

Efficacy of a mobile-based intervention for newly graduated nurses: A randomized controlled trial

DIGITAL HEALTH
Volume 12: 1–14
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DOI: 10.1177/20552076261450524
journals.sagepub.com/home/dhj
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Abstract

Objective: Newly graduated nurses often experience high job-related stress and psychological strain during their transition to clinical practice. Mobile-based interventions may provide flexible and accessible support for psychological outcomes, but evidence remains limited. This study examined the efficacy of MindMate, a mobile-based self-guided intervention integrating guided meditation with virtual plant interaction, on job stress, turnover intention, life satisfaction, and psychological capital among newly graduated nurses in South Korea. **Methods:** A randomized controlled trial registered with the Clinical Research Information Service (CRIS), Republic of Korea (Registration No. KCT0010803) was conducted with newly graduated nurses assigned to either the experimental group (n = 26) or the control group (n = 30). The experimental group completed a four-week self-guided intervention using the MindMate application within a controlled research setting. Pre- and post-intervention data were collected through validated self-report scales. Analyses included independent t-tests, paired t-tests, ANCOVA, and Cohen's d for effect size. **Results:** The intervention significantly reduced job stress and improved psychological capital in the experimental group compared to the control group. Subdomain analysis revealed reductions in workload and role conflict stress and enhancements in self-efficacy and hope. However, no statistically significant differences were found in turnover intention or life satisfaction. **Conclusion:** MindMate demonstrated efficacy in reducing job stress and enhancing certain aspects of psychological capital under controlled research conditions. Further studies are required to examine its effectiveness and scalability in real-world clinical environments.

Keywords

newly graduated nurses, job stress, mindfulness, mobile intervention, psychological capital, randomized controlled trial

Received: 17 November 2025; Revised: 8 April 2026; Accepted: 14 April 2026

1. Introduction

The transition from nursing education to professional clinical practice is one of the most critical and vulnerable periods in a nurse's career. Newly graduated nurses must quickly adapt to complex, high-pressure clinical environments while managing heavy workloads, developing clinical judgment, and navigating workplace dynamics.^{1,2} These demands place novice nurses

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under considerable psychological strain, which can compromise their well-being,³ clinical performance, and long-term professional engagement.⁴ In Korea, early attrition among new nurses has become a pressing concern for workforce sustainability: the turnover rate among new nurses within the first year of employment reached 57.4% in 2023, marking a 5% increase from the previous year.⁵ Such high turnover disrupts team cohesion, increases training and recruitment costs, and adds pressure on remaining staff,^{6,7} ultimately undermining continuity of patient care.⁸

A major factor contributing to early turnover is job stress. Newly graduated nurses report high levels of stress during the initial phase of their clinical adaptation.⁹ The most common sources of stress include excessive workload, insufficient clinical knowledge, and fear of making medical errors. These stressors reduce psychological well-being, job satisfaction, and professional commitment.¹⁰ Chronic stress can further lead to burnout, depression, and eventual withdrawal from the profession. From an institutional perspective, this represents a serious loss of investment in training and a threat to organizational resilience.¹¹

To address these challenges, mindfulness-based interventions have gained attention. By fostering present-moment awareness and a nonjudgmental attitude toward their internal experiences,¹² they reduce stress, anxiety, and burnout while improving emotional regulation and resilience.^{13,14} Similarly, nature-based interventions, such as interacting with plants and green spaces, improve mood, enhance attention, and promote stress recovery.^{15,16} However, traditional mindfulness programs often require in-person participation, significant time commitment, or prior meditation experience. Horticultural therapy depends on access to natural settings—conditions that make participation difficult for hospital-based nurses with irregular schedules.

In response, digital technologies now offer innovative alternatives by simulating mindfulness and nature-based experiences through virtual plant interactions and nature-themed mobile applications.^{17,18} Designing such interventions requires considering the characteristics of the present nursing workforce, largely comprising Generation Z nurses, who are digital natives born between 1995 and 2010.¹⁹ This cohort prefers flexible, self-directed, and visually engaging content over traditional formats.²⁰ They are particularly receptive to mobile-based, brief, and gamified applications that allow private, on-demand use.²¹ Given these characteristics, recent studies have begun exploring digital interventions that incorporate mindfulness and nature-based strategies into mobile formats, combining evidence-based psychological techniques with modern technological accessibility.²² Self-guided mobile applications offer convenience, privacy, and schedule flexibility, crucial for shift workers such as nurses.²³

Furthermore, the addition of interactive or gamified elements may enhance engagement and emotional investment.²⁴ Although such hybrid approaches are in the early stages of empirical validation, these interventions can effectively reduce stress and promote positive emotional outcomes.²⁵ Such programs are promising for newly graduated nurses with high stress but limited time. Moreover, mobile-based tools have the potential for broader dissemination across institutions; however, their efficacy must first be established under controlled research conditions.²⁶

However, despite growing interest in mobile adaptations of mindfulness and nature-based strategies, to our knowledge no randomized controlled trial has evaluated a fully self-guided mobile intervention that combines guided mindfulness with interactive, nature-based elements specifically for newly graduated nurses during the transition to practice. Existing studies seldom assess transition-relevant stress subdomains alongside psychological capital and rarely examine their efficacy under controlled research conditions in this population. Psychological capital is defined as a positive psychological state of development characterized by self-efficacy, hope, optimism, and resilience that supports individuals' capacity to cope with workplace challenges.²⁷ Unlike broader subjective well-being, which reflects an individual's overall evaluation of life satisfaction and emotional state, psychological capital specifically represents internal positive psychological resources that facilitate coping, motivation, and adaptation in the workplace.

