

# Conceptualization and Psychometric Properties of the Sleep Behavior Self-regulation Dimensions: A Theory-Based Instrument

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## Research Article

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## Abstract

**Background:** Focus on sleep regulation is crucial due to the direct health consequences of insufficient sleep to adolescents' health and education performance. This study aims to develop and validate an instrument to measure sleep behavior self-regulation (SBSR) and its influential factors in a student sample.

**Methods:** A preliminary version of the measurement instrument was developed using a literature review and conceptual framework. Expert analysis of content validity, item analysis, factor analysis and reliability analysis was performed for the psychometric evaluation. This study has a total of 401 students. The data was analyzed using SPSS 22.0 and AMOS 22.0.

**Results:** The exploratory factor analyses offered a structure with six factors. The model presents a good fit ( $\chi^2/df = 1.65$ , RMSEA = 0.053, CFI = 0.920, and GFI = 0.826). General test reliability was good ( $\alpha = 0.9$ ).

**Conclusions:** SBSRI is a multidimensional instrument and a valid and reliable way of obtaining information about sleep behavior self-regulation. The use of this instrument will make it possible to adjust behavior to subjective goals and real experiences to promote sleep-related behavior change.

## Introduction

Healthy sleep is recognized as an important component of adolescent physical and mental health development, as well as academic performance (1,2). Studies from all across the world reveal that good sleep health indicators are unfavorable among adolescents (1,3–7). Millions of adolescents worldwide get insufficient sleep, especially on school nights (1). Nonetheless, adolescent sleep problems and their consequences are not yet fully elucidated (4).

It's been linked with a wide range of health, behavioral, and cognitive problems such as obesity, anxiety, risky behaviors, poor academic performance, excessive daytime sleepiness, negative mood enhancement, and inferior quality of life (3–5,8–13). It has become a public health concern, particularly for emerging young adults (8).

Due to these concerns about adolescents' sleep problems, the movement towards identifying effective factors and interventions to improve adolescents' sleep health has speeded (6,7). Adolescents benefit from the benefits of getting enough sleep during the day and at school if they develop good sleep habits and manage competing demands before going to bed (14).

Studies show adolescents nowadays face an interactive network of internal and external factors that limit the amount of sleep they regularly get (1,7,9,15,16). It is vital to get a better understanding of the contributing effective and preventative variables (17).

Health education programmers need to be developed in adolescents to alter behaviors that may compromise sleep and to promote behaviors that may facilitate sleep (7,8).

The role of self-regulation (SR) in performing behaviors that facilitate good sleep has been noted (10,18–22). This is significant from a health standpoint because it has been identified as a mechanism in behavior change and maintenance of health-promoting behaviors and individuals' capacity to set and maintain healthy goals (11,19–21,23,24). Despite various definitions, SR is an important capacity of a person to adapt to the variety of contextual circumstances that lead to the healthy development of life (21,25,26).

Adolescence, on the other hand, is a period of rapid change in self-regulation. In terms of enhanced autonomy and a mature stage that both encourage self-regulation, proactive and preventative interventions are required. It is vital to address self-regulation in order to create healthy behaviors and improve short- and long-term outcomes (27). Accordingly, the evaluation of self-regulatory capacities using diagnostic tools highlights individual differences (5,20).

Brown et al. (1999) The SRQ was the first attempt to measure the general aptitude of self-regulation. The instrument has been used mainly for studies concerning substance use and is applied to substance-abusing patients. It has also been used in a variety of fields, such as psychological well-being and dispositional happiness (28,29).

Also, the Behavior Rating Inventory of Executive Function (BRIEF) was one of the first attempts to measure executive function and the first published measure of these self-regulatory capabilities in children and adolescents (30). The BRIEF evaluates everyday behaviors associated with EF in home and educational environments (26,31). To our knowledge, there is currently no one that assesses sleeping behavior self-regulation and it has been measured by a general self-regulation questionnaire in sleep studies (10,24,26).

