Reliability and Validity of Dysfunctional Beliefs About Sleep-2 (DBS-2), an Ultra-brief Rating Scale for Assessing Dysfunctional Thoughts About Sleep

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Background and Objective It is important to consider dysfunctional beliefs about sleep when conducting cognitive-behavioral therapy for insomnia. The purpose of this study was to examine the reliability and validity of a Dysfunctional Beliefs about Sleep-2 items (DBS-2) scale in a general population and clinical sample.

Methods Our study examined the reliability and validity of the DBS-2 scale in the general population (group I, n = 374) and in a clinical sample of subjects with insomnia disorders (group II, n = 105). An online survey targeting the general population was conducted over the course of January 10−18, 2022, and a retrospective study of medical records was conducted among a clinical sample of insomnia patients who visited the Asan Medical Center Sleep Clinic for the first time between September of 2021 and May of 2022. The internal consistency reliability of the DBS-2 scale was measured using split-half coefficients, and factor analysis was used to determine its validity. Using the Insomnia Severity Index (ISI) and the Dysfunctional Beliefs and Attitudes about Sleep-16 items (DBAS-16), convergence validity was explored.

Results Split-half coefficients for the DBS-2 were 0.862 and 0.855 in the general population and a clinical sample of insomnia disorder. DBS-2 overall report score was significantly correlated with ISI (r = 0.26, p < 0.001) and DBAS-16 (r = 0.43, p < 0.001) in the general population, and correlated with ISI (r = 0.45, p < 0.001) and DBAS-16 (r = 0.50, p < 0.001) in the clinical sample. Both groups of subjects had an optimal cut-off score of 13 for the DBS-2 scale.

Conclusions We found that the DBS-2 scale, a two-item ultra-brief rating scale, could accurately measure dysfunctional beliefs about sleep in the general population and a clinical sample of insomnia patients. **Sleep Med Res 2022;13(3):165-170**

Keywords Insomnia; Sleep; Sleep-related cognition; Validity; Reliability.

INTRODUCTION

Insomnia is one of the most common psychiatric symptoms. According to statistics from South Korea, insomnia prevalence has increased in both females and males (from 3.10% in 2005 to 7.20% in 2013 in females and from 1.62% in 2005 to 4.32% in 2013 in males) [1]. As a first-line treatment for insomnia disorder, cognitive-behavioral therapy for insomnia (CBT-I) is recommended [2]. As one component of CBT-I, cognitive therapy is a treatment that can manipulate, control, or adjust sleep-related dysfunctional beliefs to help with sleep disruption [3]. Dysfunctional beliefs about sleep refer to maladaptive ideas and

concerns about sleep that can increase sleep-related arousal or worry for sleep. It is common for poor sleepers with dysfunctional beliefs about sleep to worry excessively about immediate and long-term effects of insomnia. For example, "If I don't get enough sleep, my immune system will be broken down, then I will get sick" or "As a result of my insomnia, my health will be endangered." These unhelpful expectations and excessive worries can cause emotional distress and trigger autonomic arousal, perpetuating a vicious cycle of insomnia. According to a study evaluating CBT-I effects, dysfunctional beliefs related to sleep endorsed by patients could be reduced through CBT-I [4]. In order to effectively treat chronic insomnia, it might be necessary to examine patients' beliefs about insomnia's consequences and sleep control.

To assess dysfunctional beliefs about sleep, a rating scale such as the Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS) [3] can be used. The Dysfunctional Beliefs and Attitudes about Sleep-16 items (DBAS-16) is the most widely used rating scale to identify various sleep-disrupting thoughts such as misconceptions about insomnia causes, misattributions of insomnia's consequences, and unrealistic sleep expectations [5]. Although DBAS-16 offers many advantages, determining its grading seems to be a burden when applying digital therapeutic application for insomnia treatment.

We have developed a two-item ultra-brief scale named Cancer-related Dysfunctional Beliefs about Sleep scale (C-DBS) [6]. It can measure cancer patients' dysfunctional beliefs about sleep. The C-DBS has been successfully applied in previous numerous studies [7-12]. It this study, we examined the validity and reliability of a Dysfunctional Beliefs about Sleep-2 items (DBS-2) scale, which was adapted from the C-DBS scale, using two sample groups (a general population and a clinical sample of subjects with insomnia disorder) to explore whether it could be applied as an ultra-brief rating scale for evaluating dysfunctional beliefs about sleep.