In this context, this study developed and evaluated MindMate, a novel mobile-based psychological intervention tailored for newly graduated nurses. The application integrates guided mindfulness practices with virtual plant interaction to promote emotional regulation and reduce job stress during early clinical transition. This randomized controlled trial (RCT) examined its efficacy on job stress, turnover intention, life satisfaction, and psychological capital under controlled research conditions. These outcomes were selected because job stress is a key determinant of early career adjustment, turnover intention reflects potential workforce instability, life satisfaction was included as an indicator of broader subjective well-being, whereas psychological capital captures positive psychological resources relevant to coping and professional adaptation in the workplace. By providing preliminary evidence of efficacy, this study lays the groundwork for future research examining its effectiveness and scalability in real-world clinical environments.

2. Methods

2.1. Study design

This study employed a randomized controlled trial (RCT No. KCT0010803) to evaluate the efficacy of the MindMate application under controlled research conditions. The study was conducted in accordance with the CONSORT (Consolidated Standards of Reporting Trials) guidelines to ensure methodological rigor; the completed CONSORT checklist is provided in the Supplementary Materials (Supplementary File 1). The study was conducted between October 2024 and December 2024.

2.2. Participants

Participants comprised newly graduated nurses with less than one year of clinical experience, employed at hospitals in South Korea. Recruitment was conducted via an online advertisement posted on several nursing communities for a week in October. Inclusion criteria were as follows: (1) completion of preceptor training, (2) employment at a general hospital, and (3) consent to participate.

The required sample size was calculated using G*Power based on parameters reported in previous intervention studies among nursing populations.^{24,28} In particular, the assumed effect size ($d = 0.94$) was derived from a quasi-experimental study that evaluated a structured stress-management educational intervention among nursing students and reported a large effect on psychological stress-related outcomes.²⁸ Based on these parameters, the estimated minimum sample size per group was 23 with a power of 0.80 and a significance level of $\alpha = 0.05$. To account for potential attrition, a 15% dropout rate was considered in accordance with recommendations in nursing intervention studies,²⁹ resulting in an adjusted minimum sample size of 27 participants per group.

A total of 64 nurses initially agreed to participate and completed the baseline assessment. Participants were randomly allocated to either the experimental group ($n = 32$) or the control group ($n = 32$) using a computer-generated random sequence prepared by a researcher not involved in the study procedures. During the four-week intervention period, eight participants withdrew due to inaccessibility or incomplete responses, resulting in a final sample of 56 participants (experimental = 26; control = 30). The participant flow throughout the study is illustrated in [Figure 1](#).

2.3. MindMate application

The intervention used in this study was the MindMate application, a mobile-based psychological support application developed to support newly graduated nurses in managing stress and strengthening psychological resources. Designed to be self-directed, accessible, and engaging, the program drew on prior research indicating the efficacy of meditation^{30,31} and nature-related interactions^{32,33} in reducing stress and supporting psychological well-being. Participants received an application download link and digital user guide from the research team. A detailed description of the intervention structure and application features is provided in the Supplementary Materials (Supplementary File 2). The application is compatible with Android and iOS operating systems, with the interface optimized for mobile responsiveness to ensure usability across devices.

MindMate integrates several interactive components, including mindfulness-based guided meditation with binaural beat audio, virtual plant cultivation, goal-setting through a time capsule function, and work schedule recording with brief self-report check-ins. During each session, participants were first instructed to listen to guided meditation audio designed to enhance awareness of breathing, bodily sensations, and present-moment experiences. Themed sessions addressed emotional grounding, tension release, and acceptance, followed by interaction with the virtual plant system, where users cultivated and maintained their plant as a symbolic representation of personal growth and engagement with the program. Additional features, including the time capsule and work schedule recording functions, were available for voluntary use within the application to support reflection and self-monitoring during the intervention period. The intervention lasted four weeks, during which participants were instructed to engage in the program three times per week for at least 15 minutes per session. App usage data (e.g., login time and session activity) were monitored to assess participant engagement during the intervention period. During the intervention, participants could submit questions or feedback, and standardized responses were provided by the research team to ensure procedural consistency. The control group did not receive access to the program. Additional screenshots illustrating the intervention interface and program structure are presented in [Figure 2](#).

