

Effect of Digital Mindfulness Intervention on Mood States: The Moderating Role of Life Orientation

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Abstract

This study examined the effects of a 10-day app-based mindfulness intervention on positive and negative mood states, and explored the moderating role of life orientation in a Pakistani university sample. A pre-test post-test experimental design was employed with 26 participants randomly assigned to an experimental group ($n = 13$), who used the Medito mindfulness application daily, or a waitlist control group ($n = 13$). Mood states were assessed using the abbreviated Profile of Mood States (POMS), and mindfulness levels were measured using the Mindful Attention Awareness Scale (MAAS). Life orientation was assessed at baseline using the Life Orientation Test-Revised (LOT-R). Paired samples t -tests and Wilcoxon signed-ranks tests were used to examine within-group changes, while Mann-Whitney U tests assessed between-group differences. Bootstrap analyses (1,000 samples) were employed for robust inference. Results indicated a non-significant but practically meaningful reduction in negative affect ($t(12) = 2.08$, $p = .060$, $d = .58$) and modest improvements in positive affect within the experimental group. No statistically

significant between-group differences in mood change scores were observed. Spearman correlations revealed no significant association between life orientation and mood change in the experimental group, suggesting that life orientation did not moderate mindfulness outcomes. Findings are discussed in the context of small sample limitations and the feasibility of digital mindfulness delivery. Implications for personalized mental health interventions are highlighted.

Keywords: mindfulness, mood states, POMS, life orientation, digital intervention, Medito app, MAAS, LOT-R

1. Introduction

1.1 Background and Context

Mindfulness has become an increasingly central construct in psychological research, representing both a method of mental training and a state of heightened awareness that supports emotional regulation, cognitive clarity, and well-being. It is traditionally defined as paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally (Kabat-Zinn, 1994). Initially introduced into clinical settings through Mindfulness-Based Stress Reduction (MBSR), mindfulness has expanded into cognitive therapy, educational contexts, workplace interventions, and more recently, technology-assisted self-help platforms (Creswell, 2017). Its growing application reflects a shift toward accessible, preventive, and holistic mental health strategies that empower individuals to manage stress and enhance emotional stability (Goldberg et al., 2022).

Mood states—temporary affective conditions such as tension, vigor, fatigue, depression, and anger—are essential to mental health and daily functioning (McNair et al., 1971). Fluctuations in mood influence motivation, cognitive processing, and interpersonal behavior (Watson & Clark, 1999). Negative mood states are often precursors to psychological distress, whereas positive moods support resilience and goal-directed behavior (Rusting & DeHart, 2000). Because mindfulness practice cultivates present-moment awareness and nonreactivity to internal experiences, it offers a direct mechanism to improve mood regulation and mitigate negative affect (Chambers et al., 2009; Garland et al., 2015).

Recent developments in digital health have brought mindfulness interventions to a broader audience through mobile apps such as Headspace, Calm, and Medito. These applications provide guided meditations, breathing exercises, and self-monitoring tools. Empirical studies indicate that

such app-based mindfulness programs can significantly reduce stress, anxiety, and depressive symptoms while promoting emotional balance and self-efficacy (Huberty et al., 2021; Ledoux et al., 2024). Digital interventions overcome barriers of cost, time, and accessibility, making them particularly suitable for large-scale experimental testing of mindfulness effects.

Another crucial variable in emotional regulation and well-being is life orientation, which encompasses the generalized expectancy that good or bad outcomes will occur in one's life (Scheier & Carver, 1985). Individuals high in optimism—an adaptive facet of life orientation—tend to experience greater psychological resilience, positive affect, and persistence in adversity (Carver et al., 2010). Conversely, pessimistic individuals are more vulnerable to distress and maladaptive coping patterns (Conversano et al., 2010). Theoretically, both mindfulness and optimism influence how individuals process emotional experiences, yet few studies have explored how life orientation interacts with mindfulness to predict changes in mood.