METHODS

Participants and Procedures

Study I - general population

An online survey was conducted targeting the general population in Korea. Over the course of January 10–18, 2022, an anonymous online survey was conducted by a professional survey company, EMBRAIN (www.embrain.com). A total of 14 million general population panelists are registered with the survey company. The company sent emails to 2000–3000 of them for enrollment. A total of 374 responses were collected from 949 participants who voluntarily participated in the survey. Participants who answered that they worked on shifts were excluded. Psychiatric history, current psychiatric distress, age,

sex, region of residence, and marital status of each participant were collected. The study protocol was approved by the Institutional Review Board (IRB) of the Asan Medical Center (2021-1755). The requirement of obtaining a written informed consent was waived by the IRB.

Study II - clinical sample of subjects with insomnia disorder

Medical records of patients who visited the Sleep Clinic of Asan Medical Center for the first time due to insomnia between September of 2021 and May of 2022 were retrospectively reviewed and analyzed. Psychiatrists (S.C. and E.C.) routinely evaluated patients' psychiatric history and diagnosed patients as having insomnia disorder based on the diagnostic criteria of the International Criteria for Sleep Disorders (3rd edition). Exclusion criteria were: 1) those were immobilized, 2) those who had major medical or neurological diseases, which might limit their cognitive function, 3) those with major psychosis or delirium, 4) those who could not respond to questionnaires, or 5) those who had a communication problem. The study protocol was approved by the Institutional Review Board (IRB) of the Asan Medical Center (2022-0746). The requirement of obtaining informed consent was waived by the IRB.

Measures

Dysfunctional Beliefs about Sleep-2 items

The DBS-2 is an ultra-brief self-report rating scale derived from the C-DBS scale developed to measure cancer patients' dysfunctional beliefs about sleep [6]. DBS-2 consists of two items: Q1-"My immune system will have serious problems if I don't go to sleep at a certain time." and Q2-"If I don't sleep well at night, my health state seems to be deteriorating." Each item can be scored on a scale ranging from o (strongly disagree) to 10 (strongly agree), with a higher total score reflecting a higher level of dysfunctional beliefs about sleep.

Insomnia Severity Index

The Insomnia Severity Index (ISI) is a self-report rating scale that can assess an individuals' insomnia severity [13]. It consists of seven items, with a higher total score meaning a more severe degree of insomnia. Its Cronbach's alpha was 0.799 for the general population and 0.883 for subjects with insomnia disorder.

Patient Health Questionnaire-9 items

The Patient Health Questionnaire-9 items (PHQ-9) is a self-report rating scale that can assess an individuals' depression [14]. Nine items of the PHQ-9 can be scored on a 4-point Likert scale (0: not at all–3: nearly every day), with a higher total PHQ-9 score indication a higher degree of depression. Cronbach' alpha was 0.890 for the general population and 0.883 for subjects with insomnia disorder.

Dysfunctional Beliefs and Attitudes about Sleep-16 items

The DBAS-16 is a shortened version of a 30-item self-report rating scale that can assess an individuals' dysfunctional beliefs about sleep [3]. Originally, 16 items of the DBAS-16 were rated using 100-mm visual analog scales. However, items were rated on a scale ranging from 0 (strongly disagree) to 10 (strongly agree) in this study. The final score was calculated by dividing the total score by 16. The cut-off score for the level of unhelpful beliefs associated with clinically significant insomnia was proposed as > 3.8 [15]. Cronbach's alpha was 0.899 for the general population and 0.893 for subjects with insomnia disorder.

Sleep indices

Sleep indices of time variables (bedtime, sleep onset time, and wake-up time), duration variables (sleep onset latency and time in bed), and the index of discrepancy between desired time in bed and desired total sleep time (DBST index) [16] were analyzed in this study. These sleep indices were calculated based on responses provided by participants to the following questions: "What is your usual bedtime?" "What is your usual time to fall asleep?" and "What is your usual time to finally get out of bed in the morning?" Time variables (bedtime, sleep onset time, and wake-up time) were estimated by averaging usual times reported. For example, if the participant usually went to bed between 22:00 and 23:00, we estimated the bedtime as 22:30. Time variables were used to estimate duration variables such as sleep onset latency and time in bed. Desired total sleep time (TST) was estimated based on their responses to a question of "For how many hours do you want to sleep a day?" The desired TIB was estimated based on responses to a question of "From what time to what time do you want to sleep?" The DBST index was calculated as [desired hours of TIB]-[desired hours of TST].