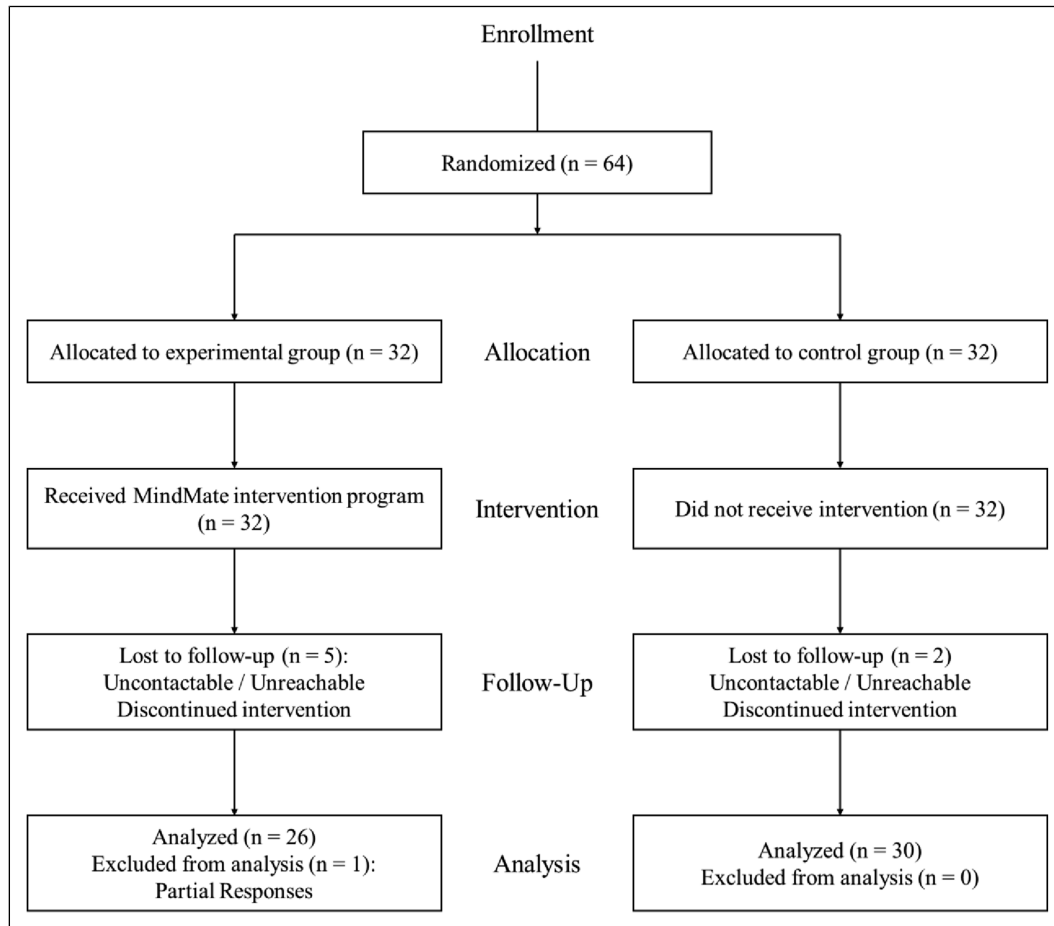


Figure 1. Flowchart of the randomized controlled trial.

2.4. Measurements

2.4.1. Job stress

Job stress was measured using a 23-item scale developed by Kim and Koo³⁴ and revised by Ahn.³⁵ The scale comprises six subdomains: work overload (5 items), lack of professional knowledge and skills (3 items), night shifts (1 item), professional role conflict (5 items), inadequate treatment and compensation (4 items), and interpersonal problems (5 items). Responses were rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree), with higher scores indicating higher levels of job stress. The reliability of the instrument was reported as Cronbach's $\alpha = 0.85$ in Ahn's study. Permission to use the revised Korean version of this instrument was obtained from the researcher who modified and validated the scale.

2.4.2. Turnover intention

Turnover intention was assessed using a 4-item scale adapted by Park³⁶ from Lawler's³⁷ turnover intention scale. Items were scored individually on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The total score ranges from 5 to 20, with higher scores indicating a higher intention to leave. The reliability of the scale in Park's study was Cronbach's $\alpha = 0.88$. Permission to use the adapted Korean version of this scale was obtained from the researcher who revised the instrument.

2.4.3. Life satisfaction

Life satisfaction was measured using the Korean version of the Satisfaction with Life Scale (K-SWLS), originally developed by Diener et al.,³⁸ translated by Cho and Cha,³⁹ and validated by Lim.⁴⁰ The scale includes five items rated on a 4-point Likert scale (1 = strongly disagree, 4 = strongly agree), with higher scores indicating greater satisfaction with life. The reliability coefficient of the scale was reported as Cronbach's $\alpha = 0.87$. Permission to use the validated Korean version of the scale was obtained from the researcher who conducted the Korean validation study.

