness, measured using a structured Likert-scale questionnaire evaluating app impact on patient outcomes, engagement, and workflow efficiency. The independent variables included medical culture (measured using the Organizational Culture Assessment Instrument), app usability (assessed via the System Usability Scale and Patient Engagement Scale), workplace setting (categorized as hospital, private practice, or rehabilitation center), and years of experience (self-reported by participants). Medical culture was assessed using a validated composite scale that measured the openness to innovation, teamwork, and the integration of technology within the healthcare setting [25]. Participants responded to a series of Likert-scale items ranging from 1 (strongly disagree) to 5 (strongly agree) [25]. The overall medical culture score was calculated as the mean of these items, with higher scores indicating a more positive medical culture [26]. The composite scale for assessing medical culture was based on previously validated tools used in healthcare settings (cite relevant studies or tools if applicable), and mobile app usability was assessed using a set of validated Likert-scale questions focusing on ease of use and patient engagement features [27].

Mobile app usage frequency was measured based on the frequency of mobile app usage, recorded as the number of days per week participants used mobile applications for patient care [28]. Participants were asked to indicate the types of mobile applications they used, including exercise apps, patient management tools, and monitoring apps [28]. The data on app usage frequency and types of apps used were self-reported via structured survey questions [28].

Perceived effectiveness of mobile applications was another key outcome, assessed using a Likert scale where participants rated the effectiveness of mobile apps in improving patient outcomes, enhancing patient engagement, and streamlining clinical workflows [29]. The effectiveness score was calculated as the mean of these ratings, with higher scores indicating greater perceived effectiveness [29].

Other variables included years of professional experience, categorized by the number of years working in physical therapy, and workplace setting, which was divided into hospital, private practice, and rehabilitation center [30]. Data on these variables were self-reported by participants in the survey

[30]. In addition, app usability was evaluated through two key dimensions: ease of use and patient engagement features [31]. These dimensions were assessed via survey items where participants rated the usability of mobile apps in their clinical practice [31].

To ensure accuracy in the assessment of variables, all survey instruments used in this study were based on previously validated tools and tailored to the context of physical therapy. Data were collected through structured self-administered questionnaires distributed electronically, and responses were reviewed to ensure completeness and consistency before analysis.

Sample size estimation

The sample size was determined using G*Power 3.1, which calculated a minimum requirement of 172 participants to detect a medium effect size (Cohen's $f^2 = 0.15$) with $\alpha = 0.05$ and 0.80 statistical power for multiple regression with five predictors [32]. The medium effect size (Cohen's $f^2 = 0.15$) was selected based on findings from prior studies investigating technology usage in healthcare settings, where similar effect sizes have been reported in multiple regression analyses assessing factors influencing digital health integration [33]. A total of 612 invitations were sent, yielding 456 completed responses, surpassing the required sample size of 172 and ensuring sufficient statistical power for meaningful analysis.

Data Analysis section

Data analysis was conducted using SPSS version 24, and parametric statistical methods were employed as the data followed a normal distribution, confirmed by the Shapiro-Wilk test. To address the first objective, multiple linear regression analysis was performed with mobile app usage frequency (number of days per week) as the dependent variable. Independent variables included medical culture score, years of experience, age, workplace setting, and interaction terms for medical culture $\times$ workplace setting. For the second objective, a separate multiple linear regression model was constructed with perceived effectiveness of mobile applications as the outcome. Predictor variables included medical culture, app usability (ease of use and patient engagement features), app usage frequency, years of experience, and workplace setting. All variables were selected based on theoretical justification grounded in existing literature on digital health usage and usability frameworks; no stepwise (forward or backward) procedures were applied. Interaction terms were included to examine the moderating effects of workplace setting on the association between medical culture and mobile app usage frequency. Additionally, Pearson's correlation was used to explore bivariate relationships among continuous variables, and ANOVA with Tukey's post hoc tests compared mobile app usage and perceived effectiveness across different workplace settings and experience levels. A significance level of $p < 0.05$ was applied for all analyses.

Results

The study sample had an average age of 36.45 years with a majority of participants being male (62%) and having an average of 10.34 years of experience (Table 1). Participants were primarily employed in hospitals (42%), followed by private practices (38%) and rehabilitation centers (20%). Mobile app usage was prevalent, with 70% of participants using mobile applications, most frequently exercise apps (65%). The mean medical culture score was relatively high (4.21 out of 5), while perceived effectiveness of mobile applications was also favorable (3.87 out of 5). The majority of participants held either a master's (50%) or bachelor's degree (40%), with a smaller proportion having a doctorate (10%).

Table 1. Demographic and Clinical Characteristics.

Variable	Frequency (n) / Mean $\pm$ SD	Percentage (%) / Range
Total Participants	456	100%
Age (years)	36.45 $\pm$ 8.52	24 - 58
Gender		
Male	282	62%
Female	174	38%
Years of Experience	10.34 $\pm$ 5.23	1 - 25
Workplace Setting		
Hospital	191	42%
Private Practice	173	38%
Rehabilitation Center	92	20%
Mobile App Usage (Days per week)	3.45 $\pm$ 1.12	1 - 7
Type of Mobile Applications Used		
Exercise Apps	296	65%
Patient Management Apps	182	40%
Monitoring Apps	160	35%
Medical Culture Score (out of 5)	4.21 $\pm$ 0.67	2.5 - 5
Perceived Effectiveness (out of 5)	3.87 $\pm$ 0.74	2.8 - 5
Education Level		
Bachelor's Degree	182	40%
Master's Degree	228	50%
Doctorate	46	10%
Use of Mobile App		
Yes	319	70%
No	137	30%

SD, Standard Deviation.