Statistical Analysis

Data of clinical characteristics or rating scales scores are summarized as means ± standard deviation. For factor analysis, normality assumption was examined using the skewness and kurtosis within the range of +/- 2. EFA showed a factor loading of 0.877 for each item. Data suitability and sampling adequacy were tested based on Kaiser-Meyer-Olkin (KMO) value and Bartlett's test of sphericity. Split-half coefficients were used to measure internal consistency reliability. A Pearson's correlation analysis was used to explore convergence validity. To explore the optimal cut-off score in accordance with DBAS-16 score > 3.8, receiver operating characteristic (ROC) analysis was conducted. Significance was considered if p-value was less than 0.05 in the two-tailed test. SPSS version 21.0, AMOS version 27 (IBM Corp., Armonk, NY, USA) and JAMOVI version 1.6.18.0 (The jamovi project, Sydney, Australia) were used for statistical analysis.

RESULTS

Study I-Validating the Dysfunctional Beliefs About Sleep-2 Items Scale Among the General Population

Table 1 shows demographic characteristics of participants (n = 374). Their mean age was 41.5 ± 10.8 years. Singles accounted for 46.5%. The skewness was -0.888 for Q1 and -1.052 for Q2. The kurtosis was 0.507 for Q1 and 1.566 for Q2. Split-half coefficients for the DBS-2 was 0.862. For factor analysis, data were suitable and sampling was adequate based on 0.500 of KMO value and significance of Bartlett's sphericity (p < 0.001). EFA

Table 1. Clinical characteristics of the study I subjects (n = 374)

Variable	Value
Male	189 (50.5)
Age (yr)	41.5 ± 10.8
Marital status	
Single	174 (46.5)
Married, with kids	158 (42.2)
Married, without kids	33 (8.8)
Others	9 (2.4)
Psychiatric history	
Did you have experience or treated depression, anxiety, or insomnia? (Yes)	50 (13.4)
Now, do you think you are depressed or anxious, or do you need help for your mood state? (Yes)	35 (9.4)
Symptoms rating	
DBS-2	13.9 ± 4.2
DBS-2 scale, Q1	6.7 ± 2.4
DBS-2 scale, Q2	7.2 ± 2.0
ISI	11.7 ± 5.1
PHQ-9	6.6 ± 5.3
DBAS-16	5.2 ± 1.4
Sleep indices	
Bedtime	12:18 ± 1:17 AM
Sleep onset time	12:37 ± 1:18 AM
Wake-up time	7:12 ± 1:16 AM
Sleep onset latency (min)	20.4 ± 34.2
Time in bed (hr)	6.9 ± 1.2
Desired total sleep time (hr)	7.0 ± 1.2 (3.0–12.0)
Desired time in bed (hr)	7.8 ± 1.1 (4.7–12.0)
DBST index	0.8 ± 1.3 (-3.0–7.0)

Values are presented as n (%), mean ± SD, or mean ± SD (range). DBS-2, Dysfunctional Beliefs about Sleep-2 items; ISI, Insomnia Severity Index; PHQ-9, Patient Health Questionnaire-9 items; DBAS-16, Dysfunctional Beliefs and Attitudes about Sleep-16 items; DBST, discrepancy between desired time in bed and desired total sleep time; SD, standard deviation.

Table 2. Pearson correlation coefficients of different variables in study I participants (n = 374)

Variables	Age	DBS-2	ISI	DBAS-16	PHQ-9
DBS-2	0.01	-	0.26**	0.43**	0.07
ISI	-0.01	0.26**	-	0.53**	0.48**
DBAS-16	-0.03	0.43**	0.53**	-	0.38**
PHQ-9	-0.15**	0.07	0.48**	0.38**	-
Desired TST	-0.05	0.06	-0.08	-0.62**	-0.03
Desired TIB	-0.12**	0.17**	0.15**	0.28**	0.15**
DBST index	-0.06	0.08	0.20**	0.16**	0.15**

*$p < 0.05$; **$p < 0.01$.
DBS-2, Dysfunctional Beliefs about Sleep-2 items; ISI, Insomnia Severity Index; DBAS-16, Dysfunctional Beliefs and Attitudes about Sleep-16 items; PHQ-9, Patient Health Questionnaire-9 items; TST, total sleep time; TIB, time in bed; DBST, discrepancy between desired time in bed and desired total sleep time.

showed a factor loading of 0.877 for each item.