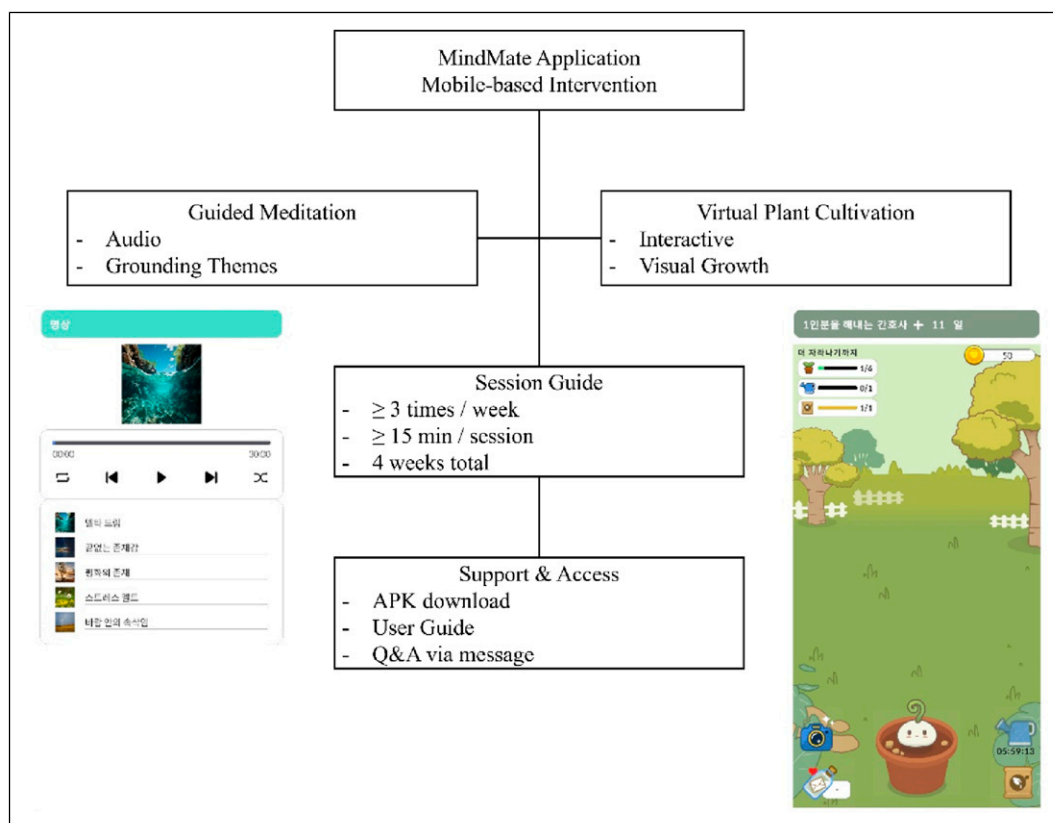


Figure 2. Structure and key components of the MindMate mobile intervention program.

2.4.4. Psychological capital

Psychological capital was measured using the Korean version of the Psychological Capital Questionnaire (PCQ), adapted by Lim⁴¹ from Luthans et al.²⁷ The 18-item scale includes four subdomains: self-efficacy (5 items), optimism (5 items), hope (5 items), and resilience (3 items). Each item was rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree), with higher scores indicating greater psychological capital. The internal consistency of the scale in Lim's study was Cronbach's $\alpha = 0.92$. Permission to use the Korean version of the Psychological Capital Questionnaire was obtained from the researcher who adapted and validated the scale.

2.5. Data collection

Data were collected before the intervention (pre-test) and immediately after the four-week intervention period (post-test). Participants were given a detailed explanation of the study and provided informed consent electronically before participation. The pre-test questionnaire, comprising four validated self-report scales, was created using Google Forms and distributed to participants via a link sent to their mobile phone numbers by the research team. Because the questionnaires were administered through Google Forms, the research team was able to confirm whether participants had completed the survey.

After the completion of the pre-test, participants were randomly assigned to either the experimental or control group using a computer-generated randomization method. Following randomization, the experimental group received access to the MindMate application. For participants using Android devices, an APK installation file was sent via email, whereas participants using iOS devices accessed the application through Apple's TestFlight platform. A digital user guide was also provided to support application use. The control group did not receive any intervention.

Throughout the intervention period, participants could submit questions or suggestions related to the app or study procedures, and standardized responses were provided by the research team as part of the structured research protocol. After the four-week intervention period, the same Google Forms questionnaire was re-administered to all the participants to measure post-intervention outcomes. Data collection was managed by research personnel not involved in intervention delivery.

2.6. Data analysis

All statistical analyses were performed using SPSS Statistics 28.0. Descriptive statistics were used to summarize participants' general characteristics and outcome variables. Baseline homogeneity between groups was assessed using independent t-tests and chi-square tests. Within-group changes from pre-test to post-test were examined using paired t-tests. Intervention effects were tested using analysis of covariance (ANCOVA) for each outcome variable, with pre-test scores included as covariates. Cases with missing post-test data were excluded from the analyses using complete-case analysis. Additionally, Cohen's *d* was calculated based on the adjusted mean differences between groups obtained from the ANCOVA models. Statistical significance was set at $p < 0.05$. Because each outcome variable represented a prespecified study outcome, no formal correction for multiple comparisons was applied. The results should therefore be interpreted in the context of the predefined hypotheses.

2.7. Ethical considerations

This study adhered to the ethical principles of the Declaration of Helsinki.⁴² Participants were informed of the study's purpose, procedures, voluntariness, and confidentiality prior to participation, and written informed consent was obtained through an online form. The study protocol was reviewed and approved by the Chung-Ang University Institutional Review Board (IRB Approval No. 1041078-20240325-HR-055). This randomized controlled trial was registered with the Clinical Research Information Service (CRIS), Republic of Korea (Registration No. KCT0010803; <https://cris.nih.go.kr/cris/search/detailSearch.do?seq=30778>). The study also followed internationally recognized guidelines for responsible research conduct and publication ethics.⁴³ All data were anonymized, securely stored, and accessible only to the research team.

3. Results

3.1. Demographic and characteristics

Table 1 presents the demographics and characteristics of the participants. Participants in the experimental and control groups showed similar demographic characteristics, including age and duration of preceptor training. Statistically significant differences were identified between groups in religion ($\chi^2 = 15.795, p = 0.001$) and internship experience ($\chi^2 = 6.249, p = 0.012$), with more participants in the control group (80.0%) having internship experience compared to the experimental group (53.8%).

3.2. Effects of the program

Table 2 presents the outcomes of the intervention. Work stress significantly decreased in the experimental group compared with the control group ($F = 25.573, p < 0.001$; Cohen's *d* = -1.419). Turnover intention showed a slight decrease in both groups; however, the between-group difference was not statistically significant ($F = 0.051, p = 0.823$). Life satisfaction increased in the experimental group; however, the between-group difference was not statistically significant ($F = 3.040, p = 0.087$). Psychological capital significantly increased in the experimental group compared with the control group ($F = 10.281, p = 0.002$; Cohen's *d* = 0.944).

Figure 3 illustrates the mean change scores (post-test minus pre-test) for each outcome variable in the experimental and control groups. In this figure, negative values indicate a reduction in job stress and turnover intention, and positive values reflect improvements in life satisfaction and psychological capital. The visualized changes illustrate the relative magnitude of pre-to post-intervention changes in each group.