The Development of the instrument was based on a theoretical framework of self-regulation theory and Evidence-based practice in studies on students' sleep behavior. To assess how regulated to behaviors that may facilitate sleep and to operationalize this construct in the form of an instrument, Zimmerman's cyclical model selected that encompasses cognitive, behavioral, and motivational aspects and elucidates the link between motivation and self-regulation in greater depth (21).

We assume the process of sleep behavior self-regulation by oneself is done through a set of positive strategies that are directed towards the goal in three phases. In the forethought phase, in which goal setting and self-motivation beliefs are key conditions for self-regulation to occur. The two key variables in the beliefs section are outcome expectations and self-efficacy. Outcomes expectations are beliefs about the success of a given task and self-efficacy are beliefs about the personal capability to perform a task (21) (23). That are posited to influence behavior directly and through the development and use of self-regulatory behaviors (20) (24). We explore how and to what extent influenced self-efficacy and outcome expectations, on their sleep behavior. In the performance phase, students must use a variety of strategies to control competitive demands to maintain a regular sleep cycle. The phase of self-reflection is

in which students judge their work and state the reasons for their results (21). The present study focuses on the development process of the sleep behavior self-regulation instrument (SBSRI) and its psychometric properties in students aged 14–18 years. Proposed the following hypotheses based on the current literature, our experience in studying sleep behavior, and self-regulation theory:

H1: The theoretical assumption of the study is that instruments have acceptable indicators.

H2: As evidence for concurrent validity, SBSRI scores would correlate positively with the Adolescent Sleep Hygiene Scale.

## Participants And Methods

### Instrument Development Process

The instrument is developed in two stages: content validation and then construct validation. The content validity of a new instrument in terms of eliciting essential concepts and assessing students' understanding of the draft instrument was assessed in initial pilot research, after which empirical validation was done to ascertain its psychometric properties (15).

#### Phase 1: Item development and content validity

##### Step 1-item development

Preliminary instrument development began with a literature review to conceptualize the construct of sleep self-regulation in students. Search phrases such as 'sleep' AND 'self-regulation'; 'Health behavior' AND 'self-regulation'; 'adolescent' OR student AND 'sleep behavior' were entered into the search method utilized for the databases used (PubMed, ProQuest, Science Direct and Scopus) and using the "Google Scholar" search engine. Also, a comprehensive review of the literature on assessment scales in self-regulatory behaviors was conducted.

##### Step 2-Content validity

An expert panel of 12 members was elected to review the items for content validity. Experts were asked to share comments in terms of grammar, wording, scaling, and item allocation of the questionnaire. Also, to calculate the content validity ratio (CVR), the experts rated each item as essential, beneficial but not essential, and not essential. Each item was judged in terms of clarity, simplicity, and relevance in order to calculate the content validity index (CVI). The CVR was then calculated via the following equations for each item;  $CVR = (N_e - N/2) / (N/2)$ , where  $N_e$  is the number of specialists indicating an "essential" item and  $N$  is the total number of reviewers (32). Also, The (I-CVI) was determined based on the proportion of items that got a rating of 3 or 4 divided by the number of expert reviewers (33). In the quantitative phase of content validity, items with CVR and (I-CVI) under 0.56 and 0.79 were deleted, respectively (34–36).

##### Step 3- Face validity

Face validity was assessed using both qualitative and quantitative methods. During the qualitative phase, ten students (ages 14 to 18) took part in interviews that lasted about an hour. Interviews were used to detect problems with participants' understanding or interpreting the questions. Attention was also paid to grammar, ease of use, and layout, using "think aloud" and verbal probing techniques. Interviews aided in the identification of questions that were ambiguous or misleading. Students' Comments were reviewed between two of the authors, using a review of notes. Changes were made to the wording of items to improve their interpretability and comprehensibility. In the quantitative stage, the students rated each item's comprehensibility using a 4-point Likert scale. Values > 79% were regarded to verify each question's comprehensibility (36).