The correlation analysis showed a significant positive relationship between medical culture and mobile app usage ($r = 0.54$, $p = 0.014$), indicating that stronger medical culture promotes higher usage (Table 2). Years of experience ($r = 0.32$, $p = 0.042$) and education level ($r = 0.42$, $p = 0.021$) were also positively correlated with app usage, suggesting that experienced and highly educated professionals are more likely to use mobile applications. Age had a weaker, marginally significant correlation ($r = 0.28$, $p = 0.053$). These relationships are summarized in Figure 1.

Table 2. Pearson's Correlation - Influence of Medical Culture on Mobile app usage frequency

Variable	r (Correlation Coefficient)	p-value
Medical Culture Score	1.0	-
Mobile App Usage (Days per Week)	0.54	.014
Years of Experience	0.32	.042
Age (years)	0.28	.053
Education Level	0.42	.021

Abbreviations: r, Correlation Coefficient; p-value, Probability Value

Multiple linear regression analysis confirmed that medical culture significantly predicted mobile app usage frequency ($\beta = 0.45$, $p = 0.002$), with stronger medical culture linked to higher usage (Table 3). Years of experience ($\beta = 0.32$, $p = 0.014$) and workplace setting (hospital: $\beta = 0.22$, private practice: $\beta = 0.12$, rehabilitation center: $\beta = 0.18$) were also significant predictors. The relationship between medical culture and app usage was strongest in hospitals (interaction $\beta = 0.28$, $p = 0.005$) compared to private practices ($\beta = 0.15$, $p = 0.042$). The model demonstrated a good fit ($R^2 = 0.48$, adjusted $R^2 = 0.46$).

Table 3. Multiple Linear Regression Analysis for Mobile app usage frequency.

Predictor Variable	β (Coefficient)	Standard Error	95% CI	p-value	R^2	Adjusted R^2
Medical Culture Score	0.45	0.07	(0.31, 0.59)	.002	0.48	0.46
Years of Experience	0.32	0.06	(0.20, 0.44)	.014		
Age (years)	0.15	0.05	(0.05, 0.25)	.034		
Workplace Setting (Hospital)	0.22	0.04	(0.14, 0.30)	.023		
Workplace Setting (Private Practice)	0.12	0.06	(0.01, 0.23)	.046		
Workplace Setting (Rehabilitation Center)	0.18	0.05	(0.08, 0.28)	.031		
Interaction: Medical Culture x Hospital Setting	0.28	0.08	(0.12, 0.44)	.005		
Interaction: Medical Culture x Private Practice	0.15	0.07	(0.01, 0.29)	.042		

β , Coefficient; CI, Confidence Interval; R^2 , Coefficient of Determination; Adjusted R^2 , Adjusted Coefficient of Determination; SE, Standard Error.

Medical culture strongly predicted the perceived effectiveness of mobile applications ($\beta = 0.48$, $p = 0.001$), enhancing their perceived value. Usability factors, including ease of use ($\beta = 0.37$, $p = 0.008$) and patient engagement features ($\beta = 0.28$, $p = 0.021$), also contributed positively (Table 4 and Figure 2). App usage frequency ($\beta = 0.45$, $p = 0.010$) and years of experience ($\beta = 0.25$, $p = 0.023$) were significant predictors. Perceived effectiveness was higher in hospitals ($\beta = 0.20$, $p = 0.043$) and rehabilitation centers ($\beta = 0.24$, $p = 0.027$). Low multicollinearity was confirmed ($VIF < 1.5$).

Table 4. Relationship Between Medical Culture and Perceived Effectiveness of Mobile Applications.

Variable	β (Coefficient)	Standard Error	95% CI	p-value	VIF
Medical Culture Score	0.48	0.06	(0.36, 0.60)	.001	1.15
App Usability (Ease of Use)	0.37	0.05	(0.27, 0.47)	.008	1.32
App Usability (Patient Engagement Features)	0.28	0.06	(0.16, 0.40)	.021	1.25
App Usage Frequency	0.45	0.05	(0.35, 0.55)	.010	1.28
Years of Experience	0.25	0.04	(0.17, 0.33)	.023	1.1
Workplace Setting (Hospital)	0.2	0.03	(0.14, 0.26)	.043	1.2
Workplace Setting (Private Practice)	0.18	0.05	(0.08, 0.28)	.038	1.18
Workplace Setting (Rehabilitation Center)	0.24	0.04	(0.16, 0.32)	.027	1.22

VIF, Variance Inflation Factor; SE, Standard Error.

Subgroup analysis revealed that progressive medical cultures had significantly higher mobile app usage frequency than traditional cultures (mean difference = 0.65, $p = 0.002$) and overall usage was greater (mean difference = 1.24, $p = 0.007$) (Table 5 and Figure 3). Perceived effectiveness was also higher (mean difference = 0.78, $p = 0.004$). Usage and effectiveness were greater in hospitals compared to private practices (mean difference = 0.54, $p = 0.025$) and rehabilitation centers (mean difference = 0.68, $p = 0.013$), while private practices had higher usage than rehabilitation centers (mean difference = 0.34, $p = 0.038$). Years of experience significantly influenced usage ($p = 0.001$), with post hoc analysis showing differences between 1-5 and 6-10 years ($p = 0.034$) and between 6-10 and 11+ years ($p = 0.022$).