Table 3 provides a detailed examination of job stress subscales between the experimental and control groups. For the work overload subscale, the experimental group showed a significant reduction compared to the control group ($F = 13.650, p < 0.001$), with a medium effect size (Cohen's *d* = 0.519). Similarly, the professional role conflict subscale exhibited a statistically significant difference between the experimental and control groups ($F = 6.248, p = 0.016$), with a medium effect size (Cohen's *d* = 0.424). The interpersonal problems subscale also revealed a significant difference ($F = 15.212, p < 0.001$), with a medium effect size (Cohen's *d* = 0.497). The lack of expertise and skills subscale demonstrated a significant group difference ($F = 18.828, p < 0.001$), with a relatively large effect size (Cohen's *d* = 0.728). The subscale inadequate treatment and compensation also displayed a significant difference between groups ($F = 14.003, p < 0.001$), with a large effect size (Cohen's *d* = 0.808). Conversely, the night shift subscale did not show a statistically significant difference between groups ($F = 2.194, p = 0.144$), indicating no substantial impact on night shift stress.

Table 4 provides a more detailed examination of psychological capital subscales between the experimental and control groups. For the self-efficacy subscale, the experimental group showed a significant increase compared to the control group

Table 1. General characteristics and homogeneity of participants (N = 56).

Characteristics		Frequency (%)		t/ χ^2	p
		EG (n = 26)	CG (n = 30)		
Sex	Male	1 (3.8)	1 (3.3)	0.011	0.918
	Female	25 (96.2)	29 (96.7)		
Age*		26.38 $\pm$ 1.791	26.03 $\pm$ 0.414	0.978	0.337
Religion	Christian	4 (15.4)	3 (10.0)	15.795	0.001
	Catholic	0 (0.0)	1 (3.3)		
	Buddhist	1 (3.8)	2 (6.7)		
	Non-religious	21 (80.8)	24 (80.0)		
Working Department	Ward	25 (96.2)	29 (96.7)	0.011	0.918
	Special	1 (3.8)	1 (3.3)		
Work Shifts	Shift	26 (100.0)	30 (100.0)	-	-
Nursing Delivery System	Team	25 (96.2)	29 (96.7)	2.393	0.122
	Function	1 (3.8)	1 (3.3)		
Nursing Care Integrated Ward	Yes	23 (88.5)	27 (90.0)	0.034	0.853
	No	3 (11.5)	3 (10.0)		
Preceptor Training	Yes	25 (96.2)	29 (96.7)	2.393	0.122
	No	1 (3.8)	1 (3.3)		
Preceptor Training Weeks*		7.88 $\pm$ 2.58	6.87 $\pm$ 1.87	1.738	0.088
Working Atmosphere Satisfaction	Yes	21 (80.8)	26 (86.7)	0.739	0.390
	No	5 (19.2)	4 (13.3)		
Internship Experience	Yes	14 (53.8)	24 (80.0)	6.249	0.012
	No	12 (46.2)	6 (20.0)		
Inter-regional Movement	Yes	15 (57.7)	14 (46.7)	0.062	0.803
	No	11 (42.3)	16 (53.3)		
Residence	Family	11 (42.3)	10 (33.3)	2.489	0.288
	Alone	13 (50.0)	19 (63.3)		
	Dormitory	2 (7.7)	1 (3.3)		

Note. * Mean $\pm$ SD; EG = experimental group; CG = control group; SD = standard deviation.

($F = 8.916$, $p = 0.004$), with a small effect size (Cohen's $d = 0.214$). Similarly, the hope subscale exhibited a statistically significant difference between the experimental and control groups ($F = 4.421$, $p = 0.040$), with a small effect size (Cohen's $d = 0.117$). Conversely, the optimism ($F = 0.258$, $p = 0.614$) and resilience ($F = 3.240$, $p = 0.078$) subscales did not show statistically significant between-group differences.

Table 2. Effects of the program (N = 56).

Variables	Groups	Mean $\pm$ SD			t (p)	Cohen's d	F (p)
		Pre-test	Post-test	Difference			
Job Stress	EG (n = 26)	60.23 $\pm$ 19.02	45.73 $\pm$ 20.95	-14.50 $\pm$ 12.66	5.842 ($<0.001^*$)	-1.419	25.573 ($<0.001^*$)
	CG (n = 30)	52.57 $\pm$ 28.07	52.67 $\pm$ 25.98	0.10 $\pm$ 7.68			
Turnover Intention	EG (n = 26)	8.62 $\pm$ 4.30	7.65 $\pm$ 3.97	-0.96 $\pm$ 2.51	1.957 (0.062)	0.068	0.051 (0.823)
	CG (n = 30)	9.93 $\pm$ 5.06	8.73 $\pm$ 4.86	-1.20 $\pm$ 4.19			
Life Satisfaction	EG (n = 26)	16.00 $\pm$ 2.43	16.85 $\pm$ 2.46	0.85 $\pm$ 1.32	-3.275 (0.003*)	0.453	3.040 (0.087)
	CG (n = 30)	15.90 $\pm$ 3.14	16.13 $\pm$ 3.18	0.23 $\pm$ 1.38			
Psychological Capital	EG (n = 26)	73.62 $\pm$ 10.31	77.08 $\pm$ 10.27	3.46 $\pm$ 4.98	-3.543 (0.002*)	0.944	10.281 (0.002*)
	CG (n = 30)	77.47 $\pm$ 12.02	75.57 $\pm$ 11.05	-1.90 $\pm$ 6.22			

Note. EG = experimental group; CG = control group; SD = standard deviation; * $p < 0.05$.