##### Step 4- Pilot study

To assess the reliability (internal consistency) of the initial SBSRI draft, the 69 respondents were randomly selected from a group of students aged 14 to 18, and the test-retest was performed at a three-week interval. The instrument was completed by 20 respondents after its re-administration. We decided to calculate the Spearman grade correlation coefficient in both the split-half (for 69 students = .93) and test-retest (for 20 students = .703) methods. The value of 0.41–0.7 was considered as moderate and 0.71–1.0 as a strong correlation (37).

Item development Based on knowledge obtained from the literature, the population to be evaluated, self-regulation phases, objectives and dimensions of the construct to be evaluated to be included, aspects relevant to the risk factors of healthy sleep, Qualitative data from published literature in the context of the study's conceptual framework and item wording was conducted by the research team. Initially, 136 sleeping behavior self-regulation items were created. The expert panel then critically examined the pool, removing items that were redundant and lowering the list to 52 items. The scale's response options were developed as 5-point Likert scales: Always (5), Most of the Time (4), Sometimes (3), Rarely (2), and Never (1) and ("1 = Not confident" to "5 = Highly confident"). The higher the scores on the corresponding questionnaire, the better individual sleep behavior self-regulation.

The content validity assessed through CVI and CVR showed a satisfactory result. CVR for all the items was  $0.6 \leq$ , indicating that all the items were essential for the study's purposes except for 1 item. I-CVI calculations showed that items with I-CVI  $0.79 \leq$  except for 5 items. Items with a CVI of  $0.79 \geq$  were eliminated from the item pool. In this process, 4 items were removed, yielding a total of 46 items. The S-CVI/Ave was 0.87, which is acceptable for the content validity index. Finally, 46 items were retained.

High school students ( $M = 16.5$ ,  $SD = .92$ ) were the study's target population. Subjects were recruited from eight high schools in ABDANAN, ILAM province. Participants were recruited from both government and private nonprofit high schools, as well from all geographical areas. Inclusion criteria were that the students were aged 15–18 years and willing to engage in the study to be considered. Through the SHAD application (online services), they received an online

questionnaire. The data was collected between February and March 2021. We received 450 filled questionnaires. Any instrument with more than 15% missing values was deleted from further analysis [38]. In turn, 401 valid samples were retained. The sample was randomly divided into two sub-samples: an exploratory sample A (n=200) and a confirmatory sample B (n=201). The majority of participants were men (62%). Their father had 66.5 per cent (n = 209) and their mother had 65.8% (n = 206) of secondary and higher education, respectively. The demographic characteristics of participants appear in Table1.

#### Phase 2: construct validity

All the 46 SBSRI items were scrutinized. More specifically, missing values were replaced with the items' mean. The goal of the analyses was to systematically reduce the items and determine whether the items would reflect underlying latent constructs (domains). Respectively, Item analysis, Exploratory and confirmatory factor analysis and reliability tests of the final domains were also assessed. To test the factorial structure, a combination of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) was conducted. Using the first half of the sample (n= 200), Before the exploratory analysis, the Kaiser-Meyer-Olkin (KMO) value was calculated to determine the adequacy of the sample size, and the Bartlett test for sphericity was used to check the item correlation matrix. The Principal component analysis (PCA) and Promax rotation were performed and the Eigenvalue of 1.00 was set as the threshold to determine the number of factors. The threshold factor loading of 0.40 was used to maintain or remove items that were used in EFA. The other half of the sample (N = 200) CFA was performed using maximum likelihood estimation (ML) with bootstrapping (200 resamples) to generate accurate estimations of standard errors with accompanying confidence intervals (bias-corrected at the 95% confidence level). using the following parameters as indices of good fit:  $\chi^2/df \leq 3$ [39], RMSEA  $\leq 0.08$ [40], comparative fit index (CFI)  $\geq 0.90$ [41], and goodness-of-fit index (GFI)  $\geq 0.90$ [42]. Lastly, Cronbach's alphas of the subscales and the total scale were calculated to determine the internal consistency of SBSR. All analyses were performed using SPSS version 23.0 and AMOS22.0.