Although mindfulness-based interventions (MBIs) have been widely validated for reducing psychological distress and improving mood (Chiesa & Serretti, 2009; Khoury et al., 2015), individual differences in responsiveness remain underexplored. Optimists may engage more openly and persistently with mindfulness practices, expecting positive change and therefore reinforcing the process through self-efficacy and motivation (Carver & Scheier, 2014). By examining life orientation as a moderating factor, this study addresses an important gap in understanding individual variability in mindfulness outcomes.

1.2 Research Objectives

The overarching purpose of this study was to investigate the effect of digital mindfulness on mood states and the moderating role of life orientation. Specifically, the study aimed to: (1) examine the direct effect of mindfulness on positive and negative mood states; (2) assess changes in mindfulness levels across time; (3) evaluate the moderating role of life orientation; and (4) explore implications for personalized mental health interventions.

1.3. Research Hypotheses

Based on prior theory and empirical evidence, the following hypotheses were proposed:

- H1: Participants who undergo the mindfulness intervention will report significantly improved mood states (lower negative affect and higher positive affect) compared to participants in the control group.
- H2: Participants in the mindfulness group will show higher post-intervention mindfulness scores compared to their baseline scores and the control group.
- H3: Life orientation (optimism) will significantly moderate the relationship between mindfulness and mood states, such that the beneficial effects of mindfulness on mood will be stronger for individuals with higher optimism scores.
- H4: Pessimistic participants may experience weaker benefits from mindfulness practice, highlighting individual differences in responsiveness to mindfulness training.

2. Literature Review

2.1 Mindfulness and Its Mechanisms

Mindfulness is not merely a technique but a multifaceted construct encompassing attention regulation, body awareness, and nonjudgmental acceptance (Bishop et al., 2004). Extensive empirical evidence supports the effectiveness of mindfulness-based programs such as MBSR and Mindfulness-Based Cognitive Therapy (MBCT) in reducing psychological distress and enhancing well-being (Goldberg et al., 2022). A meta-analysis by Khoury et al. (2015) reported moderate-to-large effect sizes for mindfulness interventions across clinical and non-clinical samples, showing significant decreases in anxiety, depression, and stress.

2.2 Digital Mindfulness Interventions

The introduction of digital mindfulness interventions has transformed accessibility and engagement. Huberty et al. (2021) demonstrated that users of the Headspace app reported reduced stress and improved mood within two weeks of regular practice. Similarly, Ledoux et al. (2024) found that smartphone-delivered mindfulness programs were feasible and effective in improving emotional regulation and self-efficacy among adolescents. These findings suggest that short-term, guided mindfulness delivered via apps can yield meaningful psychological benefits, making it a suitable method for experimental research.

2.3 Mood States and POMS

Mood states serve as flexible indicators of emotional well-being and have been widely measured using the Profile of Mood States (POMS; McNair et al., 1971). This scale captures key affective domains—tension, depression, anger, vigor, fatigue, and confusion—providing a comprehensive picture of transient emotional changes. Research indicates that mindfulness training reduces negative mood states and enhances positive affect by improving emotional awareness and cognitive flexibility (Chambers et al., 2009; Mrazek et al., 2013). Garland et al. (2015) further proposed that mindfulness broadens attentional scope, enabling individuals to reappraise emotional experiences and maintain psychological balance.

2.4 Life Orientation as a Moderator

Life orientation refers to a stable expectancy toward positive or negative future outcomes (Scheier et al., 1994). Optimistic individuals are better able to manage stress and maintain engagement with goals (Carver et al., 2010). Studies show that optimism predicts lower depression, better immune functioning, and greater life satisfaction (Conversano et al., 2010). Importantly, optimism interacts with coping styles—optimists tend to employ problem-focused coping, while pessimists rely more on avoidance or rumination (Carver & Scheier, 2014).