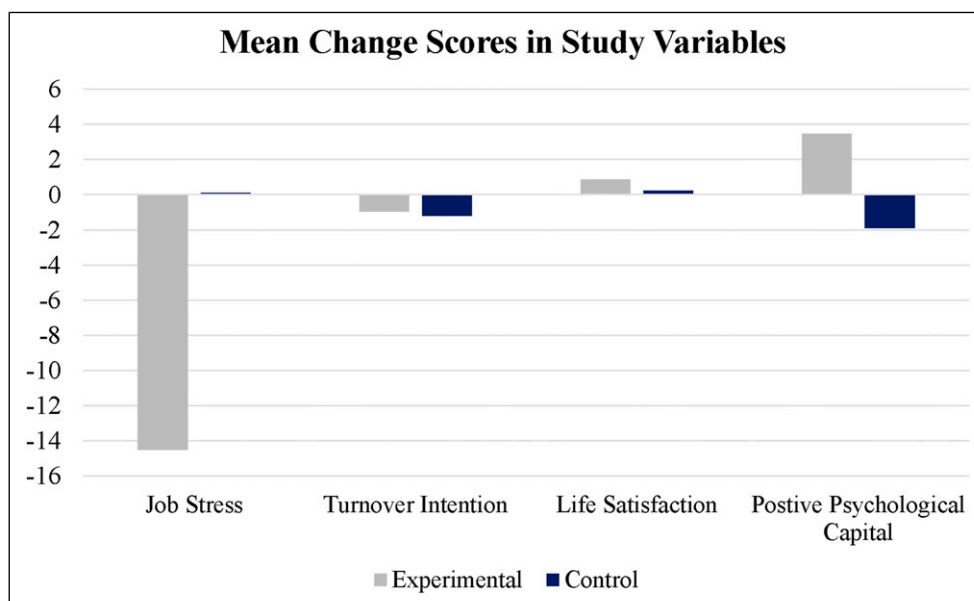


Figure 3. Mean differences in the study variables.

4. Discussion

This study examined the efficacy of the MindMate application on job stress, turnover intention, life satisfaction, and psychological capital among newly graduated nurses. Findings indicated that the application demonstrated efficacy in reducing job stress and enhancing certain aspects of psychological capital under the study conditions while its impact on turnover intention and life satisfaction was limited.

The experimental group demonstrated a significant reduction in job stress compared to the control group, with notable improvements in subscales such as work overload, role conflict, lack of expertise, interpersonal problems, and inadequate compensation. These findings are consistent with prior studies indicating that structured support interventions can reduce stress among early-career nurses.⁴⁴ These findings suggest that the intervention may have contributed to improvements in several domains of workplace strain within a relatively short intervention period under the study conditions. Considering the high demands faced by newly graduated nurses, structured support systems such as MindMate may provide supportive resources for managing workplace stress, although further research is required to confirm effectiveness in routine clinical

Table 3. Job stress subscale comparison (N = 56).

Subscales	Groups	Mean $\pm$ SD			t (p)	Cohen's d	F (p)
		Pre-test	Post-test	Difference			
Work Overload	EG (n = 26)	12.27 $\pm$ 5.01	9.88 $\pm$ 5.48	-2.39 $\pm$ 4.22	2.885 (0.008**)	0.519	13.650 (<0.001**)
	CG (n = 30)	11.77 $\pm$ 6.75	12.53 $\pm$ 6.64	0.77 $\pm$ 1.85	-2.269 (0.031*)		
Professional Role Conflict	EG (n = 26)	10.08 $\pm$ 4.06	8.12 $\pm$ 3.51	-1.96 $\pm$ 2.69	3.718 (0.001**)	0.424	6.248 (0.016*)
	CG (n = 30)	8.80 $\pm$ 4.59	8.60 $\pm$ 4.26	-0.20 $\pm$ 2.06	0.532 (0.599)		
Lack of Expertise and Skills	EG (n = 26)	8.04 $\pm$ 2.81	5.77 $\pm$ 2.99	-2.27 $\pm$ 2.29	5.053 (<0.001**)	0.728	18.828 (<0.001**)
	CG (n = 30)	7.00 $\pm$ 4.12	7.30 $\pm$ 3.86	0.30 $\pm$ 1.95	-0.843 (0.406)		
Interpersonal Problems	EG (n = 26)	15.69 $\pm$ 5.46	12.15 $\pm$ 5.52	-3.54 $\pm$ 3.57	5.055 (<0.001**)	0.497	15.212 (<0.001**)
	CG (n = 30)	13.70 $\pm$ 7.05	13.30 $\pm$ 6.85	-0.40 $\pm$ 1.96	1.119 (0.272)		
Inadequate Treatment and Compensation	EG (n = 26)	11.04 $\pm$ 2.91	7.58 $\pm$ 3.56	-3.46 $\pm$ 3.33	5.308 (<0.001**)	0.808	14.003 (<0.001**)
	CG (n = 30)	8.87 $\pm$ 4.78	8.63 $\pm$ 4.26	-0.23 $\pm$ 2.13	0.600 (0.553)		
Night Shift	EG (n = 26)	3.12 $\pm$ 1.07	2.23 $\pm$ 4.12	-0.89 $\pm$ 1.48	3.051 (0.005**)	0.563	2.194 (0.144)
	CG (n = 30)	2.43 $\pm$ 1.57	2.30 $\pm$ 1.26	-0.13 $\pm$ 1.01	0.724 (0.475)		