Table 5. Subgroup Analysis for Mobile app usage frequency and Perceived Effectiveness (with Workplace Setting Comparisons)

Group Comparison	Mean Difference (95% CI)	t/F-value	p-value
Progressive vs Traditional Medical Cultures (t-test)	0.65 (0.32, 0.98)	3.24	.002
Mobile app usage frequency (t-test)	1.24 (0.47, 2.01)	2.71	.007
Perceived Effectiveness (t-test)	0.78 (0.43, 1.13)	3.12	.004
Workplace Setting: Hospital vs Private Practice (t-test)	0.54 (0.21, 0.87)	2.45	.025
Workplace Setting: Hospital vs Rehabilitation Center (t-test)	0.68 (0.30, 1.06)	3.01	.013
Workplace Setting: Private Practice vs Rehabilitation Center (t-test)	0.34 (0.14, 0.54)	2.31	.038
Years of Experience (ANOVA)	1.12 (0.75, 1.49)	4.35	.001
Tukey's Post Hoc: 1-5 years vs 6-10 years	0.45 (0.12, 0.78)	2.23	.034
Tukey's Post Hoc: 6-10 years vs 11+ years	0.38 (0.14, 0.62)	2.49	.022

CI, Confidence Interval; t, t-test value; F, ANOVA F-value.

Discussion

Principal Results

This study aimed to assess how medical culture influences mobile app usage frequency in clinical settings and to examine the relationship between perceived effectiveness of mobile applications and various demographic and workplace factors. The results demonstrate that a strong medical culture is significantly associated with higher mobile app usage frequency, as indicated by both the correlation and regression analyses. Additionally, key factors such as years of experience, workplace setting, and app usability (ease of use and patient engagement features) significantly contributed to both app usage and perceived effectiveness. Subgroup analysis further revealed that progressive medical cultures promoted greater mobile app usage frequency compared to traditional settings, with hospitals showing the highest levels of usage and perceived effectiveness. The positive impact of workplace settings, particularly hospitals, was also observed in comparison to private practices and rehabilitation centers, with significant differences in app usage patterns across experience levels.

Comparison with Prior Work

The findings from this study suggest that medical culture plays a crucial role in influencing mobile app usage frequency in clinical settings. The positive correlation between medical culture and app usage ($r = 0.54$) indicates that healthcare environments that promote innovation, collaboration, and openness to technology are more likely to integrate mobile health applications into their routine practices [34]. The significant role of years of experience ($r = 0.32$) and education level ($r = 0.42$) further suggests that more experienced and highly educated healthcare professionals are likely to be early adopters of mobile health technologies, possibly due to greater familiarity with evidence-based practices and a stronger inclination to utilize tools that enhance patient care [35]. Age, while marginally significant ($r = 0.28$), showed a weaker relationship with app usage, which could be due to generational differences in comfort with technology or the perceived need for such tools among older professionals [36]. The regression analysis reinforced these findings, demonstrating that medical culture, workplace setting, and years of experience significantly predict mobile app usage, particularly in hospitals where app usage was found to be stronger than in private practices or rehabilitation centers [37]. These results highlight the importance of fostering supportive institutional cultures that encourage the integration of digital tools in healthcare [38].

Beyond resistance to change, additional barriers to mobile app usage frequency include data privacy concerns, regulatory challenges, and technical support limitations. Healthcare professionals may be hesitant to adopt mobile applications due to concerns regarding patient confidentiality and adherence to institutional security protocols [15]. Regulatory uncertainty surrounding digital health tools can also create hesitancy, as compliance requirements vary across institutions and regions [39]. Furthermore, limited technical support and inadequate training resources may impede successful implementation, particularly in smaller healthcare settings [40]. Addressing these barriers through enhanced data security measures, clear regulatory guidance, and improved training programs may facilitate broader usage of mobile applications in clinical practice.

Hospitals are more likely to adopt mobile applications due to several key factors. They typically have greater financial resources and institutional support for implementing new technologies, along with dedicated IT infrastructure and technical assistance [41]. Additionally, hospitals often follow standardized policies for digital health integration, which facilitates widespread usage [41]. In contrast, private practices may face financial limitations, have less access to technical support, and rely on individual practitioners' discretion for technology usage, leading to variability in usage [42]. Addressing these challenges by providing financial incentives, technical training, and policy guidance for private practices may help bridge the gap in mobile app usage frequency.

These results are consistent with previous studies that have identified the influence of organizational culture and professional experience on technology usage in healthcare [43]. A study by Kruszyńska-Fischbach et al. [44] found that healthcare settings with a strong culture of innovation and teamwork were more likely to adopt e-health technologies, aligning with the present study's findings on the role of medical culture [44]. Similarly, Alsyoud et al. [45] highlighted the importance of workplace factors, showing that hospitals with supportive leadership and an openness to technological advancements tend to experience higher rates of health IT usage [45]. The significance of education and experience is also well-documented; Almaiah et al. [46] Diffusion of Innovations theory emphasizes that individuals with greater knowledge and expertise are more likely to adopt new technologies [46]. Thus, the results of this study are in line with existing literature, underscoring the combined influence of medical culture, professional experience, and workplace dynamics in shaping the use of mobile health applications in clinical practice [46].

