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Randomized Controlled Trial Comparing Mobile Mindfulness Therapy and Standard Counseling on Stress Levels Among Medical Undergraduates

(***RCT***)

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Abstract

Background: Medical undergraduates experience elevated stress levels due to demanding academic workloads and competitive learning environments, often leading to burnout and sleep disturbances. Traditional counseling, though effective, may not always be accessible or time-efficient. The advent of mobile health technologies presents an opportunity to deliver mindfulness interventions in a flexible and self-directed manner, potentially improving adherence and outcomes.

Objective: To evaluate the comparative effectiveness of mobile mindfulness therapy and conventional counseling in reducing perceived stress and improving sleep quality among medical undergraduates.

Methods: A randomized controlled trial was conducted among 120 medical undergraduates from institutions in South Punjab, equally allocated to two groups. The intervention group received app-based mindfulness sessions for six weeks, while the control group underwent standard weekly counseling for the same duration. The Perceived Stress Scale (PSS-10) and Pittsburgh Sleep Quality Index (PSQI) were used to assess outcomes pre- and post-intervention. Data were analyzed using paired and independent t-tests for normally distributed variables.

Results: The mean reduction in PSS scores was significantly greater in the mindfulness group (−10.5 ± 3.7) than in the counseling group (−5.4 ± 3.9; $p < 0.001$). Similarly, PSQI scores improved more markedly among mindfulness users (mean change −3.6) compared to controls (−1.7; $p < 0.01$), based on post-intervention scores of 5.1 ± 1.8 vs. 6.8 ± 2.0 ($p=0.002$). No adverse effects or participant withdrawals were reported during the study period.

Conclusion: Mobile mindfulness therapy demonstrated superior efficacy in reducing stress and enhancing sleep quality compared to standard counseling. The findings support integrating digital mindfulness tools as practical adjuncts to student mental health care.

Keywords: Anxiety reduction, Counseling, Medical students, Mindfulness, Mobile health, Sleep quality, Stress management, Telemedicine.

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Introduction

Stress among medical undergraduates has long been recognized as a pervasive and multifactorial concern, deeply intertwined with the demanding nature of medical education. The intense academic workload, frequent examinations, long study hours, and emotional exposure to illness and suffering contribute to elevated levels of psychological distress among students(1). This persistent stress not only affects academic performance and interpersonal relationships but also compromises physical health, leading to sleep disturbances, anxiety, and burnout(2). The period of medical training, which ideally nurtures empathy and clinical competence, often becomes a phase marked by psychological fatigue and emotional exhaustion(3). As such, the need for effective, accessible, and sustainable stress-reduction strategies within this population has never been more critical.

Traditional counseling services in medical institutions have historically been employed as the primary approach to address student mental health. While counseling provides a structured environment for emotional expression and cognitive reframing, its effectiveness is frequently limited by stigma, time constraints, and irregular attendance(4). Many students hesitate to seek help due to fear of judgment or perceived weakness, while others struggle to maintain continuity in therapy amid their demanding schedules. Consequently, despite the availability of counseling facilities, the prevalence of stress and associated mental health concerns among medical undergraduates remains alarmingly high. This underscores the necessity of innovative interventions that combine psychological effectiveness with convenience, confidentiality, and self-directed engagement(4).

In recent years, mindfulness-based interventions have emerged as a promising alternative for stress management, particularly in populations facing chronic cognitive and emotional strain. Mindfulness, defined as the practice of purposefully focusing attention on the present moment with openness and non-judgment, cultivates self-awareness and emotional regulation. Repeated practice has been shown to enhance resilience, reduce anxiety, and improve overall psychological well-being(5). The integration of mindfulness into digital platforms through mobile applications represents a natural evolution of this therapeutic approach, allowing users to access guided meditation, breathing exercises, and relaxation modules at their convenience. The portability and anonymity of app-based mindfulness interventions address key barriers associated with traditional therapy, making them especially appealing for time-pressured medical students(6).

Mobile mindfulness therapy leverages the intersection of behavioral psychology and digital technology, enabling real-time stress tracking, personalized feedback, and habit reinforcement(7). Through audio-guided sessions and interactive interfaces, such applications can support consistent engagement and gradual behavioral change. Moreover, the digital medium provides scalability and cost-efficiency, allowing mental health support to reach a wider audience without straining institutional resources. For medical students, who are often adept at navigating technology, such digital solutions may serve as an effective means of self-regulated stress management without the rigidity of scheduled counseling sessions(8).