Note. EG = experimental group; CG = control group; SD = standard deviation; * $p < 0.05$; ** $p < 0.01$.

settings.^{45,46} As many new nurses are vulnerable within their first year of clinical practice,⁴⁷ a specifically targeted program may offer supportive resources during the early months of clinical work, although further evidence is required to confirm its broader applicability. Conversely, the subscale related to night shifts did not improve significantly, probably due to the complex nature of night work stress, shaped by physiological and environmental factors that are typically less responsive to short-term interventions.⁴⁸ Unlike interpersonal and work-related issues that can be directly addressed through education or cognitive support,^{49,50} this outcome suggests that shift-related stress may require systemic and organizational strategies such as staffing reforms or schedule adjustments,⁵¹ in addition to individualized fatigue management approaches.⁵² Future intervention designs may benefit from incorporating components that directly address these shift-specific stressors.

Regarding psychological capital, the experimental group showed a significant increase, with improvements in self-efficacy and hope, while optimism and resilience displayed positive but non-significant trends. Thus, while the intervention had a generally favorable influence, its impact was limited to certain domains. One possible explanation is that self-efficacy and hope, both of which are associated with task-related confidence and goal orientation, may be more responsive to short-term, skill-based educational interventions.⁵³ These components were emphasized in the program content and closely align with the developmental needs of novice nurses.^{54,55} Conversely, optimism and resilience may reflect their trait-like constructs, formed through life experiences and stable dispositions, making them less responsive to brief interventions.^{56,57}

These findings align with previous studies indicating that self-efficacy can be enhanced through structured education,⁵⁸ while traits such as resilience may require long-term developmental approaches.⁵⁹ Future interventions to cultivate more enduring traits may need to incorporate sustained exposure, experiential learning, or individualized coaching.

Although the reduction in turnover intention was not statistically significant, both groups showed a slight decrease. This finding contrasts with those of previous studies that reported significant reductions in turnover intention following interventions targeting stress reduction, emotional support, or mentoring for newly graduated nurses.^{60,61} While the magnitude of change was modest, the downward trend may reflect the influence of broader, long-term factors, such as organizational culture, perceived job security, or career trajectory, which are less responsive to short-term interventions.⁶² This outcome does not negate the potential value of the MindMate application but highlights the need for extended or longitudinal support to influence such complex behavioral outcomes.⁶³ Multi-session, long-duration programs are more likely to produce durable changes in turnover-related behaviors.⁴⁴ These findings suggest that while preliminary efficacy was observed for certain psychological outcomes, behavioral intentions such as turnover may require longer or more intensive interventions to demonstrate measurable change. In addition, external workplace factors such as staffing conditions, workload variability, or organizational support may also influence turnover intentions and could have affected the observed results.

Similarly, the increase in life satisfaction observed in the experimental group was not statistically significant. Nevertheless, it was included based on earlier evidence suggesting that mindfulness-based or psychosocial interventions can improve life satisfaction among healthcare professionals and young adults.^{64,65} The limited duration and intensity of the intervention may have been insufficient to influence this multifaceted construct. Life satisfaction is influenced by multiple personal, social, and organizational factors⁶⁶ and often requires more intensive or sustained engagement to produce significant changes.⁶⁷ Furthermore, newly graduated nurses often encounter steep learning curves, uncertainty, and emotional fluctuations during their transition to clinical practice, which may temporarily suppress improvements in subjective well-being.⁶⁸

The randomized controlled design represents an important methodological strength of this study. Random allocation of participants to the experimental and control groups helps reduce selection bias and supports internal validity by minimizing

Table 4. Psychological capital subscale comparison (N =56).

Subscales	Groups	Mean $\pm$ SD			t (p)	Cohen's d	F (p)
		Pre-test	Post-test	Difference			
Self-efficacy	EG (n = 26)	20.12 $\pm$ 2.16	21.58 $\pm$ 3.01	1.462 $\pm$ 2.32	-3.213 (0.004**)	0.214	8.916 (0.004**)
	CG (n = 30)	21.77 $\pm$ 3.38	21.00 $\pm$ 3.15	-0.767 $\pm$ 2.25	1.863 (0.073)		
Optimism	EG (n = 26)	20.58 $\pm$ 2.98	21.23 $\pm$ 2.79	0.654 $\pm$ 1.60	-2.086 (0.047*)	0.012	0.258 (0.614)
	CG (n = 30)	21.37 $\pm$ 3.36	21.63 $\pm$ 3.08	0.267 $\pm$ 1.80	-0.812 (0.423)		
Hope	EG (n = 26)	20.46 $\pm$ 3.67	21.65 $\pm$ 2.65	1.192 $\pm$ 2.35	-2.587 (0.016*)	0.117	4.421 (0.040*)
	CG (n = 30)	21.40 $\pm$ 3.72	21.03 $\pm$ 3.89	-0.367 $\pm$ 2.61	0.771 (0.447)		
Resilience	EG (n = 26)	12.46 $\pm$ 2.45	12.62 $\pm$ 2.47	0.154 $\pm$ 1.95	-0.402 (0.691)	0.421	3.240 (0.078)
	CG (n = 30)	12.93 $\pm$ 2.12	11.90 $\pm$ 2.31	-1.033 $\pm$ 2.46	2.304 (0.029*)		

Note. EG = experimental group; CG = control group; SD = standard deviation; * $p < 0.05$; ** $p < 0.01$.

systematic differences between groups at baseline. This design strengthens the interpretation that the observed differences in outcomes were likely associated with the intervention rather than pre-existing group differences.