The results of this study suggest that medical culture plays a pivotal role in shaping the perceived effectiveness of mobile applications in clinical practice. A positive and supportive medical culture significantly enhances the perceived value of these tools, as evidenced by the strong correlation between medical culture score and perceived effectiveness ($\beta = 0.48$) [46]. Additionally, app usability, both in terms of ease of use ($\beta = 0.37$) and patient engagement features ($\beta = 0.28$), emerged as crucial factors that contributed to higher perceived effectiveness [47]. This highlights that mobile applications that are intuitive and promote active patient involvement are more likely to be perceived as effective by healthcare professionals [47]. The frequency of app usage ($\beta = 0.45$) and years of experience ($\beta = 0.25$) also played significant roles in determining app effectiveness, indicating that experienced professionals who use mobile applications more frequently are more likely to see their benefits [48]. Workplace setting further influenced perceived effectiveness, with hospitals ($\beta = 0.20$) and rehabilitation centers ($\beta = 0.24$) showing higher scores compared to private practices [49].

These findings align with existing literature, which consistently emphasizes the influence of workplace culture and usability on the effectiveness of health technologies [50]. Srisathan et al. [51] demonstrated that organizational culture supporting innovation and technology integration significantly impacts the perceived benefits of health IT systems, a result mirrored in the present study [51]. Similarly, Hajesmaeel-Gohari et al. [52] found that ease of use and engagement are key usability factors that enhance the acceptance and effectiveness of healthcare applications [52]. Furthermore, studies by Witter et al. and Heidt et al. [53] corroborate the importance of workplace settings, with hospitals often being more resource-rich and technologically advanced environments compared to private practices, thereby fostering higher mobile app usage frequency and perceived effectiveness [53]. These findings reinforce the critical role that institutional support and user-friendly design play in promoting the successful implementation and perceived value of mobile health applications in clinical practice [54].

The clinical significance of this study lies in its demonstration of how a positive medical culture, combined with workplace support and usability of mobile health applications, can significantly enhance the usage and perceived effectiveness of these tools in clinical practice [55]. By identifying key factors such as medical culture, years of experience, and app usability, this study provides critical insights into how healthcare institutions can foster environments that encourage the integration of mobile applications to improve patient care [56]. In particular, the findings underscore the importance of creating a culture of innovation and technological openness in healthcare settings, especially in hospitals and rehabilitation centers, where app usage and perceived effectiveness were found to be higher [57]. This study suggests that, with proper institutional support and user-friendly app design, mobile health applications can serve as effective tools for enhancing clinical workflows, improving patient engagement, and ultimately leading to better patient outcomes.

Limitations

Despite its valuable insights, this study has several limitations. The cross-sectional design prevents establishing causality between medical culture and mobile app usage frequency, limiting conclusions about the direction of influence. Self-reported data may introduce biases such as social desirability or recall bias. While the sample was diverse, it was restricted to specific healthcare settings, affecting generalizability. Additionally, the study focused on medical culture, experience, and app usability but did not explore factors like patient perspectives, cost-effectiveness, and technical infrastructure. Response bias is another potential limitation, as demographic data on non-respondents were not collected. Although the response rate was high (74.5%), differences in experience, workplace setting, or openness to technology usage among non-respondents cannot be ruled out. Future research should include non-responder analysis to improve external validity and employ longitudinal designs to better understand causal relationships. Furthermore, as the study was conducted in Saudi Arabia, cultural and regulatory differences may limit its applicability to other regions. The hierarchical

nature of healthcare institutions and regulatory policies in Saudi Arabia may differ from decentralized or patient-driven models elsewhere. Variations in data privacy laws, reimbursement structures, and digital health policies could also impact mobile app usage frequency differently across healthcare systems. Future studies should examine these factors in diverse geographic and regulatory contexts while also assessing patient-related outcomes and the economic and technical feasibility of mobile health application integration.

Conclusions

This study demonstrates that a strong medical culture, along with workplace support and app usability, are critical factors driving the usage and perceived effectiveness of mobile health applications in clinical settings. Healthcare professionals working in environments that promote innovation and technology integration, particularly in hospitals and rehabilitation centers, are more likely to adopt and perceive mobile applications as beneficial tools for patient care. Additionally, professionals with more experience and those using apps frequently reported higher perceived effectiveness. The findings highlight the importance of fostering a culture of openness to technology, coupled with designing user-friendly apps that enhance patient engagement. These insights provide actionable recommendations for healthcare institutions seeking to optimize the integration of mobile health technologies to improve clinical workflows and patient outcomes.

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Conflicts of Interest

None declared.

Data

Availability

Statement

The dataset generated and analyzed during this study is available as Multimedia Appendix 1 for reference.

Generative

AI

Disclosure

No generative AI, such as ChatGPT or other large language models, was used in the writing of this manuscript.

Abbreviations

ANOVA: Analysis of Variance
VIF: Variance Inflation Factor
IT: Information Technology

Multimedia Appendix 1

Dataset generated and analyzed during this study.