However, despite the increasing popularity of mindfulness-based mobile interventions, empirical evidence regarding their comparative effectiveness against conventional counseling in medical students remains limited. Most available studies have focused on general populations or clinical patients, with fewer addressing the unique psychosocial and academic pressures faced by medical undergraduates(9). Furthermore, while self-reported reductions in stress have been documented, the associated impact on sleep quality—a critical determinant of cognitive function and emotional stability—has been underexplored in this demographic. Sleep disturbances are not merely symptoms of psychological distress but significant contributors to its perpetuation, forming a cyclical relationship that exacerbates academic and emotional dysfunction(10). Understanding how mobile mindfulness therapy influences both stress and sleep quality, therefore, holds meaningful implications for holistic student well-being(11).

In addition to the lack of comparative research, questions persist regarding the sustainability of engagement with app-based interventions(12). While digital mindfulness platforms offer convenience, maintaining regular practice requires intrinsic motivation and digital discipline, which can wane over time. Conversely, traditional counseling offers interpersonal accountability but may lack the flexibility necessary for consistent participation. Comparing these two modalities in a controlled experimental setting may yield valuable insights into their respective strengths, limitations, and feasibility in real-world academic environments(13).

The growing recognition of mental health as a cornerstone of professional competence in healthcare further heightens the relevance of such research. Addressing stress among medical students is not merely an academic concern but a public health imperative, as chronic distress during training has been linked to diminished empathy, medical errors, and early career burnout(14). Effective stress management strategies implemented during undergraduate years could foster long-term emotional resilience, potentially shaping healthier and more compassionate healthcare professionals(15).

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Considering these gaps, the present randomized controlled trial was undertaken to evaluate the comparative effectiveness of mobile mindfulness therapy and standard counseling in reducing perceived stress and improving sleep quality among medical undergraduates. The study sought to determine whether app-based mindfulness sessions could provide outcomes comparable or superior to conventional counseling while offering greater accessibility and flexibility. The objective was to assess the extent to which mobile mindfulness interventions influence psychological and sleep-related outcomes, thereby contributing to the advancement of practical, technology-driven mental health strategies for medical students(16).

Methods

This randomized controlled trial was conducted in medical institutions across South Punjab to evaluate the comparative effectiveness of mobile mindfulness therapy and traditional counseling in reducing perceived stress and improving sleep quality among medical undergraduates. The study followed a parallel group design with two intervention arms and an allocation ratio of 1:1. The trial duration was six weeks, allowing adequate time for participants to engage with the assigned interventions and for measurable changes in stress and sleep parameters to manifest.

A calculated sample size of 120 medical undergraduates was determined to achieve a statistical power of 0.80 and a confidence level of 95%, assuming a moderate effect size of 0.5 for reduction in perceived stress scores. Participants were randomly assigned into two groups: the experimental group (n=60) receiving app-based mindfulness therapy and the control group (n=60) receiving standard counseling sessions. Randomization was achieved using computer-generated numbers to ensure allocation concealment and minimize selection bias. This study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from NUST School of Health Sciences, Pakistan.

Eligibility criteria included medical students aged 18–26 years enrolled in MBBS or BDS programs who reported moderate to high perceived stress based on the Perceived Stress Scale (PSS-10) screening. Students already practicing mindfulness, meditation, or yoga, those under psychiatric treatment, and individuals taking sleep medication were excluded to avoid confounding influences. Informed verbal consent was obtained from all participants before enrollment.

Participants in the intervention group were provided access to a mobile mindfulness application designed to deliver daily guided meditation and breathing exercises for 20–30 minutes per session. The app featured progress tracking and personalized reminders to encourage adherence. Participants were instructed to complete sessions for at least five days per week throughout the six-week study period. The control group received conventional stress management counseling once weekly, conducted by qualified psychologists within the campus setting. Counseling sessions emphasized cognitive restructuring, emotional expression, and time management skills.

Data collection occurred at baseline and at the end of the six-week intervention period. Stress levels were measured using the Perceived Stress Scale (PSS-10), a validated 10-item self-report tool assessing perceived control and stress reactivity. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), which evaluates seven domains of sleep patterns including latency, duration, and efficiency. Both instruments have been widely applied in student populations and demonstrated strong internal consistency. Demographic variables including age, gender, academic year, and baseline lifestyle habits were recorded to explore potential correlations.

