



A Multiple Mediator Model of Depression, Dysfunctional Beliefs about Sleep, and Sleep Effort in the Relationship between Psychological Inflexibility and Insomnia in Shift Working Nurses

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Abstract

The aims of this study were to explore the influence of shift working nursing professionals' psychological inflexibility on their level of insomnia. Additionally, we investigated the mediation effect of depression and sleep-related cognitions on this association. An online survey was conducted among 202 nursing professionals at Asan Medical Center from July to August, 2023. Participants responded to questionnaires including the Insomnia Severity Index (ISI), Acceptance and Action Questionnaire-II (AAQ-II), Dysfunctional Beliefs and Attitudes about Sleep – 16 (DBAS-16), Glasgow Sleep Effort Scale (GSES), Patient Health Questionnaire-9 items (PHQ-9), and the Discrepancy between desired time in bed and desired total sleep time index (DBST index). Pearson's correlation and linear regression were performed to explore the factors predicting ISI scores. Mediation analysis was implemented. Linear regression revealed that insomnia severity was predicted by DBAS-16 ($\beta=0.15, p=0.008$), GSES ($\beta=0.48, p<0.001$), and PHQ-9 ($\beta=0.26, p<0.001$). Mediation analysis showed that the relationship between the psychological inflexibility of shift-working nursing professionals' and insomnia severity was fully mediated by depression, dysfunctional beliefs about sleep, and sleep effort. Psychological inflexibility does not directly influence insomnia severity, but depression, dysfunctional beliefs about sleep, and sleep effort fully mediate the relationship.

Keywords Insomnia · Sleep · Dysfunctional beliefs · Psychological inflexibility · Shift worker

Introduction

Shift work is essential to the nursing profession, which requires continuous care of patients for 24 h. Shift work can cause psychological problems in nurses, such as anxiety, stress, and depression, as well as physiological problems, including biochemical changes [1]. In addition, it is a risk factor for sleep disorders, metabolic disorders, diabetes, cardiovascular

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disorders [2], and breast cancer [3], and can also reduce the quality of work [4]. Depression and anxiety were found in 58.82% and 62.08% of shift-working nurses, and in particular, psychological stress and fatigue during night shifts were reported to worsen symptoms of depression and anxiety [5]. A meta-analysis also found a statistically significant relationship between night work and depression in nurses [6].

Shift-working nurses face challenges that can significantly impact their psychological well-being [5, 7]. Mindfulness-based interventions have been reported to effectively reduce nurses' psychological distress, stress, depression, and burnout and improve their psychological well-being [8]. Mindfulness is also an integral component of Acceptance and Commitment Therapy (ACT), which emphasizes the role of psychological inflexibility in the development of psychopathology.

ACT emphasizes psychological inflexibility as a key mechanism causing psychopathology [9, 10]. Psychological inflexibility manifests as rigid psychological responses that hinder the effective coordination of behavior in alignment with an individual's situational context and values. It mediates the relationship between dysfunctional cognition and negative behavioral and emotional outcomes [11]. It has been studied as a vulnerable factor, indicating it increases susceptibility to stress and negative emotional outcomes such as insomnia, depressive disorder, and post-traumatic stress disorder [12]. In a previous study, nurses experiencing mental fatigue exhibited heightened psychological inflexibility [13]. Notably, psychological inflexibility mediated the relationship between nurses' mental fatigue and negative emotions [13, 14]. Nurses with psychological inflexibility may encounter challenges in effectively managing stressors, meeting work demands, and navigating personal difficulties [15].

There is a notable emphasis on the role of cognitive processes in the development and maintenance of insomnia disorders. These processes involve how we interpret sleep, including dysfunctional beliefs [16] and secondary arousals related to sleep [17]. For instance, examples of these processes include excessive worry about the consequences of sleep deprivation, catastrophic thoughts about the effects of insomnia, and unrealistic expectations about the amount of sleep needed. Greater psychological inflexibility is correlated with higher sleep difficulty [18], highlighting the interconnectedness of cognitive processes and insomnia. However, those associations have not been observed well among shift workers.