Despite the meaningful findings, several limitations warrant consideration. First, the relatively short duration of the intervention may have constrained its impact on stable psychological traits or long-term behavioral outcomes. Second, the sample size calculation was based on a large effect size derived from a quasi-experimental intervention study, which may have overestimated the expected effect of a self-guided mobile intervention. This may have resulted in limited statistical power to detect smaller but potentially meaningful effects, particularly for outcomes such as turnover intention and life satisfaction. Third, although participants were recruited from multiple institutions, the relatively small sample size may limit the representativeness of the study population and restrict the generalizability of the findings. Fourth, the sample consisted predominantly of female participants, with only a small number of male nurses included. Although this reflects the gender distribution of the nursing workforce, the limited representation of male participants restricts the ability to explore potential gender differences in stress responses and intervention effects. Future studies with larger samples may benefit from targeted recruitment of male nurses and planned subgroup analyses by gender. Fifth, all variables were measured through self-reported questionnaires, possibly subject to response bias. Sixth, the lack of long-term follow-up prevents assessment of the program's durability. Seventh, this study was conducted under structured research conditions, including researcher support during the intervention period. While this design was appropriate for evaluating efficacy, it may limit the generalizability of the findings to routine clinical environments. Therefore, further pragmatic trials are needed to determine the program's effectiveness in real-world practice without intensive researcher involvement. Additionally, multiple subscale analyses were conducted in this study as exploratory analyses, which may increase the risk of Type I error; therefore, the findings should be interpreted with appropriate caution.

Another consideration concerns the sustainability of the intervention beyond the study period. In the present study, access to the MindMate application was provided exclusively for research purposes. Future development and implementation efforts should consider mechanisms for sustained use, such as institutional integration, user support systems, or ongoing content updates that maintain user engagement. Evaluating long-term adoption and continued engagement will be important for determining the practical viability of the intervention in real clinical environments.

Overall, the findings provide preliminary evidence suggesting that the MindMate application may have beneficial effects under controlled research conditions. While the observed effects were primarily limited to certain psychological domains, they suggest the potential value of short-term, skill-based digital interventions during early clinical transition. Future studies conducted in routine clinical settings are necessary to establish effectiveness and long-term sustainability. From a practical perspective, mobile-based interventions such as MindMate could potentially be incorporated into orientation or transition support programs for newly graduated nurses. Integrating such tools with existing mentorship systems or institutional well-being initiatives may enhance accessibility and engagement. Future research should also explore how the intervention can be optimized, for example by adapting content to shift schedules, incorporating personalized feedback, or extending the intervention duration to support longer-term psychological outcomes.

5. Conclusion

This study examined the efficacy of the MindMate application under controlled research conditions among newly graduated nurses in South Korea. The intervention was associated with significant reductions in job stress and improvements in overall psychological capital. No statistically significant changes were observed for turnover intention or life satisfaction during the study period.

The findings provide preliminary support for the potential value of mobile-based, self-guided digital interventions for newly graduated nurses. However, further large-scale studies conducted in routine clinical environments are necessary to establish effectiveness, long-term sustainability, and broader applicability.

Future research should examine the long-term effects of similar interventions using larger samples and explore additional components, such as shift-specific support strategies or personalized feedback. Evaluation under real-world conditions is required to determine whether broader implementation would be appropriate.

Acknowledgments

The authors used an artificial intelligence (AI)-based language tool to assist with English language editing and grammar refinement during the preparation of this manuscript. The AI tool was used solely for linguistic improvement. All study design, data collection, statistical analyses, interpretation of results, and final manuscript decisions were conducted entirely by the authors.

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Ethical considerations

This study adhered to the ethical principles of the Declaration of Helsinki. Participants were informed of the study's purpose, procedures, voluntariness, and confidentiality prior to participation, and written informed consent was obtained through an online form. The study protocol was reviewed and approved by the Chung-Ang University Institutional Review Board (IRB Approval No. 1041078-20240325-HR-055). This randomized controlled trial was registered with the Clinical Research Information Service (CRIS), Republic of Korea (Registration No. KCT0010803; <https://cris.nih.go.kr/cris/search/detailSearch.do?seq=30778>). The study also followed internationally recognized guidelines for responsible research conduct and publication ethics. All data were anonymized, securely stored, and accessible only to the research team.

Consent to participate

All participants provided written informed consent electronically via an online form prior to enrollment, in accordance with approval by the Chung-Ang University Institutional Review Board (IRB No. 1041078-20240325-HR-055). The consent process on-screen confirmations of study purpose, procedures, voluntariness, confidentiality, and data use. Participation was entirely voluntary, and participants could withdraw at any time without penalty or loss of entitled benefits. Only individuals who provided consent proceeded to take part in the study, and participants who completed study procedures received an IRB-approved honorarium.

Author contributions

Study design: YC, HS; Data collection: HS, CL, HN; Data analysis: CL, HN; Study supervision: YC; Manuscript writing: CL, HN; Critical revisions for important intellectual content: YC, HS, CL, HN

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIP) (No. RS-2023-NR076968).

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Data Availability Statement

The de-identified dataset contains sensitive information from human participants and is governed by the Chung-Ang University Institutional Review Board (IRB No. 1041078-20240325-HR-055). In accordance with the approved protocol and participant consent, the data are not publicly available. De-identified data may be shared upon reasonable request to the corresponding author for research purposes, subject to additional IRB review and a data use agreement.

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