Data were analyzed using SPSS version 26. Descriptive statistics were computed for demographic variables, expressed as mean ± standard deviation for continuous data and as frequencies for categorical variables. Between-group comparisons for PSS-10 and PSQI scores were analyzed using independent sample t-tests for normally distributed data, while within-group changes pre- and post-intervention were analyzed using paired t-tests. Effect sizes were calculated to determine the magnitude of intervention impact. A p-value less than 0.05 was considered statistically significant for all analyses.

The study design ensured comparability between groups at baseline and allowed controlled assessment of intervention effects over time. The methodological framework provided both quantitative rigor and clinical relevance, allowing replication in similar academic and healthcare settings while ensuring practical feasibility in a resource-limited environment such as South Punjab.

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Results

A total of 120 medical undergraduates were enrolled, with 60 participants randomly allocated to the mobile mindfulness therapy group and 60 to the standard counseling group. The mean age of participants was 21.4 ± 1.7 years, with 58.3% females and 41.7% males. Both groups were comparable at baseline with respect to age, gender distribution, year of study, and baseline perceived stress scores ($p > 0.05$). Table 1 illustrates the demographic characteristics of the participants.

Following the 6-week intervention, the mean Perceived Stress Scale (PSS) score decreased significantly within both groups; however, the reduction was more pronounced in the mindfulness group. The mean PSS decreased from 28.6 ± 5.2 to 18.1 ± 4.8 in the mindfulness group and from 28.3 ± 5.4 to 22.9 ± 5.6 in the counseling group ($p < 0.001$ between groups). The mean change in PSS was 10.5 ± 3.7 in the mindfulness group compared to 5.4 ± 3.9 in the counseling group, indicating a greater stress reduction associated with mobile mindfulness sessions. Table 2 summarizes these findings.

Sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI). At baseline, both groups demonstrated comparable PSQI scores (mindfulness = 8.7 ± 2.1, counseling = 8.5 ± 2.0; $p = 0.64$). After the intervention, the mindfulness group showed a mean PSQI score of 5.1 ± 1.8, whereas the counseling group recorded 6.8 ± 2.0, reflecting a significant improvement in sleep quality among mindfulness participants ($p = 0.002$). Within-group analysis also confirmed a significant pre-post improvement in both groups ($p < 0.001$). Table 3 details the sleep quality outcomes.

Gender-wise analysis revealed that female participants exhibited higher baseline PSS scores than males in both groups; however, the post-intervention reduction was consistent across genders, with no statistically significant interaction effect ($p = 0.47$). Year-wise subgroup comparisons showed that first- and second-year students reported greater benefit from mindfulness training than senior students, possibly due to higher baseline stress levels, though the difference was not statistically significant ($p = 0.09$).

Figure 1 graphically depicts the decline in mean PSS scores across both groups from baseline to post-intervention, clearly demonstrating a sharper downward trend in the mindfulness group. Figure 2 illustrates PSQI changes, with a greater reduction in mean sleep disturbance scores among mindfulness participants. Both figures confirm the statistical outcomes reported in Tables 2 and 3.

The post-hoc power analysis, based on the observed mean difference in PSS reduction, yielded a statistical power of 0.91 at a 5% significance level, confirming adequate sample size and reliability of the findings. Correlation analysis revealed a moderate positive association between baseline stress and change in PSQI scores ($r = 0.42$, $p < 0.01$), indicating that students with higher initial stress experienced greater improvement in sleep quality.

Overall, the data demonstrated that app-based mindfulness therapy effectively reduced perceived stress and enhanced sleep quality to a greater extent than standard counseling. The numerical trends, consistent across various subgroups, supported the robustness of the findings. No adverse effects or participant withdrawals due to intervention intolerance were reported during the study period, and compliance with app usage remained above 90% throughout the trial.