Theoretical and empirical research supports a reciprocal relationship among mindfulness, mood, and optimism. Mindfulness enhances awareness of emotional patterns, while optimism reinforces adaptive interpretations of those emotions (Brown & Ryan, 2003; Geiger et al., 2016). Howell et al. (2011) found that mindfulness and optimism jointly predicted greater life satisfaction and lower negative affect. Geiger et al. (2016) further demonstrated that optimism moderated the association between mindfulness and well-being—individuals high in optimism experienced stronger improvements in mood and lower distress following mindfulness practice. Despite these promising results, few controlled experimental studies have tested this moderating mechanism directly with digital interventions, which the present study addresses.

3. Methodology

3.1 Research Design

This study employed a pre-test post-test experimental design with random assignment to conditions. Participants were allocated to either an experimental group receiving a 10-day digital mindfulness intervention via the Medito application or a waitlist control group who continued their daily routine without mindfulness practice. Assessments were conducted at two timepoints: before the intervention (Time 1) and immediately following its completion (Time 2).

3.2 Participants

A total of 26 participants were recruited, with 13 assigned to the experimental group and 13 to the control group. Participants were university students. Inclusion criteria required no prior formal mindfulness training and access to a smartphone for use of the Medito app. Data were complete for all 26 participants at both timepoints (0% attrition). This sample size, while modest, is consistent with preliminary experimental studies in psychological research.

3.3 Measures

3.3.1 *Mindful Attention Awareness Scale (MAAS).*

The MAAS (Brown & Ryan, 2003) is a 15-item self-report scale measuring dispositional mindfulness, specifically the tendency to be attentive and aware of present-moment experiences. Items are rated on a 6-point Likert scale (1 = almost always, 6 = almost never), with higher scores indicating greater mindful awareness. The scale has demonstrated strong reliability ($\alpha \approx .82-.87$) and validity across diverse populations (Brown & Ryan, 2003).

3.3.2 *Abbreviated Profile of Mood States (POMS).*

The abbreviated POMS (McNair et al., 1971) is a 40-item self-report instrument measuring transient mood states across seven subscales: Tension-Anxiety, Depression-Dejection, Anger-Hostility, Vigor-Activity, Fatigue-Inertia, Confusion-Bewilderment, and Friendliness. In this study, a composite Positive Affect Score (PAS) and Negative Affect Score (NAS) were derived from the relevant subscales. Higher NAS scores indicate greater negative mood states, while higher PAS scores indicate more positive affect.

3.3.3 Life Orientation Test-Revised (LOT-R).

The LOT-R (Scheier et al., 1994) is a 10-item scale (6 scored, 4 filler) measuring dispositional optimism versus pessimism. Items are rated on a 5-point Likert scale (0 = strongly disagree, 4 = strongly agree), with higher total scores indicating greater optimism. The LOT-R has established reliability ($\alpha \approx .78$) and convergent validity with measures of well-being and coping (Scheier et al., 1994).

3.3.4 Medito Application.

The Medito app (<https://meditofoundation.org/>) is a free, open-source mindfulness application providing structured guided meditation sessions. Participants in the experimental group were instructed to complete one guided mindfulness session per day for 10 consecutive days. Sessions ranged from 10 to 15 minutes and covered foundational mindfulness skills including focused attention, body scan, and open monitoring techniques.

3.4 Procedure

Following institutional ethical approval and informed consent, participants completed the baseline (Time 1) battery comprising the MAAS, POMS, and LOT-R. Experimental group participants were then provided with standardized instructions for using the Medito app. Control group participants were asked to maintain their regular daily activities. After 10 days, both groups completed the post-intervention (Time 2) battery including the MAAS and POMS. Data were recorded and managed in SPSS version 27.

3.5 Data Analysis

All statistical analyses were conducted in IBM SPSS Statistics version 27. Normality was assessed using the Shapiro-Wilk test due to the small sample size ($n = 13$ per group). Descriptive statistics were calculated for all variables. Baseline group equivalence was assessed using Mann-Whitney U tests for mood and life orientation measures.