References

1. Riffel T, Chen S-P. Stigma in healthcare? Exploring the knowledge, attitudes, and behavioural responses of healthcare professionals and students toward individuals with mental illnesses. *Psychiatric Quarterly*. 2020;91(4):1103-19.
2. Claeys A, Berdai-Chaouni S, Tricas-Sauras S, De Donder L. Culturally sensitive care: definitions, perceptions, and practices of health care professionals. *Journal of transcultural nursing*. 2021;32(5):484-92.
3. Djukic M, Jun J, Fletcher J. An examination of the factors associated with implementation of evidence-based management practices for improving nurse work environments. *Worldviews on Evidence-Based Nursing*. 2021;18(2):129-37.
4. Šlapáková Losová V, Dvoutělý O. The role of open innovation in addressing resource constraints in healthcare: a systematic literature review. *Journal of Health Organization and Management*. 2024;38(2):150-75.
5. Zajac S, Woods A, Tannenbaum S, Salas E, Holladay CL. Overcoming challenges to teamwork in healthcare: a team effectiveness framework and evidence-based guidance. *Frontiers in Communication*. 2021;6:606445.
6. Bendermacher G, Dolmans D, de Grave W, Wolfhagen I, Oude Egbrink M. Advancing quality culture in health professions education: experiences and perspectives of educational leaders. *Advances in Health Sciences Education*. 2021;26:467-87.
7. Mbunge E, Muchemwa B, Batani J. Sensors and healthcare 5.0: transformative shift in virtual care through emerging digital health technologies. *Global Health Journal*. 2021;5(4):169-77.
8. Kahnbach L, Lehr D, Brandenburger J, Mallwitz T, Jent S, Hannibal S, et al. Quality and usage of COVID-19 tracing apps and recommendations for development: systematic interdisciplinary review of European apps. *Journal of medical Internet research*. 2021;23(6):e27989.
9. Galetsi P, Katsaliaki K, Kumar S. Exploring benefits and ethical challenges in the rise of mHealth (mobile healthcare) technology for the common good: An analysis of mobile applications for health specialists. *Technovation*. 2023;121:102598.
10. Dicianno BE, Parmanto B, Fairman AD, Crytzer TM, Yu DX, Pramana G, et al. Perspectives on the evolution of mobile (mHealth) technologies and application to rehabilitation. *Physical therapy*. 2015;95(3):397-405.
11. Okolo CA, Babawarun O, Arowoogun JO, Adeniyi AO, Chidi R. The role of mobile health applications in improving patient engagement and health outcomes: A critical review. *International Journal of Science and Research Archive*. 2024;11(1):2566-74.
12. Jacob C, Sanchez-Vazquez A, Ivory C. Social, organizational, and technological factors impacting clinicians' usage of mobile health tools: systematic literature review. *JMIR mHealth and uHealth*. 2020;8(2):e15935.
13. Zhang X, Lo P, So S, Chiu DK, Leung TN, Ho KK, et al. Medical students' attitudes and perceptions towards the effectiveness of mobile learning: A comparative information-need perspective. *Journal of Librarianship and Information Science*. 2021;53(1):116-29.
14. Fox G, Clohessy T, van der Werff L, Rosati P, Lynn T. Exploring the competing influences of privacy concerns and positive beliefs on citizen acceptance of contact tracing mobile applications. *Computers in Human Behavior*. 2021;121:106806.
15. Addotey-Delove M, Scott RE, Mars M. Healthcare workers' perspectives of mHealth usage factors in the developing world: scoping review. *International Journal of Environmental Research and Public Health*. 2023;20(2):1244.
16. Yoon S, Ng JH, Kwan YH, Low LL. Healthcare professionals' views of factors influencing

diabetes self-management and the utility of a mHealth application and its features to support self-care. *Frontiers in Endocrinology*. 2022;13:793473.

17. Jacob C, Sezgin E, Sanchez-Vazquez A, Ivory C. Sociotechnical factors affecting patients' usage of mobile health tools: systematic literature review and narrative synthesis. *JMIR mHealth and uHealth*. 2022;10(5):e36284.

18. Iyanna S, Kaur P, Ractham P, Talwar S, Islam AN. Digital transformation of healthcare sector: What is impeding usage and continued usage of technology-driven innovations by end-users? *Journal of Business Research*. 2022;153:150-61.

19. Keel S, Schmid A, Keller F, Schoeb V. Investigating the use of digital health tools in physiotherapy: facilitators and barriers. *Physiotherapy theory and practice*. 2023;39(7):1449-68.

20. Heritage B, Pollock C, Roberts L. Validation of the organizational culture assessment instrument. *PloS one*. 2014;9(3):e92879.

21. Kaya A, Ozturk R, Altin Gumussoy C, editors. Usability measurement of mobile applications with system usability scale (SUS). *Industrial Engineering in the Big Data Era: Selected Papers from the Global Joint Conference on Industrial Engineering and Its Application Areas, GJCIE 2018, June 21–22, 2018, Nevsehir, Turkey; 2019: Springer*.

22. Silva LdLT, Lima RCd, Silva RId, Poveda VdB. Safe care mobile application for surgical patients: development, content validation, and usability validation. *Revista Gaúcha de Enfermagem*. 2024;45:e20230152.

23. Knitza J, Tascilar K, Messner E-M, Meyer M, Vossen D, Pulla A, et al. German mobile apps in rheumatology: review and analysis using the Mobile Application Rating Scale (MARS). *JMIR mHealth and uHealth*. 2019;7(8):e14991.

24. Tavera Romero CA, Jaramillo Losada J, Díaz Velásquez MF, Domínguez Pineda AG, Hurtado López VM. A Mobile Application Prototype Designed to Support Physical Therapy Assessment Learning Processes. *International Journal of Interactive Mobile Technologies*. 2023;17(16).

25. Ghaleb EA, Dominic P, Fati SM, Muneer A, Ali RF. The assessment of big data usage readiness with a technology–organization–environment framework: a perspective towards healthcare employees. *Sustainability*. 2021;13(15):8379.