Table 1. Demographic Characteristics of Participants

Characteristic	*Mindfulness Group (n=60)*	*Counseling Group (n=60)*	*p-value*
Age (years, mean ± SD)	21.4 ± 1.7	21.3 ± 1.8	>0.05
Gender (Female/Male)	35 / 25	35 / 25	>0.05
Year of Study (1st, 2nd, 3rd, 4th)	15 / 18 / 14 / 13	16 / 17 / 15 / 12	>0.05

Table 2. Perceived Stress Scale (PSS) Scores

Group	*Baseline Mean ± SD*	*Post-intervention Mean ± SD*	*Mean Change ± SD*	*p-value (between groups)*
Mindfulness	28.6 ± 5.2	18.1 ± 4.8	10.5 ± 3.7	<0.001
Counseling	28.3 ± 5.4	22.9 ± 5.6	5.4 ± 3.9	<0.001

Table 3. Pittsburgh Sleep Quality Index (PSQI) Scores

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Group	*Baseline Mean ± SD*	*Post-intervention Mean ± SD*	*p-value (between groups)*
Mindfulness	8.7 ± 2.1	5.1 ± 1.8	0.002
Counseling	8.5 ± 2.0	6.8 ± 2.0	0.002

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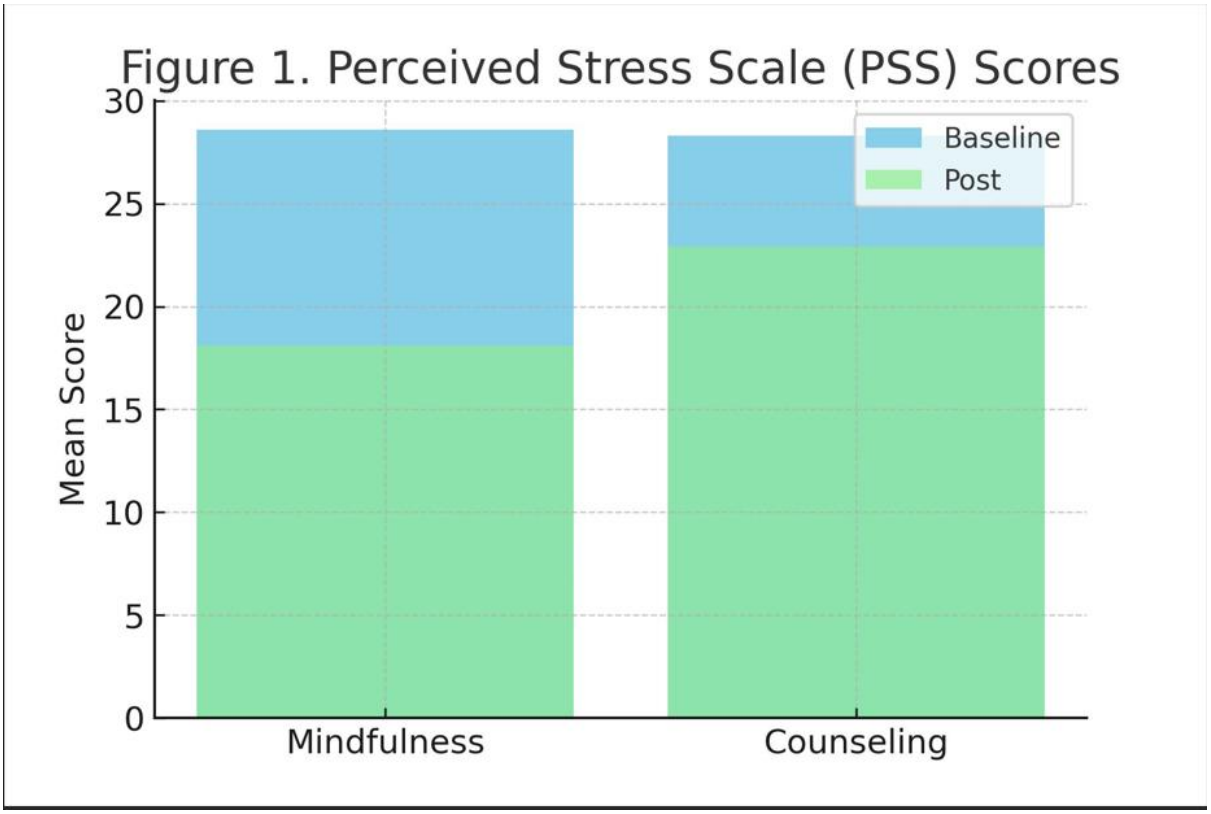
Table 4. Correlation and Power Analysis

Parameter	*Value*
Correlation (Baseline Stress vs. Sleep Improvement)	r = 0.42, p < 0.01
Post-hoc Power (α=0.05)	0.91