## Results Phase 2

### Step 1- Item analysis:

The item analysis aimed to identify the item of SBSRI that had poor psychometric properties, which would be excluded from the further analysis. For each item, we determined the following criteria for poorly performing items: distribution characterized by substantial departure from normality Kurtosis (-7, +7), skewness (-2, +2), floor or ceiling effects to be present if > 15% of the participants scored the lowest or highest possible score on the scales, as well as an ITC of  $0.3 \geq$  formed the basis for the elimination of an item. There are no definite cutoffs for item variance; nevertheless, one suggestion is to choose items with higher variance. However, if an observed value deviated from these standards and the item was regarded as critical to the domain measured by the instrument, such an item was retained(38,39) Table2 shows the 38 items that were preserved.

### Step 2- Exploratory factor analysis

The KMO value was .925, and there was a statistically significance of Bartlett's sphericity ( $\chi^2 = 4549.882$ ,  $df=703$ ,  $p < 0.000$ ), indicating that the samples met the criteria for factor analysis. Communalities of the variables ranged between 0.52 and 0.75. Factor analysis yielded a 7-factor solution with an explained loading of 64.058% and eigenvalues  $>1$ . The Eigenvalues for the seven factors were 14.403, 3.086, 1.965, 1.478, 1.211, 1.154 and 1.045 respectively. According to the screen plot (Fig. 1), the slope of the curve became smooth at the seventh point, and factor 1 contributed 37.902% of the accumulated variance. The majority of items held their highest factor loading on the scale to which they theoretically belonged. Several items were also loaded on other factors, but never higher than .44, and the loading was 0.40 or above for all items in Table 3. We then sorted the items by factor loadings and removed an additional 2 items (15-22) from Factor 1, 2 items (21-19) from Factor 2 and 1 item (26) from Factor 5, given that their factor loadings were  $<.42$ . As a result, thus, 33 items were retained. We had ten items in Factor 1 (Cronbach's alpha = .93), six items in Factor 2 (Cronbach's alpha = .879), four items in Factor 3 (Cronbach's alpha = .76), five items in Factor 4 (Cronbach's alpha = .782), three items in Factor 5 (Cronbach's alpha = .765) and five items in Factor 6 (Cronbach's alpha = .74). The 7th factor has been removed, but its belonged question (se2) will be analyzed in factor 6.

More details of the factors are described below:

Factor 1-The first factor that explains the most variance in behavior is related to the goal-setting questions and motivational beliefs that are properly loaded into this factor, except for question 28, which was designed as a reward itself but loaded into this factor and we accepted it because we identified self-satisfaction as a motivational belief.

Factor 2-The second factor is related to the self-control part of the performance phase and includes questions about controlling the risk factors for delaying the sleep-wake program.

Factor 3-The third factor is related to some of the self-efficacy questions that deal with the ability to perform behaviors that make sleep time not be delayed.

Factor 4-The fourth factor of expectations is the positive result of having enough and regular sleep, which includes a positive effect on education, mood and relationships with others.

Factor 5-The fifth factor consists of three questions, each of which is a kind of self-reaction to the waking sleep program, and we considered it to be related to the self-reactive part.

Factor 6-The second part of the questions is self-efficacy and includes the ability to perform behaviors that are required to have a regular sleep schedule and are related to the individual, such as the ability to control negative emotions.

### Step 3-Confirmatory Factory Analysis (CFA):

Following the above EFA results, we constructed a model Using the two halves of the sample (n= 201) that included the 6 factors measured by the 33 items, these factors included 3 to 9 items, with the factor loadings ranging between 0.51 and 0.88, with the exception of two items in factor 1, which were deleted. The correlations among factors ranged from 0.31 to .78. Model fit results showed that Chi-square was significant ( $X^2 = 729.199$ ,  $df = 458$ ,  $p = 0.00$ ), and the values of CFI (.920), GFI (.826), RMSEA (.053), and PCFI (.71). were all within the proper range Overall, we deemed the model fit acceptable. Figure 2 displays the path model and the factor loadings within each latent factor. Note that the factor loadings of the items are majority greater than 0.50 and can be considered important for the associated items.