In this study, we investigated whether psychological inflexibility in shift-working nurses psychological inflexibility influences their insomnia severity and if depression and sleep-related cognition mediate the relationship. We posited that (1) psychological inflexibility in shift-working nurses would be positively associated with insomnia severity; (2) depression would mediate the relationship between psychological flexibility and insomnia; and (3) sleep-related cognition would mediate the relationship between psychological inflexibility and insomnia.

Methods

Participants and Procedure

We conducted an anonymous online survey among nurses who worked rotating (e.g., day, evening, and night shifts) or fixed shifts of varying durations, such as 8-hour or 12-hour

shifts in the wards or intensive care units at Asan Medical Center from July 26 to August 17, 2023. Nurses who were interested in participating in the survey were able to access the enrollment link posted on the intranet advertisement. They were provided a reward of a 5-dollar gift coupon for participation. Via the survey form, we collected participants' demographic information (age, sex, total years of employment as a nursing professional, and marital status) and information about their place of work (wards), past psychiatric history, and current psychiatric distress. A total of 212 participants completed the survey, and we finally analyzed 202 responses after excluding 10 responses completed by doctors or other healthcare workers. The Institutional Review Board of Asan Medical Center approved the study protocol (2023–0858). Written informed consent paper was not given to participants, but they could voluntarily participate in the survey after checking “agree” to the agreement question with the information on this study.

Measures

Insomnia Severity Index (ISI)

The ISI is a self-reported rating scale developed to assess insomnia severity [19]. It consists of seven items that can be scored on a Likert scale (0–4), and a higher total score indicates a more severe degree of insomnia. In this study, the ISI was used to measure the severity of insomnia as the primary variable. We utilized the validated Korean version of the scale [20]. The Cronbach's alpha for this sample was 0.833.

Acceptance and Action Questionnaire-II (AAQ-II)

The AAQ-II is a revised version of the AAQ that can measure experiential avoidance and psychological inflexibility. The AAQ-II includes 10 items that can be scored on a Likert-type scale (1-never true to 7-always true). It can be applied as a 7-item or 10-item version. In this study, we applied the 10-item version of the AAQ-II. Three items need to be reversely scored (items 1, 6, and 10), and the total score of the AAQ-II was used to measure psychological inflexibility as the key variable. The validated Korean version of the AAQ-II [21] was applied, and Cronbach's alpha for this sample was 0.838.

Dysfunctional Beliefs and Attitudes about Sleep-16 (DBAS-16)

The DBAS-16 is a self-report rating scale developed to measure one's sleep-related dysfunctional beliefs [22]. It consists of 16 items that can be scored from 0 to 10, and the average score of all items indicates the degree of dysfunctional beliefs about sleep. For the purposes of this study, the DBAS-16 was used to assess dysfunctional beliefs about sleep, with higher mean scores indicating a greater degree of dysfunctional beliefs and attitudes about sleep. We utilized the validated Korean version of the scale [23], and Cronbach's alpha for this sample was 0.898.

Glasgow Sleep Effort Scale (GSES)

The GSES is a self-report rating scale developed to measure one's present state of sleep effort [24]. It contains seven items that can be scored on a 3-point Likert scale including not at all (0), to some extent (1), and very much (2). A higher total score indicates a greater effort to sleep. In this study, the GSES was utilized to assess the level of sleep effort. We used the validated Korean version of the scale [25]. The Cronbach's alpha for this sample was 0.826.

Patient Health Questionnaire (PHQ-9)

The PHQ-9 is a self-report rating scale developed to assess the severity of depression [26]. It consists of nine items that can be scored on a Likert scale (0-not at all to 3-nearly every day), and a higher total score indicates a more severe degree of depression. In this study, the PHQ-9 was used to evaluate the severity of depressive symptoms. We utilized the validated Korean version of the scale [27]. The Cronbach's alpha for this sample was 0.814.

Discrepancy between Desired Time in Bed and Desired Total Sleep Time (DBST Index)

The DBST index is derived by determining the discrepancy between a patient's desired Total Sleep Time (dTST) and their desired Time In Bed (dTIB) [28]. During clinical assessments, clinicians inquire about the patient's sleep preferences by asking two key questions: "For how many hours would you like to sleep each day? (dTST)" and "From what time to what time do you prefer to sleep? (dTIB)." The estimation of dTST involves averaging the patient's responses. For instance, if a patient states, "I want to sleep for 6 or 7 h," the dTST is computed as 6.5 h. The determination of dTIB is based on the indicated time duration for being in bed. For example, if a patient specifies, "I want to sleep from 10:00 PM to 6:00 AM," the dTIB is calculated as 8 h. The DBST index is then computed by subtracting the desired hours of TST from the desired hours of TIB. In this study, the DBST index was used to assess the discrepancy between the desired sleep duration and the desired time spent in bed.