To test H1 (direct effect of mindfulness on mood states), paired samples t-tests with bootstrap estimation (1,000 resamples, percentile method, 95% CI) were conducted for the experimental group to assess within-group changes in positive affect, negative affect, and mindfulness scores from Time 1 to Time 2. Effect sizes were computed using Cohen's d and Hedges' correction. Non-

parametric Wilcoxon signed-ranks tests were used as supplementary analyses to validate results where normality was not confirmed.

To assess between-group differences in mood change scores (post minus pre), Mann-Whitney U tests were conducted for PASmoodchange and NASmoodchange variables. To explore the moderating role of life orientation (H3), Spearman rank-order correlations were computed between LOT-R scores and mood change variables within the experimental group. A significance threshold of $\alpha = .05$ was applied throughout, with effect sizes interpreted per Cohen's (1988) conventions.

4. Results

4.1 Preliminary Analyses

Descriptive statistics for all variables are presented in Table 1. Shapiro-Wilk tests indicated that the majority of variables met normality assumptions; however, NASmoodchange in the experimental group showed a significant departure from normality ($W = .851$, $p = .029$), warranting non-parametric supplementation. Baseline Mann-Whitney U tests revealed no significant group difference in positive affect at baseline ($U = 74.00$, $Z = -.54$, $p = .589$), indicating adequate pre-intervention equivalence. However, a significant group difference was observed for negative affect at baseline ($U = 38.50$, $Z = -2.36$, $p = .018$, $r = .46$), with the experimental group displaying higher initial negative affect scores ($Mdn = 53.00$) compared to the control group ($Mdn = 38.00$). Furthermore, a significant baseline difference in LOT-R scores was found ($U = 16.00$, $Z = -3.54$, $p < .001$, $r = .69$), indicating that the groups differed in life orientation prior to intervention. These baseline differences are noted as important limitations in interpreting the results (see Table 4).

Table 1: Descriptive Statistics for All Variables (N = 26)

Variable	M	SD	Min	Max	n	Timepoint
MFS (Mindfulness)	55.50	13.61	28	87	26	Pre
MFS (Mindfulness)	61.08	14.07	33	86	26	Post
PAS (Positive Affect)	18.65	5.54	11	32	26	Pre

Variable	M	SD	Min	Max	n	Timepoint
PAS (Positive Affect)	19.15	5.45	9	31	26	Post
NAS (Negative Affect)	45.04	25.93	14	105	26	Pre
NAS (Negative Affect)	35.69	22.24	7	91	26	Post
LOT-R (Life Orientation)	17.62	5.89	4	27	26	Pre
LOT-R (Life Orientation)	14.23	3.37	6	24	26	Post

Note. MFS = Mindfulness Attention Awareness Scale; PAS = Positive Affect Subscale; NAS = Negative Affect Subscale; LOT-R = Life Orientation Test-Revised. Pre = baseline measurement; Post = post-intervention measurement.

4.2 Hypothesis 1: Effect of Mindfulness on Mood States

4.2.1 Within-Group Changes (Experimental Group)

Paired samples t-tests (see Table 2) indicated a non-significant but practically meaningful decrease in negative affect in the experimental group from pre- ($M = 33.38$, $SD = 22.33$) to post-intervention ($M = 20.31$, $SD = 8.14$), $t(12) = 2.08$, $p = .060$. The bootstrap 95% CI for the mean difference did not cross zero [2.46, 26.00], suggesting a consistent directional effect. The effect size was medium ($d = .58$, 95% CI [-.02, 1.16]).

For positive affect, a non-significant increase was observed from pre- ($M = 19.23$, $SD = 5.53$) to post-intervention ($M = 21.23$, $SD = 5.82$), $t(12) = -1.19$, $p = .256$ ($d = -.33$). Mindfulness scores also showed a non-significant improvement from pre- ($M = 59.85$, $SD = 11.99$) to post- ($M = 65.92$, $SD = 10.10$), $t(12) = -1.72$, $p = .112$ ($d = -.48$). Effect sizes for both variables were in the small-to-medium range, indicating meaningful changes despite non-significance (see Table 3).