Step 4 - tests of reliability:

Step 5-Concurrent Validity

Concurrent validity was explored by correlating the SBSRI with the Adolescent Sleep Hygiene Scale-Revised (ASHS-r) self-reported was used to measure how often sleep hygiene behaviors or events occurred with each item rated on a 6-point scale (never, 0% to always, 100%). Scores are reversed, so higher scores indicate better sleep hygiene. This scale has reliability with Cronbach's alpha of internal consistency of 0.71 in the Iranian version (40).

The findings indicated a positive and significant correlation between the SBSRI and ASHS ( $r = .58$ ,  $p < .001$ ). demonstrates good concurrent validity (Table 4).

Finally, the predictive validity of the SBSRI was examined using correlational analysis and level of sleepiness. a negative linear relationship between increasing sleepiness scores and decreasing the sleep behavior self-regulation was found. The results of the correlations between the SBSRI and Cleveland Adolescent Sleepiness displayed in Table 7, showed that Predictive validity was also found to be Medium

## Discussion

The goal of this study was to document the construction of the Sleep Behavior Self-Regulation instrument (SBSRI) and analyze its psychometric features. The conceptual framework that guided the instrument's development derived from self-regulation theory's structural dimensions. Having an instrument derived from a theory improves consistency in efforts to better understand and strengthen health behavior through research, education, and practice(41). In a random sample, the psychometric properties of the tool (including structural, convergent, and concurrent validity) were tested and thoroughly reviewed. The findings back up the instrument's validity. The SBSRI has 31 items and six components. The loadings of the items under their extracted factors and the total variance explained by each factor are within the acceptable thresholds, indicating statistical significance and practical importance of the retained items. Overall, there was support for the convergent and divergent validity of the SBSRI. Evidence of convergent validity was found through the Significant correlations between the SBSRI total score and subscales with a measure of sleep health as measured by the ASHS-r ( $r$ 's between .15 and .43), with the Stronger links between the ASHS-r and the SBSRI total score (.403) and the factor 3 self-efficacy subscale (.434). Goals and motivational beliefs are personal variables that develop and maintain the motivation to perform the task. (21). The total of questions that assess these variables has the most explained sleep behavior self-regulation variance (37.9% variance explained), according to the exploratory and confirmatory factor analysis results. Researchers have looked into why people choose to engage or disengage in various activities, as well as how their beliefs and goals affect their achievement behaviors, and have emphasized the role of complex interaction them(42).

Investigating the effect of self-regulation on health interventions has shown that two mechanisms, self-efficacy and frequency of self-monitoring, are introduced as the factors effectively(19) Also, Self-efficacy has been addressed in studies on the mechanisms of self-regulation and behavior change [43]. The sleep self-efficacy scale has been developed to assess self-efficacy as a predictor of multiple insomnia symptoms(43). The sleep self-efficacy scale has been developed to assess self-efficacy as a predictor of multiple insomnia symptoms(44). But we utilized behavioral tasks or barriers to healthy sleep to demonstrate the impact of self-efficacy, although both tools are in the same item common. Nine questions were constructed to assess sleep self-efficacy that, contrary to our expectations, were loaded with two factors. Both self-efficacy dimensions had a significant relationship with sleep hygiene in our study. In previous studies, the 6 separate sleep hygiene domains were also strongly connected with sleep health efficacy in Wolfson's study (2015)(6).