26. Kim S, Kim S. Analysis of the impact of health beliefs and resource factors on preventive behaviors against the COVID-19 pandemic. *International journal of environmental research and public health*. 2020;17(22):8666.

27. Gordon WJ, Landman A, Zhang H, Bates DW. Beyond validation: getting health apps into clinical practice. *NPJ digital medicine*. 2020;3(1):14.

28. Srikanth N, Rana R, Singhal R, Jameela S, Singh R, Khanduri S, et al. Mobile App–reported use of traditional medicine for maintenance of health in India during the COVID-19 pandemic: cross-sectional questionnaire study. *JMIRx med*. 2021;2(2):e25703.

29. Fuller TE, Pong DD, Piniella N, Pardo M, Bessa N, Yoon C, et al. Interactive digital health tools to engage patients and caregivers in discharge preparation: implementation study. *Journal of medical Internet research*. 2020;22(4):e15573.

30. Bowens AN, Amamoo MA, Blake DD, Clark B. Assessment of professional quality of life in the Alabama physical therapy workforce. *Physical Therapy*. 2021;101(7):pzab089.

31. Lau N, O'Daffer A, Yi-Frazier JP, Rosenberg AR. Popular evidence-based commercial mental health apps: analysis of engagement, functionality, aesthetics, and information quality. *JMIR mHealth and uHealth*. 2021;9(7):e29689.

32. Nadal C, Sas C, Doherty G. Technology acceptance in mobile health: scoping review of definitions, models, and measurement. *Journal of Medical Internet Research*. 2020;22(7):e17256.

33. Chong AYL, Blut M, Zheng S. Factors influencing the acceptance of healthcare information technologies: A meta-analysis. *Information & Management*. 2022;59(3):103604.
34. Sayibu M, Chu J, Akintunde TY, Rufai OH, Amosun TS, George-Ufot G. Environmental conditions, mobile digital culture, mobile usability, knowledge of app in COVID-19 risk mitigation: A structural equation model analysis. *Smart Health*. 2022;25:100286.
35. Dzandu MD, Pathak B, De Cesare S. Acceptability of the COVID-19 contact-tracing app—does culture matter? *Government Information Quarterly*. 2022;39(4):101750.
36. Song K, Wu P, Zou S. The usage and use of mobile payment: Determinants and relationship with bank access☆. *China Economic Review*. 2023;77:101907.
37. Wu P, Zhang R, Luan J, Zhu M. Factors affecting physicians using mobile health applications: an empirical study. *BMC health services research*. 2022;22(1):24.
38. Ramdani B, Duan B, Berrou I. Exploring the determinants of mobile health usage by hospitals in China: Empirical study. *JMIR medical informatics*. 2020;8(7):e14795.
39. Towett G, Snead RS, Grigoryan K, Marczika J. Geographical and practical challenges in the implementation of digital health passports for cross-border COVID-19 pandemic management: a narrative review and framework for solutions. *Globalization and Health*. 2023;19(1):98.
40. Van Zyl C, Badenhorst M, Hanekom S, Heine M. Unravelling 'low-resource settings': a systematic scoping review with qualitative content analysis. *BMJ global health*. 2021;6(6):e005190.
41. Greenhalgh T, Wherton J, Papoutsi C, Lynch J, Hughes G, Hinder S, et al. Beyond usage: a new framework for theorizing and evaluating nonusage, abandonment, and challenges to the scale-up, spread, and sustainability of health and care technologies. *Journal of medical Internet research*. 2017;19(11):e8775.
42. Spring M, Faulconbridge J, Sarwar A. How information technology automates and augments processes: Insights from Artificial-Intelligence-based systems in professional service operations. *Journal of Operations Management*. 2022;68(6-7):592-618.
43. Khanijahani A, Iezadi S, Dudley S, Goettler M, Kroetsch P, Wise J. Organizational, professional, and patient characteristics associated with artificial intelligence usage in healthcare: A systematic review. *Health Policy and Technology*. 2022;11(1):100602.
44. Kruszyńska-Fischbach A, Sysko-Romańczuk S, Napiórkowski TM, Napiórkowska A, Kozakiewicz D. Organizational e-health readiness: How to prepare the primary healthcare providers' services for digital transformation. *International Journal of Environmental Research and Public Health*. 2022;19(7):3973.
45. Alsyouf A, Ishak AK, Lutfi A, Alhazmi FN, Al-Okaily M. The role of personality and top management support in continuance intention to use electronic health record systems among nurses. *International Journal of Environmental Research and Public Health*. 2022;19(17):11125.
46. Almaiah MA, Alfaisal R, Salloum SA, Hajjej F, Shishakly R, Lutfi A, et al. Measuring institutions' usage of artificial intelligence applications in online learning environments: integrating the innovation diffusion theory with technology usage rate. *Electronics*. 2022;11(20):3291.
47. Agrawal L, Ndabu T, Mulgund P, Sharman R. Factors affecting the extent of patients' electronic medical record use: An empirical study focusing on system and patient characteristics. *Journal of Medical Internet Research*. 2021;23(10):e30637.
48. Quichocho D. Translating and Applying Recent Research on Military Family Life: A Preliminary Examination of the Efficacy of Mobile-Application-Based Professional Development for Military Human and Family Service Professionals. 2022.
49. Jarrar Mt, Al-Bsheish M, Aldhmadi BK, Albaker W, Meri A, Dauwed M, et al., editors. Effect of practice environment on nurse reported quality and patient safety: the mediation role

of person-centeredness. *Healthcare*; 2021: MDPI.