Statistical Analysis

The demographic variables and rating scale scores are presented with descriptive statistics as mean \pm standard deviation. The level of significance was set at $p < 0.05$ for two-tailed tests. Continuous variables were analyzed using Student's t-test, while categorical variables were assessed using the Chi-square test. Correlation analyses employed Pearson's correlation analysis. To examine clinical variables predicting the ISI score, linear regression analysis was conducted, adjusting for rating scale scores correlated with the ISI. Furthermore, to investigate whether psychological inflexibility directly influences insomnia severity and psychological factors mediate this relationship, we employed the bootstrap method with 2,000 resamples for mediation analysis. In these analyses, we controlled demographic variables to account for their potential confounding effects. Statistical analysis was performed using SPSS version 21.0 and AMOS version 27 for Windows (IBM Corp., Armonk, NY, USA), as well as JASP (JASP teams, Amsterdam, Netherlands).

Results

A total of 202 shift-working nurses participated in this survey (Table 1). Their mean age was 31.6 ± 17.9 years, mean years of employment was 7.4 ± 6.1 years, 194 (96.0%) were female, and 143 (70.8%) were not married. In addition, 17.3% responded that they have a past psychiatric history, and 5.9% responded that they are currently experiencing psychiatric distress. All participants were shift workers.

Insomnia severity, as measured using the ISI was significantly correlated with psychological inflexibility (measured by the AAQ-II; $r=0.34$, $p<0.01$), dysfunctional beliefs about sleep (measured by the DBAS-16; $r=0.51$, $p<0.01$), sleep effort (measured by the GSES; $r=0.68$, $p<0.01$), and depressive symptoms (measured by the PHQ-9; $r=0.58$, $p<0.01$, Table 2). The discrepancy between desired sleep duration and desired time in bed (DBST index) was not significantly correlated with insomnia severity (ISI). The psychological inflexibility score (AAQ-II) was significantly correlated with dysfunctional beliefs about sleep (DBAS-16; $r=0.36$, $p<0.01$), sleep effort (GSES; $r=0.35$, $p<0.01$), and depressive symptoms (PHQ-9; $r=0.39$, $p<0.01$).

Linear regression analysis using the enter method was performed to explore variables that could predict the insomnia severity. Dysfunctional beliefs about sleep (DBAS-16; $\beta=0.139$, $p=0.017$), sleep effort (GSES; $\beta=0.440$, $p<0.001$), and depressive symptoms

Table 1 Clinical characteristics of the participants ($n=202$)

Variable	$n=202$ Mean \pm SD, n(%)
Female, n (%)	194 (96.0%)
Age (years)	31.6 \pm 17.9
Years of employment (years)	7.4 \pm 6.1
Marital status	
Single	143 (70.8%)
Married, without children	25 (12.4%)
Married, with children	34 (16.8%)
Engaged in shift work (yes)	202 (100.0%)
Working place	
Ward - internal medicine	108 (53.5%)
Ward - surgical	47 (23.3%)
Ward - pediatric	14 (6.9%)
ICU - internal medicine	21 (10.4%)
ICU - surgical	9 (4.5%)
ICU - pediatric	3 (1.5%)
Past psychiatric history (yes)	35 (17.3%)
Current psychiatric distress (yes)	12 (5.9%)
The rating scales	
Insomnia Severity Index (ISI)	8.7 \pm 4.9
Acceptance and Action Questionnaire-II (AAQ-II)	29.2 \pm 6.4
Dysfunctional Beliefs about Sleep scale-16 items (DBAS-16)	4.6 \pm 1.6
Glasgow Sleep Effort Scale (GSES)	4.9 \pm 3.3
Patient Health Questionnaire-9 (PHQ-9)	4.6 \pm 3.7
Discrepancy between desired time in bed and desired total sleep time (DBST index)	0.5 \pm 1.0