Using the discriminant validity approach, we were able to extrapolate the sex differences in measured sleep behavior self-regulating in the recruited sample and found that females scored higher on the SBSRI compared with males. Many studies have already confirmed the existence of this difference in self-regulation. Study results had the aim of investigating whether adolescent males and females differ in self-perceived self-regulation. They found that females evaluated their attention higher than males, and they reported higher levels of self-control and self-monitoring during adolescence(45). Another study (46)found that females also showed a higher mean level of self-regulation over time, according to the findings of another study. But this difference is not always and in all behaviors in the interest of women. For example, women appear more likely than men to use a passive, self-focused response to negative moods (47). In general, self-regulation in men has more problems with self-management of time and self-motivation, while women demonstrate greater difficulties in the self-regulation of emotions(48). The sex differences in self-regulation in adolescence may therefore explain part of the difference males and females in this age group exhibit in health behaviors. This difference seems to be a theoretical challenge in designing health interventions and behavior change at different ages.

The instrument suffers from a ceiling effect, with maximum scores (ie, 5 on the 5-point Likert scale) provided by 20–62%. A slight floor effect was observed in the case responses for four of the questions related to the self-regulation dimension (items 18, 20, and 24). We were expecting that education and The factors affecting it to be of high importance to students. We expected students to value education and the factors that influence it highly, but The results may have been influenced by the completion of the questionnaire through the formal educational system, because students may want to present themselves in the best light possible.

## Limitations

The pandemic of COVID-19 has led to the closure of educational institutions around the world. The use of online methods during COVID-19 to complete the questionnaires created communication restrictions with students, and confinement has important implications for one's lifestyle including on sleep pattern and sleep regulation methods. It has been effective further research with students living in other geographical areas, cultural contexts and adolescents outside the school setting is needed to determine the generalizability of our findings.

## Conclusion

This paper has demonstrated that the SBSRI Scale is a valid and reliable instrument. Valid and reliable instruments are necessary to identify knowledge gaps, adjust the educational response and evaluate the effectiveness or outcomes of education programs. The instrument developed might help create a theory-based intervention to change self-regulation behaviors among pupils. It will take you about 15 minutes to complete.

## Declarations

### Ethical considerations

The study was started after being approved by Isfahan University of Medical Sciences and ILAM University of Medical Sciences and ILAM Education organization. The purpose of the study was explained to the participants in writing. The researcher's It was emphasized that confidentiality of data and the voluntary nature of participation were parental informed consent and students were considered as inclusion criteria.

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### Conflict of interest statement

There are no conflicts of interest declared by the authors. This study's findings are provided openly, honestly, and without fabrication, falsification, or data manipulation.

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## Tables

Table 1: demographic characteristics of respondents (N = 401)

Sample characteristic	n	%
<b>M (SD)</b>		
Age (M/SD)	399	
	<b>16.54± .920</b>	
Gender		
<b>Female</b>	153	38.2
<b>Male</b>	248	61.8
Grade		
<b>1</b>	148	37.3
<b>2</b>	140	35.3
<b>3</b>	109	27.5
School		
<b>Governmental</b>	292	73.0
<b>Private Nonprofit</b>	108	27.0