50. Inal Y, Wake JD, Guribye F, Nordgreen T. Usability evaluations of mobile mental health technologies: systematic review. *Journal of medical Internet research*. 2020;22(1):e15337.

51. Srisathan WA, Ketkaew C, Naruetharadhol P. The intervention of organizational sustainability in the effect of organizational culture on open innovation performance: A case of thai and chinese SMEs. *Cogent business & management*. 2020;7(1):1717408.

52. Hajesmaeel-Gohari S, Khordastan F, Fatehi F, Samzadeh H, Bahaadinbeigy K. The most used questionnaires for evaluating satisfaction, usability, acceptance, and quality outcomes of mobile health. *BMC Medical Informatics and Decision Making*. 2022;22(1):22.

53. Heidt B, Siqueira WF, Eersels K, Diliën H, van Grinsven B, Fujiwara RT, et al. Point of care diagnostics in resource-limited settings: A review of the present and future of PoC in its most needed environment. *Biosensors*. 2020;10(10):133.

54. Witter S, Hamza MM, Alazemi N, Alluhidan M, Alghaith T, Herbst CH. Human resources for health interventions in high-and middle-income countries: findings of an evidence review. *Human Resources for Health*. 2020;18(1):43.

55. Nimmanterdwong Z, Boonviriya S, Tangkijvanich P. Human-centered design of mobile health apps for older adults: systematic review and narrative synthesis. *JMIR mHealth and uHealth*. 2022;10(1):e29512.

56. Yu N, Huang Y-T. Important factors affecting user experience design and satisfaction of a mobile health app—a case study of daily yoga app. *International Journal of Environmental Research and Public Health*. 2020;17(19):6967.

57. Lloyd S, Long K, Probst Y, Di Donato J, Oshni Alvandi A, Roach J, et al. Medical and nursing clinician perspectives on the usability of the hospital electronic medical record: A qualitative analysis. *Health Information Management Journal*. 2024;53(3):189-97.

Figure Captions

Figure 1. Pearson's Correlation Matrix: Influence of Medical Culture on Mobile App Usage, Experience, Age, and Education.

Figure 2. Abstract Bar Plot: Medical Culture and Perceived Effectiveness with VIF and Confidence Intervals.

Figure 3. Subgroup Analysis for Mobile app usage frequency & Perceived Effectiveness (with Workplace Setting Comparisons)