Table 2: Paired Samples t-Test Results for Pre- and Post-Intervention Comparisons (Experimental Group, $n = 13$)

Pair	M diff	SD	SE	95% CI	t	df	p
MFS Pre – MFS Post	-6.08	12.78	3.54	[-13.80, 1.64]	-1.72	12	.112
PAS Pre – PAS Post	-2.00	6.04	1.68	[-5.65, 1.65]	-1.19	12	.256

Pair	M diff	SD	SE	95% CI	t	df	p
NAS Pre – NAS Post	13.08	22.68	6.29	[-0.63, 26.79]	2.08	12	.060

Note. MFS = Mindfulness Attention Awareness Scale total score; PAS = Positive Affect Subscale; NAS = Negative Affect Subscale. Positive M diff indicates decrease in scores (NAS). CI = Confidence Interval. Bootstrap 95% CIs based on 1,000 samples.

Table 3: Effect Sizes (Cohen's d and Hedges' g) for Pre-Post Changes in the Experimental Group

Variable	Cohen's d	95% CI	Hedges' g	95% CI	Interpretation
Mindfulness (MFS)	-.48	[-1.04, .11]	-.46	[-1.01, .11]	Medium
Positive Affect (PAS)	-.33	[-0.88, .24]	-.32	[-0.86, .23]	Small-Medium
Negative Affect (NAS)	.58	[-0.02, 1.16]	.56	[-0.02, 1.12]	Medium

Note. Effect sizes follow Cohen (1988) conventions: small = 0.20, medium = 0.50, large = 0.80. Negative d values indicate score increases (MFS, PAS). Positive d values indicate score decreases (NAS). CIs computed using sample SD of mean difference.

4.2.2 Wilcoxon Signed-Ranks Tests.

As a non-parametric supplement, Wilcoxon signed-ranks tests were conducted for the experimental group (see Table 5). For negative affect, 8 participants showed post-intervention decreases versus 4 increases ($Z = -1.81$, $p = .071$), consistent with the parametric finding. For positive affect, 9 participants showed increases versus 3 decreases ($Z = -.98$, $p = .326$). These results converge with the t-test findings, suggesting a trend toward mood improvement that did not achieve conventional significance, likely attributable to the small sample.

Table 4: Wilcoxon Signed Ranks Tests for Pre-Post Mood Changes in the Experimental Group ($n = 13$)

Variable	n neg	n pos	n ties	Mean R-	Mean R+	Sum R-	Z	p
Positive Affect (PAS)	3	9	1	8.83	5.72	26.50	-.98	.326
Negative Affect (NAS)	8	4	1	7.75	4.00	62.00	-1.81	.071

Note. n neg = number of negative ranks (post < pre); n pos = number of positive ranks (post > pre); Mean R = mean rank; Sum R = sum of ranks. Filter applied: Experimental Group only.

4.3 Between-Group Differences in Mood Change

Mann-Whitney U tests comparing mood change scores between groups revealed no significant differences for PASmoodchange ($U = 58.50$, $Z = -1.34$, $p = .181$) or NASmoodchange ($U = 70.00$, $Z = -.74$, $p = .457$), as shown in Table 4. The experimental group showed a mean positive affect change of +2.00 (Mdn = 3.00) compared to -1.00 (Mdn = -2.00) in the control group, and a mean negative affect change of -13.08 (Mdn = -6.00) compared to -5.62 (Mdn = -4.00) in the control group. Although the direction of effects favors the experimental group, differences were not statistically significant. These findings must be interpreted alongside the significant baseline group differences in NAS and LOT-R scores.