ICU: Intensive Care Unit

Table 2 Pearson correlation coefficients of the variables in all participants ($n=202$)

Variables	Years of employment	ISI	AAQ-II	DBAS-16	GSES	PHQ-9
ISI	0.08					
AAQ-II	0.06	0.34**				
DBAS-16	0.09	0.51**	0.36**			
GSES	-0.06	0.68**	0.25**	0.47**		
PHQ-9	0.12	0.58**	0.39**	0.41**	0.47**	
DBST index	-0.01	0.01	0.10	0.03	0.01	0.06

ISI: Insomnia Severity Index; AAQ-II: Acceptance and Action Questionnaire-II; DBAS-16: Dysfunctional Beliefs and Attitudes about Sleep-16 items; GSES: Glasgow Sleep Effort Scale; PHQ-9: Patient Health Questionnaire-9 items; DBST index: Discrepancy between desired time in bed and desired total sleep time

** $p < 0.01$; * $p < 0.05$

Table 3 Linear regression analysis of expected insomnia severity among shift-working nursing professionals

Dependent Variables	Included parameters	β	p -value	Adjusted R^2	F, p -value
ISI	Years of employment	0.04	0.494	0.58	F=28.2 $p < 0.001$
	Sex (Male vs. Female)	0.003	0.946		
	Marital status (Single vs. Married)	0.013	0.816		
	Past psychiatric history (Yes vs. No)	0.093	0.102		
	Current psychiatric distress (Yes vs. No)	0.085	0.118		
	AAQ-II	0.084	0.169		
	DBAS-16	0.139	0.017		
	GSES	0.440	<0.001		
	PHQ-9	0.145	0.029		
	DBST index	-0.018	0.704		

ISI: Insomnia Severity Index; AAQ-II: Acceptance and Action Questionnaire-II; DBAS-16: Dysfunctional Beliefs and Attitudes about Sleep-16 items; GSES: Glasgow Sleep Effort Scale; PHQ-9: Patient Health Questionnaire-9 items; DBST index: Discrepancy between desired time in bed and desired total sleep time

(PHQ-9; $\beta = 0.145$, $p = 0.029$, Table 3) were statistically significant. Demographic variables were included in the model but were not statistically significant. Mediation analysis was conducted to explore the relationship between shift-working nurses' psychological inflexibility and insomnia severity, and the mediating effect of depression and sleep-related cognitions. It showed that psychological inflexibility does not directly influence insomnia severity. However, the relationship was fully mediated by depression, dysfunctional beliefs about sleep, and sleep effort (Table 4; Fig. 1).

Discussion

In this study, we observed that psychological inflexibility in shift-working nurses was correlated with insomnia severity. However, the effect of psychological inflexibility on insomnia was not direct. Mediation analysis results indicated that depression, dysfunctional beliefs about sleep, and sleep effort fully mediated the relationship between psychological inflexibility and insomnia severity, rather than psychological inflexibility directly influencing insomnia severity.

Table 4 Results of the mediation analysis

Effect	Standardized Estimator	Z-Value	p	95% CI
Direct effect:				
Inflexibility → Insomnia	0.06	1.11	0.267	-0.2
Indirect effect:				
Inflexibility → Depression → Insomnia	0.11	4.18	<0.001	0.06–0.16
Inflexibility → Dysfunctional beliefs about sleep → Insomnia	0.06	2.82	0.005	0.02–0.10
Inflexibility → Sleep effort → Insomnia	0.12	3.16	0.002	0.05–0.19
Path coefficients				
Inflexibility → Depression	0.39	6.19	<0.001	0.27–0.51
Depression → Insomnia	0.27	4.72	<0.001	0.16–0.38
Inflexibility → Dysfunctional beliefs about sleep	0.36	5.86	<0.001	0.24–0.48
Dysfunctional beliefs about sleep → Insomnia	0.16	3.08	0.002	0.06–0.26
Inflexibility → Sleep effort	0.25	3.71	<0.001	0.12–0.39
Sleep effort → Insomnia	0.47	7.07	<0.001	0.34–0.59
Total effect:				
Inflexibility → insomnia	0.34	4.69	<0.001	0.20 to 0.48