Table 2. Descriptive Statistics

	N	missing	Mean	Std. Deviation	Variance	Skewness	Kurtosis	Cronbach's $\alpha$	ITC	Floor effect (%)	Ceiling effect (%)	Excluded in Step
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
Os6	392	9	4.28	.928	.862	-1.285	1.269	0.95	0.41	1.5	53.8	
Os9	391	10	4.30	1.039	1.079	-1.566	1.808	0.95	0.49	3.3	59.8	
Os10	390	11	4.32	1.016	1.031	-1.454	1.235	0.95	0.49	1.8	61.8	
Os11	390	11	4.46	.850	.722	-1.752	2.852	0.95	0.47	1.0	64.9	*
Os12	390	11	4.38	.946	.894	-1.648	2.312	0.95	0.48	2.1	62.1	
Os13	389	12	4.08	1.171	1.371	-1.218	.570	0.95	0.25	5.7	51.4	*
Os14	388	13	3.65	1.306	1.706	-.638	-.717	0.95	0.17	9.5	36.1	*
Os15	389	12	4.06	1.189	1.413	-1.229	.585	0.95	0.50	6.4	50.9	
Os16	378	23	3.82	1.192	1.421	-.786	-.252	0.95	0.48	6.3	39.9	*
Os17	389	12	4.18	1.228	1.509	-1.416	.847	0.95	-0.01	6.9	61.4	*
Se1	391	10	3.82	1.261	1.590	-.810	-.464	0.95	0.48	6.9	41.4	
Se2	389	12	3.61	1.318	1.736	-.709	-.626	0.95	0.35	11.6	32.1	
Se3	390	11	3.79	1.133	1.284	-.705	-.190	0.95	0.45	5.1	35.1	
Se4	387	14	3.76	1.194	1.427	-.629	-.603	0.95	0.55	4.9	37.2	
Se5	391	10	3.88	1.075	1.155	-.787	-.032	0.95	0.52	3.3	35.8	
Se6	389	12	4.28	1.091	1.190	-1.527	1.464	0.95	0.38	3.9	61.7	
Se7	390	11	3.61	1.467	2.152	-.596	-1.074	0.95	0.48	14.4	43.3	
Se8	389	12	4.05	1.245	1.550	-1.078	-.076	0.95	0.49	5.4	55.3	
Se9	389	12	3.85	1.292	1.668	-.781	-.620	0.95	0.42	6.7	47.0	
Sr1	390	11	3.4512	1.40763	1.981	-.505	-.983	0.95	0.72	16.2	32.1	
Sr2	385	16	3.2755	1.33493	1.782	-.316	-1.008	0.95	0.63	15.1	23.4	
Sr4	386	15	3.6167	1.32217	1.748	-.652	-.678	0.95	0.64	11.4	35.0	
Sr5	380	21	3.5685	1.30117	1.693	-.548	-.802	0.95	0.74	10.0	33.2	
Sr6	385	16	3.8104	1.27785	1.633	-.844	-.390	0.95	0.68	8.3	42.1	
Sr7	386	15	3.2566	1.37077	1.879	-.240	-1.100	0.95	0.59	15.8	26.2	
Sr8	383	18	3.6030	1.39434	1.944	-.617	-.866	0.95	0.60	13.6	39.4	
Sr9	383	18	3.5196	1.26254	1.594	-.513	-.704	0.95	0.71	9.9	29.0	
Sr10	382	19	3.5866	1.23557	1.527	-.588	-.535	0.95	0.66	9.2	30.4	
Sr11	384	17	3.4455	1.27755	1.632	-.431	-.796	0.95	0.75	10.9	27.3	
Sr12	384	17	2.5653	1.36049	1.851	.469	-.918	0.95	0.11	30.2	14.6	*
Sr13	382	19	3.6413	1.24686	1.555	-.656	-.492	0.95	0.69	9.2	33.0	
Sr14	384	17	2.6094	1.41015	1.989	.372	-1.138	0.95	0.22	32.0	15.1	*
Sr15	383	18	3.7077	1.20960	1.463	-.669	-.443	0.95	0.68	7.0	34.7	
Sr16	382	19	3.3846	1.23737	1.531	-.365	-.709	0.95	0.66	10.7	24.1	
Sr17	383	18	3.7886	1.26082	1.590	-.825	-.326	0.95	0.72	8.6	40.5	
Sr18	382	19	2.9632	1.39775	1.954	.022	-1.212	0.95	0.64	22.3	20.2	
Sr19	384	17	3.3465	1.38829	1.927	-.338	-1.096	0.95	0.78	15.4	20.2	
Sr20	379	22	2.4431	1.44355	2.084	.545	-1.065	0.95	0.43	40.9	14.8	
Sr21	383	18	3.3236	1.33964	1.795	-.261	-1.035	0.95	0.70	13.3	27.9	
Sr22	381	20	3.5511	1.22704	1.506	-.519	-.611	0.95	0.70	8.7	29.1	
Sr23	383	18	3.5380	1.30882	1.713	-.557	-.753	0.95	0.67	11.5	31.6	