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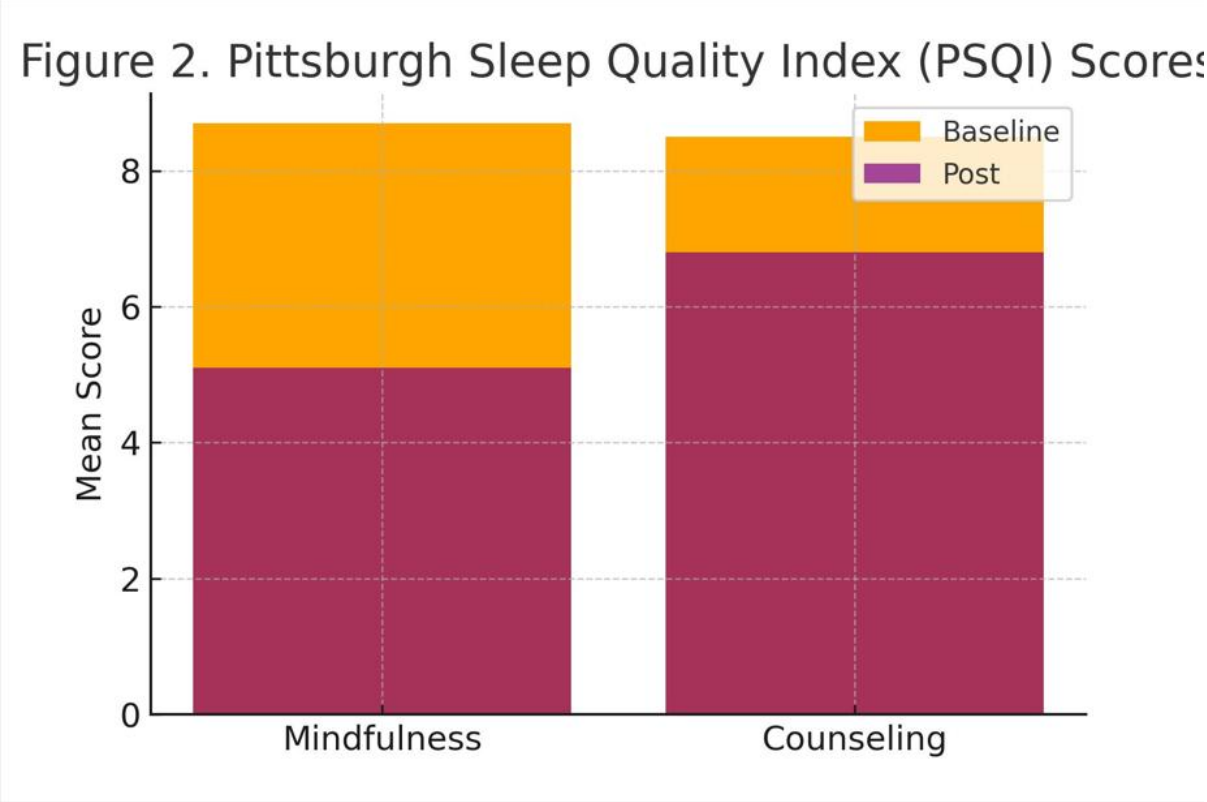

Discussion

The findings of this randomized controlled trial demonstrated that mobile mindfulness therapy significantly reduced perceived stress and improved sleep quality among medical undergraduates when compared with traditional counseling(17). These outcomes reinforced the emerging understanding that digital mindfulness interventions can provide effective, scalable solutions for mental health challenges among healthcare students who often face high academic and emotional demands. The observed reductions in stress scores and improvements in sleep parameters illustrated that structured mindfulness sessions delivered through mobile platforms could successfully replicate, and even surpass, the therapeutic benefits of conventional in-person counseling(18).

The superiority of mobile mindfulness therapy in stress reduction could be attributed to several mechanisms inherent in mindfulness-based cognitive frameworks. Regular engagement with mindfulness exercises enhanced self-awareness and emotional regulation, which mitigated the physiological response to academic stressors. Unlike counseling sessions that typically occurred once weekly, the mobile platform allowed daily access and self-paced participation, promoting consistent reinforcement of relaxation and cognitive restructuring techniques. The significant mean reduction of 10.5 points in perceived stress within the mindfulness group suggested that continuous and accessible digital interventions had a substantial behavioral impact, particularly in young adults accustomed to mobile technology integration in their daily routines(19).