CI: confidence interval

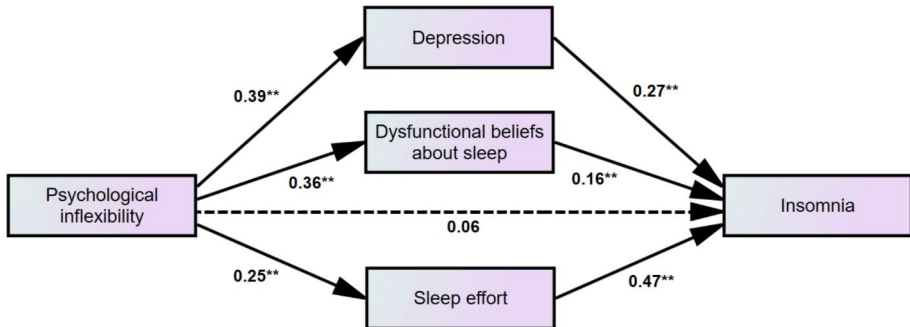


Fig. 1 Mediation model showing the effect of psychological inflexibility (independent variable) on insomnia (outcome), mediated by depression, dysfunctional beliefs about sleep, and sleep effort (mediators). Numbers next to the arrows represent standardized estimates. $p < 0.01$

In this study, psychological inflexibility was correlated with insomnia among nurses in accordance with previous studies [17, 29]. As expected, higher psychological inflexibility was significantly correlated with higher symptoms of depression and insomnia. Previous studies have shown this correlation to have a medium-to-large effect size. Additionally, in a structural equation modeling study, psychological inflexibility was linked with insomnia via depressive symptoms and was associated with higher levels of sleep disturbance, even after controlling for the influence of depressive symptoms. These findings may help motivate clinicians to use ACT for insomnia. A recent review study [30] has shown the high prevalence of insomnia in shift workers ranges from 12.8 to 76.4%. This highlights the significant need for effective interventions in this population. ACT has shown efficacy in treating insomnia

in the general population, suggesting that ACT can be used as an appropriate treatment method for insomnia in shift workers.

Sleep-related cognitions were also correlated with psychological inflexibility. According to existing studies [31, 32], using ACT to treat insomnia resulted in good treatment effects on dysfunctional beliefs related to sleep. Zakiei et al. [31] reported significant improvements in sleep-related cognitions, while El Rafihi-Ferreira et al. [32] observed positive changes in these cognitions, despite the lack of noticeable clinical effects. However, the association between psychological inflexibility and dysfunctional beliefs about sleep has not been well studied. We speculate that psychological inflexibility and the inability or difficulty in adapting one's behavior in response to situational demands can result in rigid thinking patterns or maladaptive behaviors that interfere with a person's ability to adjust to changes in their sleep patterns or address sleep-related issues. Furthermore, this association has not previously studied among shift workers.

Espie et al. proposed the attention-intention-effort pathway for psychophysiological insomnia [33]. This theory identified three essential processes: selective attention, explicit intention, and sleep effort. In this study, we observed that persistent sleep effort, a central factor in the maintenance of insomnia [33], was significantly correlated with psychological inflexibility. This finding suggests that sleep effort, as part of the attention-intention-effort pathway, may be influenced by psychological inflexibility. Sleep effort is a modifiable factor, so our findings suggest that targeting psychological inflexibility through ACT may be helpful in reducing maladaptive sleep effort and managing psychophysiological insomnia.

We also examined how psychological inflexibility and depression were related to insomnia in shift-working nurses. One main result of this study is the mediation model, which shows the key role of depressive symptoms as mediators of the negative impact of psychological inflexibility on insomnia among our sample. Psychological inflexibility has also been shown to capture resistance to emotional change [34]. A recent meta-analysis demonstrated that ACT has moderate efficacy in treating depression [35]. However, future research is needed on the efficacy of ACT for insomnia in alleviating symptoms of depression, or ACT for depression in improving insomnia.