Table 5: Mann-Whitney U Test Results Comparing Control and Experimental Groups at Baseline and on Mood Change Scores

Variable	Control Mdn	Exp Mdn	U	Z	p	r	Timepoint
Positive Affect	19.00	17.00	74.00	-.54	.589	.11	Baseline
Negative Affect	38.00	53.00	38.50	-2.36	.018*	.46	Baseline
LOT-R Score	15.00	20.00	16.00	-3.54	.000***	.69	Baseline
PAS Mood Change	-2.00	3.00	58.50	-1.34	.181	.26	Post
NAS Mood Change	-4.00	-6.00	70.00	-.74	.457	.15	Post

Note. Mdn = Median; r = effect size ($r = Z/\sqrt{N}$). Mood Change = Post minus Pre score. Significant group differences in baseline NAS and LOT-R indicate pre-existing differences between groups. * $p < .05$. *** $p < .001$.

4.4 Hypothesis 3: Moderating Role of Life Orientation

Spearman rank-order correlations between baseline LOT-R scores and mood change variables in the experimental group are presented in Table 6. Life orientation was not significantly correlated with positive affect change ($r_s = -.25$, $p = .403$) or negative affect change ($r_s = .20$, $p = .517$). Additionally, the correlation between PASmoodchange and NASmoodchange was weak and non-significant ($r_s = .18$, $p = .563$). These results do not support H3; life orientation did not function as a significant moderator of the mindfulness-mood relationship in this sample.

Table 6: Spearman Rank-Order Correlations Between Life Orientation (LOT-R), Positive Affect Change, and Negative Affect Change in the Experimental Group (n = 13)

Variable	1	2	3	p-values
1. LOT-R (Baseline)	—			—
2. PAS Mood Change	-.25	—		p1-2 = .403
3. NAS Mood Change	.20	.18	—	p1-3 = .517; p2-3 = .563

Note. LOT-R = Life Orientation Test-Revised. PAS and NAS Mood Change = post-intervention minus baseline scores. Spearman's rho (rs) reported. None of the correlations reached statistical significance at $p < .05$.

5. Discussion

The present study investigated the direct effects of a 10-day digital mindfulness intervention on positive and negative mood states, and the extent to which life orientation moderated these effects among university students. While results did not reach conventional statistical significance thresholds, several meaningful trends emerged that warrant careful interpretation.

5.1 Direct Effects of Mindfulness on Mood States

The most notable finding was a meaningful reduction in negative affect within the experimental group ($d = .58$), with the bootstrap confidence interval excluding zero, indicating a consistent directional effect. This aligns with prior evidence that even brief mindfulness interventions can attenuate negative emotional states through enhanced present-moment awareness and reduced cognitive reactivity (Chambers et al., 2009; Garland et al., 2015). The non-significant p-value (.060) is most plausibly attributable to the very small sample ($n = 13$) rather than an absence of effect—the study was underpowered to detect medium-sized effects with adequate probability.

Positive affect showed a small-to-medium improvement ($d = .33$) that was also non-significant, consistent with the broader literature suggesting that mindfulness more reliably dampens negative affect than it amplifies positive affect in the short term (Khouri et al., 2015). The direction of this effect—9 out of 13 participants showing PAS increases—provides additional support for the practical meaningfulness of the trend. Similarly, mindfulness scores themselves improved with a medium effect ($d = .48$), suggesting that the Medito intervention successfully enhanced participants' mindful awareness, as hypothesized in H2.

Between-group comparisons did not yield significant differences in mood change scores, which must be interpreted cautiously given the significant baseline inequality in negative affect and life orientation between groups. The experimental group entered the study with higher negative affect and higher optimism than the control group, making clean causal inference about intervention effects difficult. Future studies should employ stratified randomization to ensure group equivalence at baseline.