Improvement in sleep quality, as measured by the PSQI, provided further evidence of the holistic benefits of mindfulness training. Sleep disturbance in medical students often arises from psychological stress, irregular schedules, and cognitive hyperarousal(20). The mindfulness group displayed a post-intervention PSQI score decrease to 5.1, reflecting meaningful restoration of sleep patterns and reduction of insomnia symptoms(20). These findings emphasized that mindfulness practices not only target psychological distress but also exert secondary benefits on physiological processes such as sleep regulation. The consistent reduction in stress and improvement in sleep collectively highlighted the interdependence between psychological calmness and restorative rest(21).

Comparative interpretation indicated that while standard counseling offered moderate benefits, it lacked the same magnitude of effect. Counseling primarily relied on scheduled interpersonal sessions and verbal coping strategies, which may have been insufficient for sustained emotional regulation in high-stress academic environments. Conversely, mobile mindfulness encouraged independent practice and cognitive engagement beyond the therapeutic setting. The flexibility of time and setting, combined with non-judgmental self-awareness training, likely strengthened adherence and intrinsic motivation, thereby enhancing overall efficacy(22).

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The study presented several notable strengths. Randomized allocation minimized selection bias and ensured comparability between groups. The adequate sample size provided strong statistical power, as confirmed by post-hoc analysis, supporting the reliability of the results. The use of validated tools such as the Perceived Stress Scale and Pittsburgh Sleep Quality Index ensured standardized and objective assessment of outcomes. Furthermore, high compliance rates and the absence of participant withdrawal indicated the acceptability and practicality of mobile-based interventions among the student population. The integration of quantitative outcomes with behavioral insights offered a comprehensive understanding of therapeutic impact(23).

However, certain limitations warranted acknowledgment. The study duration of six weeks may not have captured long-term sustainability of stress and sleep improvements. Self-reported questionnaires, although validated, were subject to response bias and could have influenced the magnitude of measured effects. Additionally, the absence of physiological indicators such as cortisol levels or actigraphic sleep tracking limited the ability to correlate subjective outcomes with objective biological markers. The single-region setting within South Punjab restricted generalizability across diverse educational or cultural contexts, as environmental stressors and digital literacy levels could vary considerably. Despite these limitations, the study maintained methodological rigor and internal validity(24).

The implications of these findings were substantial in both clinical and educational contexts. Incorporating mobile mindfulness interventions into medical curricula could serve as a preventive and supportive mental health strategy, reducing burnout risk and promoting overall well-being among future healthcare professionals. From a broader public health perspective, the scalability of mobile platforms allowed cost-effective dissemination of stress management tools to populations with limited access to counseling services. The integration of mindfulness programs into institutional wellness initiatives could normalize mental health care and foster resilience in demanding professional pathways.

Future research should aim to expand upon these results by extending follow-up duration to evaluate the persistence of psychological and physiological benefits. Hybrid designs integrating both app-based and in-person components may enhance social support while maintaining flexibility. Incorporating biometric monitoring and neurocognitive measures would deepen understanding of underlying mechanisms and validate the subjective reports observed in this study. Comparative trials involving other digital interventions such as cognitive-behavioral therapy or biofeedback applications could further contextualize the efficacy of mindfulness-based approaches within the broader spectrum of digital mental health solutions.

In summary, this randomized controlled trial demonstrated that mobile mindfulness therapy was more effective than standard counseling in reducing perceived stress and improving sleep quality among medical students. The results supported the practical utility of digital mindfulness as an accessible, engaging, and evidence-based strategy for psychological well-being. The study contributed meaningful insights into the evolving landscape of digital mental health interventions and highlighted the potential of mobile technologies to transform traditional approaches to stress management and emotional resilience in healthcare education.

Conclusion

The study concluded that mobile mindfulness therapy effectively reduced perceived stress and improved sleep quality among medical undergraduates compared to standard counseling. The accessibility, flexibility, and self-directed nature of the mobile intervention enhanced adherence and psychological outcomes. These findings underscored the potential of app-based mindfulness programs as scalable, cost-effective strategies for promoting mental health and resilience among students in high-stress academic environments, marking a progressive step toward integrating digital interventions into medical education and wellness frameworks.

AUTHOR CONTRIBUTIONS

Author	**Contribution**
Zuha Arshad	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Abdullah Ayoob	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing

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Aiman Zahra*	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published

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