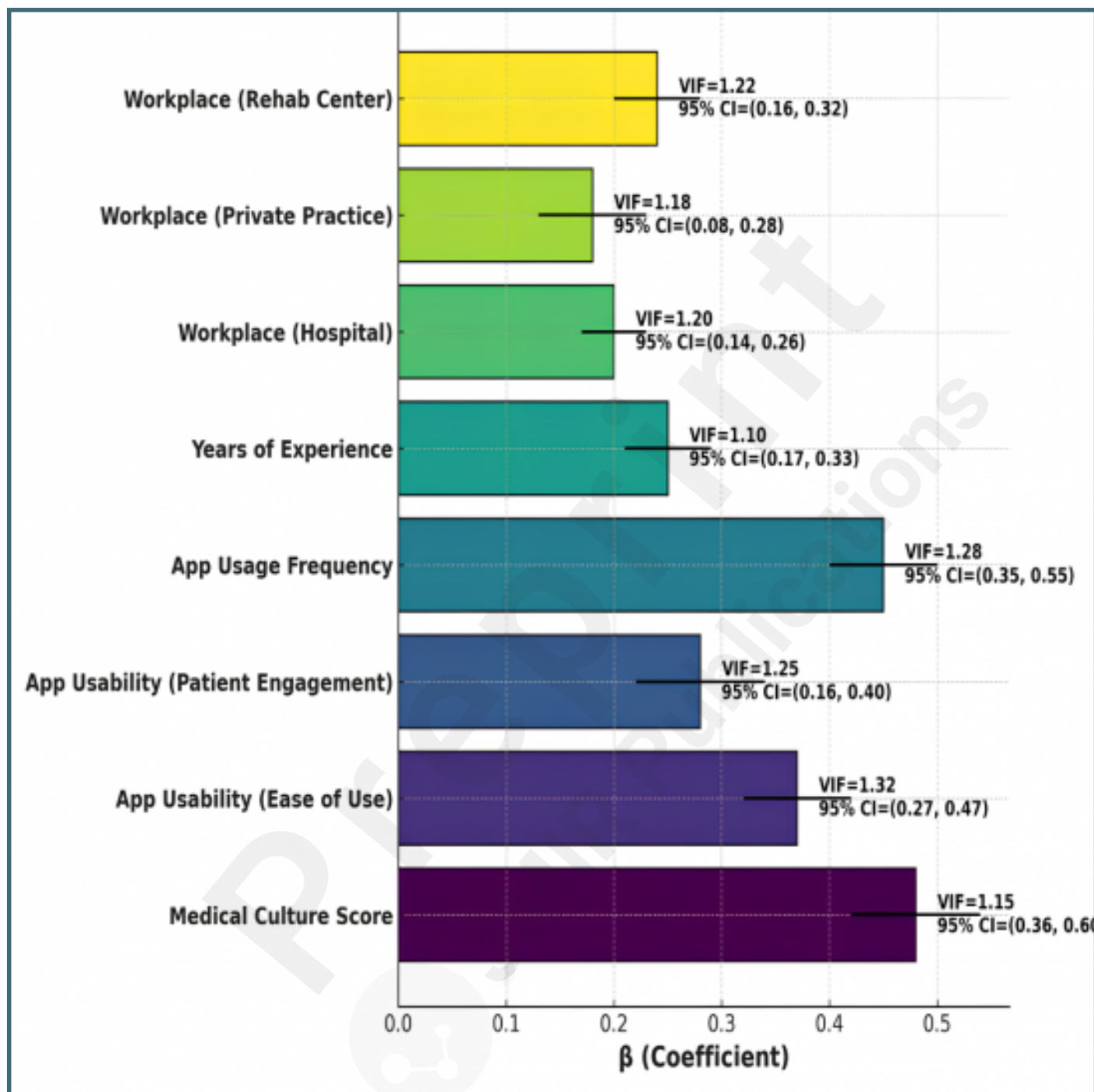
Supplementary Files

Figures

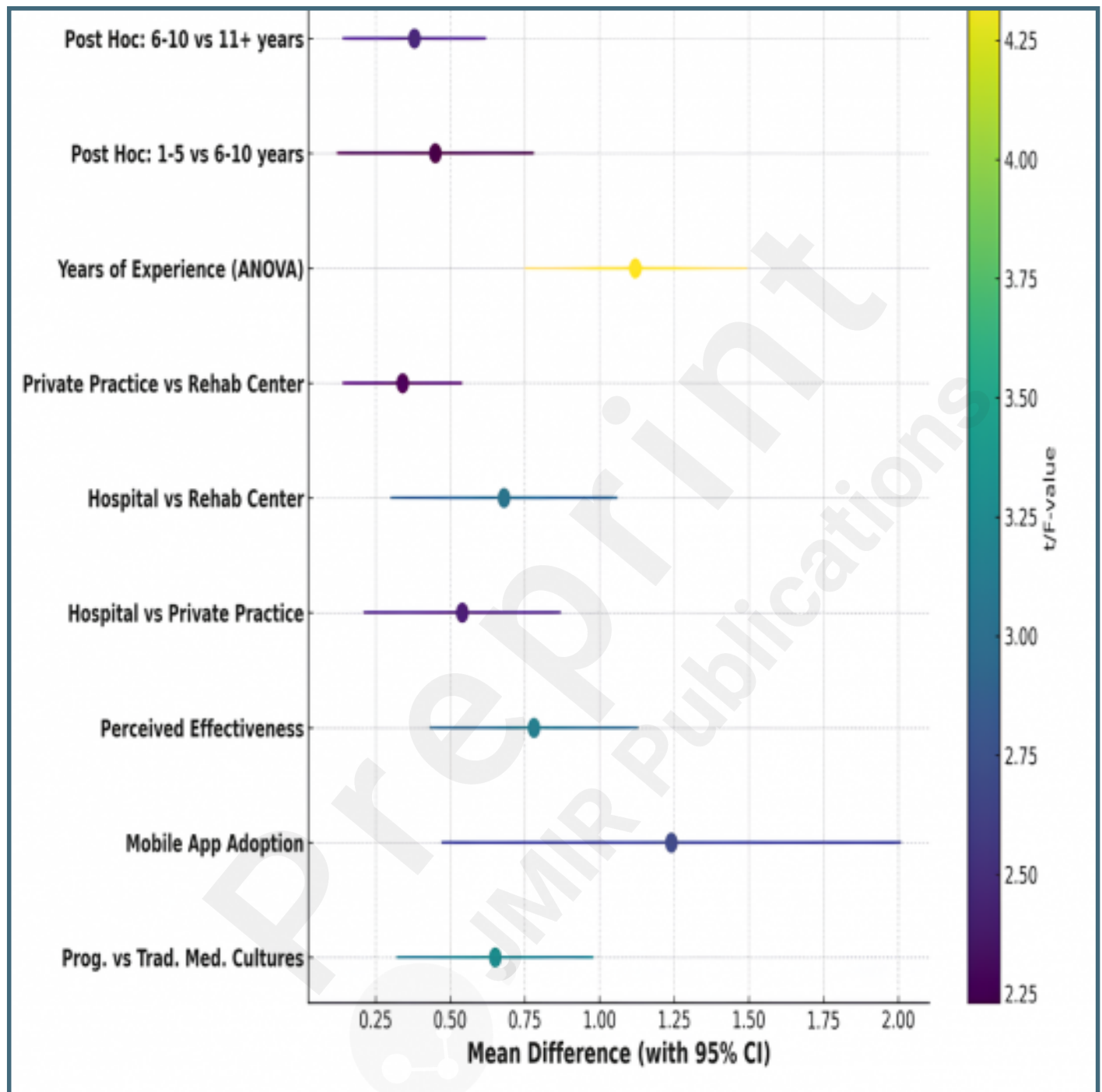
Pearson's Correlation Matrix: Influence of Medical Culture on Mobile App Usage, Experience, Age, and Education.



Abstract Bar Plot: Medical Culture and Perceived Effectiveness with VIF and Confidence Intervals.



Subgroup Analysis for Mobile App Adoption & Perceived Effectiveness.



Multimedia Appendixes

Dataset generated and analyzed during this study.

URL: <http://asset.jmir.pub/assets/1e30075fa6f004cf362dd41073057610.xlsx>