Scores of Q1 and Q2 were highly correlated with each other ($r = 0.77$, $p < 0.01$). The DBS-2 total score was significantly correlated with high level of the ISI ($r = 0.26$, $p < 0.001$) and DBAS-16 ($r = 0.43$, $p < 0.001$), early desired bedtime ($r = -0.17$, $p < 0.05$), and longer desired TIB ($r = 0.17$, $p < 0.01$) (Table 2). ROC analysis showed that the optimal cut-off point of DBS-2 scale in accordance with 3.8 point of DBAS-16 was estimated as 13 (sensitivity = 72.7%, specificity = 52.7%, and accuracy = 69.8%, area under the ROC curve [AUC] = 0.70).

Study II-Validating the Dysfunctional Beliefs About Sleep-2 Items Scale Among Clinical Sample of Insomnia Disorder

Table 3 shows demographic characteristics of subjects with insomnia disorder (n = 105). Their mean age was 57.6 ± 14.2 years. Comorbid sleep or psychiatric disorders are shown in Table 3. The skewness was -0.597 for Q1 and -1.072 for Q2. The kurtosis was -0.708 for Q1 and 0.418 for Q2. Split-half coefficient for the DBS-2 was 0.855. For factor analysis, data were suitable and sampling was adequate based on 0.500 of KMO value and significance of Bartlett's sphericity ($p < 0.001$). EFA showed a factor loading of 0.867 for each item. Q1 and Q1 scores were highly correlated with each other ($r = 0.75$, $p < 0.01$). The DBS-2 scale total score was significantly correlated with ISI ($r = 0.45$, $p < 0.001$) and DBAS-16 ($r = 0.50$, $p < 0.001$) (Table 4). ROC analysis showed that the optimal cut-off point of DBS-2 scale in accordance with 3.8 point of DBAS-16 was 13 (sensitivity = 76.3%, specificity = 60.0%, accuracy = 72.4%, AUC = 0.73).

DISCUSSION

In this study, we found that the DBS-2 scale, a two-item ultra-brief rating scale, could accurately measure dysfunctional be-

Table 3. Clinical characteristics of the study II subjects with insomnia disorder (n = 105)

Variable	Value
Male	36 (34.3)
Age (yr)	57.6 ± 14.2
Co-morbid sleep complaints	
Initiation insomnia	89 (84.8)
Maintenance insomnia	72 (68.6)
Insomnia & snoring or sleep apnea	19 (18.1)
Insomnia & restless legs syndrome	15 (14.3)
Insomnia & parasomnia	9 (8.6)
Co-morbid psychiatric disease	
Insomnia disorder	65 (61.9)
Insomnia disorder & depression	18 (17.1)
Insomnia disorder & anxiety disorder	5 (4.8)
Insomnia disorder & adjustment disorder	4 (3.8)
Insomnia disorder & somatic symptom disorder	2 (1.9)
Symptoms rating	
DBS-2	13.4 ± 5.3
DBS-2 scale, Q1	6.2 ± 3.0
DBS-2 scale, Q2	7.2 ± 2.7
ISI	16.8 ± 6.8
DBAS-16	5.4 ± 1.9
PHQ-9	10.1 ± 7.0
Sleep indices	
Bedtime	10:48 ± 1:27 PM
Sleep onset time	11:59 ± 1:51 PM
Wake-up time	6:56 ± 1:26 AM
Sleep onset latency (min)	72.0 ± 74.4
Time in bed (hr)	8.1 ± 1.5
Desired total sleep time (hr)	6.8 ± 1.2 (3.0–10.0)
Desired time in bed (hr)	7.4 ± 1.1 (5.0–11.0)
DBST	0.6 ± 1.1 (-2.0–5.0)

Values are presented as n (%), mean ± SD, or mean ± SD (range). DBS-2, Dysfunctional Beliefs about Sleep-2 items; ISI, Insomnia Severity Index; DBAS-16, Dysfunctional Beliefs and Attitudes about Sleep-16 items; PHQ-9, Patient Health Questionnaire-9 items; DBST, discrepancy between desired time in bed and desired total sleep time; SD, standard deviation.

liefs about sleep in the general population and a clinical sample of insomnia patients. The DBS-2 scale also showed a good convergent validity with ISI and DBAS-16 scales in the general population and the clinical sample of insomnia patients. Its optimal cut-off score was 13 for both groups of subjects.