In this study, the DBST index was not correlated with psychological inflexibility or insomnia severity among shift-working nurses. The DBST index reflects the discrepancy between an individual's desired time in bed and desired total sleep time, and we previously reported that the DBST index can be used as a brief tool for measuring insomnia severity among the general population [28]. The DBST index can be considered as a rigid and pre-occupied way of thinking, with individuals who have higher levels of insomnia responding with larger discrepancies between their desired time in bed and desired total sleep time. However, we did not observe any relationship between the DBST index and insomnia severity among shift working nurses. Furthermore, the DBST index was not associated with insomnia severity in this study, which was not consistent with a previous study [36]. The meaning or utility of the DBST index among shift workers needs to be explored further.

There are several limitations to this study. First, the results should be considered cautiously because they are based on self-reported measures via online surveys. Second, the participants were shift-working nurses in one hospital, so the results cannot easily be generalized to other hospitals or populations. Third, the mean age of participants was relatively low (31.6 ± 17.9 years), which might bias the results.

Despite the limitations of this study, our results may help in understanding variables that play a role in connecting psychological inflexibility and insomnia among shift-working nurses. We observed that the impact of psychological inflexibility on insomnia severity was fully mediated by depression, dysfunctional beliefs about sleep, and sleep effort. These findings highlight the importance of addressing psychological factors, particularly depression and maladaptive sleep-related beliefs, in interventions targeting insomnia among shift-working nurses.

Author Contributions Myung Hee Ahn: Conceived and designed the analysis, Performed the analysis, Wrote the paper. Sooyeon Suh: Conceived and designed the analysis, Contributed data or analysis tools, Wrote the paper. Seockhoon Chung: Conceived and designed the analysis, Collected the data, Contributed data or analysis tools, Performed the analysis, Wrote the paper.

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Data Availability Data will be available from the authors when requested.

Declarations

Ethics Approval This study was conducted in accordance with the Declaration of Helsinki, and the Institutional Review Board of Asan Medical Center approved the study protocol (2023–0858).

Consent to Participate Participants could voluntarily participate in the survey after checking “agree” to the agreement question with the information on this study, and obtaining written informed consent was waived by the IRB.

Conflict of Interest The authors have no conflicts of interest to disclose.

References

1. Torquati L, et al. Shift work and poor mental health: a meta-analysis of longitudinal studies. *Am J Public Health*. 2019;109(11):e13–20.
2. Vyas MV, et al. Shift work and vascular events: systematic review and meta-analysis. *BMJ*. 2012;345:e4800.
3. Jia Y, et al. Does night work increase the risk of breast cancer? A systematic review and meta-analysis of epidemiological studies. *Cancer Epidemiol*. 2013;37(3):197–206.
4. Gu F, et al. Total and cause-specific mortality of U.S. nurses working rotating night shifts. *Am J Prev Med*. 2015;48(3):241–52.
5. Li Y, et al. Effects of factors related to shift work on depression and anxiety in nurses. *Front Public Health*. 2022;10:926988.
6. Okechukwu CE et al. The relationship between working night shifts and depression among nurses: a systematic review and meta-analysis. *Healthcare (Basel)*. 2023;11(7).
7. Chigwedere OC et al. The impact of epidemics and pandemics on the mental health of healthcare workers: a systematic review. *Int J Environ Res Public Health*. 2021;18(13).
8. Suleiman-Martos N, et al. The effect of mindfulness training on burnout syndrome in nursing: a systematic review and meta-analysis. *J Adv Nurs*. 2020;76(5):1124–40.
9. Hayes SC. Acceptance and commitment therapy, relational frame theory, and the third wave of behavioral and cognitive therapies - republished article. *Behav Ther*. 2016;47(6):869–85.
10. Hayes SC, et al. Acceptance and commitment therapy: model, processes and outcomes. *Behav Res Ther*. 2006;44(1):1–25.
11. Kashdan TB, et al. Experiential avoidance as a generalized psychological vulnerability: comparisons with coping and emotion regulation strategies. *Behav Res Ther*. 2006;44(9):1301–20.