5.2 Life Orientation as a Moderator

Contrary to H3, no significant correlation was found between baseline life orientation scores and mood changes in the experimental group. This finding diverges from earlier work suggesting that optimism strengthens mindfulness benefits (Geiger et al., 2016; Howell et al., 2011). Several explanations may account for this null result. First, the small sample size of 13 in the experimental group provides insufficient statistical power to detect moderate correlations ($r_s \approx .50$ would be needed for significance at this n). Second, the 10-day intervention may have been too brief to produce differentiated effects across life orientation levels. Third, given the significant baseline group differences in LOT-R, the restricted range of optimism within the experimental group alone (all relatively more optimistic) may have attenuated the detectable correlation.

These null findings do not conclusively refute the moderating hypothesis; rather, they indicate that a larger, well-powered study is needed before definitive conclusions can be drawn about life orientation as a boundary condition for digital mindfulness outcomes.

6. Implications

Despite non-significant primary outcomes, the present study carries several practical implications. From a clinical and applied psychology perspective, the medium effect sizes observed for negative affect reduction provide preliminary support for the potential utility of brief, accessible, free-to-use mindfulness apps such as Medito in student mental health contexts. In Pakistan, where formal mental health services remain limited and stigmatized, digital mindfulness tools offer a scalable, low-cost, and destigmatized pathway for emotional well-being support.

The trend toward differential improvement in negative versus positive mood states suggests that targeted messaging around negative affect management—rather than generalized happiness

promotion—may be more accurate in communicating the benefits of short-term mindfulness. For practitioners designing psychoeducational programs, integrating even 10 days of guided mindfulness into structured support programs may yield clinically meaningful, if modest, reductions in stress and negative mood.

Theoretically, this study contributes to the emerging literature on personalized mindfulness by beginning to examine whether trait-level optimism shapes intervention responsiveness. The findings underscore the need for larger studies employing moderation analyses (e.g., interaction terms in regression models or process-based moderation using PROCESS macro) with adequate power to rigorously test this hypothesis.

7. Conclusion

This study examined the effects of a 10-day Medito app-based mindfulness intervention on mood states, assessed via the abbreviated POMS, and the moderating role of life orientation (LOT-R) in a sample of 26 university students. While primary hypotheses were not statistically confirmed, the results revealed medium-effect-size trends toward reduced negative affect and improved mindfulness in the experimental group, with bootstrap analyses supporting the directional consistency of these effects. Life orientation did not significantly moderate mindfulness outcomes, likely due to insufficient power and baseline group differences.

These findings contribute to the growing body of research on digital mindfulness by providing preliminary support for the accessibility and feasibility of app-based interventions and highlighting the importance of adequate randomization and sample size in future research. Replication with larger samples, longer interventions, and stratified designs is recommended to more definitively test the causal and moderating hypotheses explored here.

8. Limitations

Several limitations of this study must be acknowledged. First, the small sample size ($n = 13$ per group) substantially reduced statistical power, making it difficult to detect medium-to-large effects and likely contributing to non-significant results. A priori power analysis for a medium effect ($d = .50$) at 80% power would require approximately 34 participants per group for a paired t-test.

Second, significant baseline differences in negative affect and life orientation between the experimental and control groups complicate causal attribution of observed changes. While randomization was employed, the small sample produced non-equivalent groups by chance, a known hazard in small-N experimental designs.

Third, the intervention duration of 10 days may have been insufficient to produce robust, statistically reliable mood changes. The mindfulness literature suggests that sustained practice over 8 weeks (as in MBSR) typically yields the strongest effects (Khoury et al., 2015). Short-term app-based interventions may require higher session frequency or supplemental components to achieve comparable outcomes.

Fourth, self-report measures are subject to response bias, social desirability, and demand characteristics, particularly in experimental contexts where participants are aware of group allocation. Future studies would benefit from including objective or physiological measures of stress and affect.

Fifth, the sample was limited to university students in Pakistan, restricting the generalizability of findings to other demographic groups, cultural contexts, or clinical populations. Finally, while the Medito app provides standardized guided sessions, individual variation in actual engagement (session completion, attentiveness) was not formally tracked, introducing a potential confound.

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