The DBS-2 scale was derived from the C-DBS scale which was developed to briefly measure cancer-related dysfunctional beliefs about sleep. The C-DBS scale has already been successfully

Table 4. Pearson correlation coefficients of different variables in study II subjects with insomnia disorder (n = 105)

Variables	Age	DBS-2	ISI	DBAS-16	PHQ-9
DBS-2	0.05	-	0.45**	0.50**	0.15
ISI	-0.09	0.45**	-	0.55**	0.49**
DBAS-16	0.08	0.50**	0.55**	-	0.43**
PHQ-9	-0.20*	0.15	0.49**	0.43**	-
SOL	-0.27**	0.09	0.19	0.06	0.14
TIB	-0.02	0.17	-0.10	0.03	-0.01
Desired TST	-0.20*	-0.05	-0.30**	-0.19	-0.02
Desired TIB	-0.15	0.004	-0.12	-0.04	0.06
DBST index	-0.08	0.06	0.22*	0.17	0.08

*p < 0.05; **p < 0.01.
DBS-2, Dysfunctional Beliefs about Sleep-2 items; ISI, Insomnia Severity Index; DBAS-16, Dysfunctional Beliefs and Attitudes about Sleep-16 items; PHQ-9, Patient Health Questionnaire-9 items; SOL, sleep onset latency; TIB, time in bed; TST, total sleep time; DBST, discrepancy between desired time in bed and desired total sleep time.

applied to numerous studies on sleep problems of cancer patients [10-12]. While applying digital CBT-I using digital therapeutic application to patients with insomnia, brief measure tools are needed to assess insomnia-related symptoms or psychological problems such as depression, anxiety, insomnia severity, and dysfunctional beliefs about sleep. Although DBAS-16 is popularly and widely used in clinical practice, repetitive measures using 16 items DBAS-16 scale is sometimes a burden to participants, which might decrease its compliance. This was the reason why we developed an ultra-brief version of the rating scale to assess dysfunctional beliefs about sleep.

The DBS-2 scale showed a good internal consistency reliability among two groups of subjects (general population and insomnia disorder patients). It also showed good fits for the model as a single factor scale in both groups. The DBS-2 showed a good convergent validity with ISI and DBAS-16 scales scores. We found that the optimal cut-off score of DBS-2 scale in accordance with the DBAS-16 > 3.8 was 13 in both the general population and subjects with insomnia disorders. Previously, the cut-off score of DBAS-16 was estimated to be 3.8 for the level of unhelpful beliefs associated with clinically significant insomnia [15], though the score was slightly lower to identify unhelpful sleep-related beliefs in highly screened primary insomnia and medical patient groups. We consider that 13 out of 20 points of DBS-2 total score is relatively high to define dysfunctional beliefs about sleep. The cut-off score of DBAS-16 was not popularly explored or used. There is no previous study on the cut-off score of the Korean version of DBAS-16. Further study is needed to explore the optimal cut-off score of DBS-2.

This study has several limitations. First, responses of the general population were collected via an anonymous on-line survey, which might lead to bias. In addition, subjects with insomnia disorders were enrolled in a tertiary-level general hospital,

which might limit the generalizability of study results. Second, comorbid sleep disorders or psychiatric disease were not fully explored among participants in study I. Although it is not easy to explore these via an online survey, lack of comorbidity information might mislead results. Third, the size of the clinical sample was small, which might influence study results in that this sample could not cover characteristics of all insomnia disorder patients.

Despite these limitations, this study reveals that DBS-2, an ultra-brief measure, can be used to assess an individuals' dysfunctional beliefs about sleep. It is a reliable and valid tool that can be applied to the general population and insomnia patients who visit sleep clinics. It might be useful for measuring peoples' unhelpful beliefs about sleep when applying a digital therapeutic modality for insomnia to patients with insomnia disorder.

Availability of Data and Material

The datasets generated or analyzed during the study are available from the corresponding author on reasonable request.

Author Contributions

Conceptualization: Seockhoon Chung and Kyumin Kim. Data curation: all authors. Formal analysis: Seockhoon Chung. Investigation: Seockhoon Chung. Methodology: Seockhoon Chung, Eulah Cho. Project administration: Seockhoon Chung. Resources: Seockhoon Chung. Software: Seockhoon Chung. Supervision: Seockhoon Chung. Validation: Seockhoon Chung. Writing—original draft: all authors. Writing—review & editing: all authors.

Conflicts of Interest

Seockhoon Chung, a contributing editor of the *The Korean Society of Sleep Medicine*, was not involved in the editorial evaluation or decision to publish this article. All remaining authors have declared no conflicts of interest.

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