12. Curtiss J, Klemanski DH. Teasing apart low mindfulness: differentiating deficits in mindfulness and in psychological flexibility in predicting symptoms of generalized anxiety disorder and depression. *J Affect Disord.* 2014;166:41–7.
13. Wang D, et al. Mental fatigue and negative emotion among nurses during the COVID-19 pandemic. *Curr Psychol.* 2022;41(11):8123–31.
14. Prapanjaroensin A, Patrician PA, Vance DE. Conservation of resources theory in nurse burnout and patient safety. *J Adv Nurs.* 2017;73(11):2558–65.
15. Holmberg J et al. Psychological flexibility and its relationship to distress and work engagement among intensive care medical staff. *Front Psychol.* 2020;11:603986.
16. Lundh L-G. The role of acceptance and mindfulness in the treatment of insomnia. *J Cogn Psychother.* 2005;19(1).
17. Ong JC, Ulmer CS, Manber R. Improving sleep with mindfulness and acceptance: a metacognitive model of insomnia. *Behav Res Ther.* 2012;50(11):651–60.
18. Kato T. Impact of psychological inflexibility on depressive symptoms and sleep difficulty in a Japanese sample. *Springerplus.* 2016;5(1):712.
19. Morin CM, et al. The insomnia severity index: psychometric indicators to detect insomnia cases and evaluate treatment response. *Sleep.* 2011;34(5):601–8.
20. Chung S, Ahmed O, Cho E, Bang YR, Ahn J, Choi H, Um YH, Choi JW, Kim SJ, Jeon HJ. Psychometric properties of the insomnia severity index and its comparison with the shortened versions among the general population. *Psychiatr Investig.* 2024;21(1):9–17.
21. Heo JH, Choi MS, Jin HJ. Study on the reliability and validity of Korean translated acceptance-action questionnaire-II. *Korean J Couns Psychother.* 2009;21(4):861–78.
22. Morin CM, Vallieres A, Ivers H. Dysfunctional beliefs and attitudes about sleep (DBAS): validation of a brief version (DBAS-16). *Sleep.* 2007;30(11):1547–54.
23. Yu ES, et al. Validation of the Korean version of dysfunctional beliefs and attitudes about sleep(K-DBAS-16). *Korean J Clin Psychol.* 2009;28(1):309–20.
24. Broomfield NM, Espie CA. Towards a valid, reliable measure of sleep effort. *J Sleep Res.* 2005;14(4):401–7.
25. Kim MK, et al. Validation of Korean version of Glasgow Sleep Effort Scale(GSES). Validation Korean Version Glasg Sleep Effort Scale(GSES). 2014;14(2):319–37.
26. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med.* 2001;16(9):606–13.
27. Pfizer. Patient Health Questionnaire (PHQ) screeners. [cited 2014 January 1]; <https://www.phqscreeners.com/>
28. Chung S. The DBST index, the discrepancy between desired time in bed and desired total sleep time: the possible new sleep index predicting severity of insomnia. *Sleep Med Res.* 2022;13(2):85–93.
29. El Rafihi-Ferreira R, et al. Cognitive and psychological factors associated with severe insomnia in Brazilian women: a cross-sectional study. *Psicol Reflex Crit.* 2022;35(1):39.
30. Brito RS, et al. Prevalence of insomnia in shift workers: a systematic review. *Sleep Sci.* 2021;14(1):47–54.
31. Zakiei A et al. Acceptance and commitment therapy (ACT) improves sleep quality, experiential avoidance, and emotion regulation in individuals with insomnia-results from a randomized interventional study. *Life (Basel).* 2021;11(2).
32. El Rafihi-Ferreira R, et al. Acceptance and commitment therapy-based behavioral intervention for insomnia: a pilot randomized controlled trial. *Braz J Psychiatry.* 2021;43(5):504–9.
33. Espie CA, et al. The attention-intention-effort pathway in the development of psychophysiological insomnia: a theoretical review. *Sleep Med Rev.* 2006;10(4):215–45.
34. Gilbert KE, Tonge NA, Thompson RJ. Associations between depression, anxious arousal and manifestations of psychological inflexibility. *J Behav Ther Exp Psychiatry.* 2019;62:88–96.
35. Bai Z, et al. Acceptance and Commitment Therapy (ACT) to reduce depression: a systematic review and meta-analysis. *J Affect Disord.* 2020;260:728–37.
36. Bzeih W, et al. No association between insomnia severity, and discrepancy between desired time in bed and desired total sleep time among shift-working nursing professionals. *Sleep Med Res.* 2023;14(3):155–60.

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