Sr24	383	18	3.0913	1.41050	1.990	-0.73	-1.217	0.95	0.59	19.8	24.3	
Sr25	384	17	3.7554	1.28159	1.642	-0.805	-0.382	0.95	0.74	9.6	39.6	
Sr26	382	19	3.3507	1.29903	1.687	-0.322	-0.959	0.95	0.66	11.8	25.4	
Sr27	382	19	2.4975	1.25648	1.579	.439	-0.775	0.95	-0.04	29.3	9.2	*
Sr28	383	18	3.7623	1.26627	1.603	-0.795	-0.356	0.95	0.72	9.1	39.7	
Valid N	401											

Table 3: Rotated component and structure matrix with PCA and promax rotation(n = 200)

Factor loadings							
Items	1	2	3	4	5	6	7
Sr4	.981						
Sr6	.882						
Sr13	.866						
Sr5	.738						
Sr1	.717						
Sr17	.699						
Sr25	.650						
Sr2	.614						
Sr16	.555						
Sr28	.478						
Sr7		.792					
Sr23		.790					
Sr8		.772					
Sr10		.732					
Sr11		.650					
Sr9		.624					
Se9			.783				
Se7			.756				
Se8			.745				
Se6			.599				
Os10				.841			
Os9				.833			
Os6				.708			
Os12				.670			
Os15				.527			
Sr20					.909		
Sr24					.701		
Sr18					.663		
Se1						.703	
Se3						.699	
Se5						.576	
Se4						.553	
Se2						.332	.682
Eigenvalues	14.403	3.086	1.965	1.478	1.211	1.154	1.045
variance	37.902	8.121	5.170	3.889	3.188	3.036	2.751
Total variance		64.057					
Extraction Method: Principal Component Analysis. Rotation Method: Promax with Kaiser Normalization.							
a. Rotation converged in 9 iterations.							

Table4. The factor–total correlations and intra-correlations, as well as the correlation between

No. of items	Cronbach's alpha	Mean ASHS-r	Mean Sleepiness	factor1	factor2	factor3	factor4	factor5	factor6
factor1	8	.90	.344**	-.307	1.000				
factor2	6	.87	.378**	-.373	.785**	1.000			
factor3	4	.76	.434**	-.314	.538**	.539**	1.000		
factor4	5	.86	.150**	-.288	.573**	.498**	.403**	1.000	
factor5	3	.75	.231**	-.215	.595**	.569**	.319**	.356**	1.000
factor6	5	.77	.347**	-.307	.563**	.570**	.609**	.462**	.403**
Total	31	.90	.403**	-.424	.919**	.876**	.685**	.671**	.673**
SBSRI and the ASHS-r. the Cronbach 's alpha coefficients for all scales ranged from 0.75 to 0.92, indicating satisfactory internal consistency.									
**Correlation is significant at the 0.01 level (2-tailed).									

## Appendix A1

The final version of the sleep behavior self-regulation instrument

Sr1- I decided in order that 8 hours of sleep a night, have a regular sleep-wake schedule (Based on the concept of goal setting)

Sr2- I made lifestyle changes to follow a regular sleep-wake schedule (Based on the concept of Strategic planning)

Sr4- I was interested in following a regular sleep-wake schedule (Based on the concept of Self-motivation beliefs)

Sr5- I had enough motivation to follow a regular sleep-wake schedule (Based on the concept of Self-motivation beliefs)

Sr6- I was confident that sticking to a regular sleep-wake schedule was the goal I could achieve (Based on the concept of Self-motivation beliefs)

Sr7- I resisted the temptations to not follow a regular sleep-wake schedule (such as spending time on social networks (Based on the concept of Self-control)

Sr8- To have a regular sleep-wake schedule, I have had principles regarding the diet (for example, I did not drink caffeinated beverages before going to bed) ((Based on the concept of the Task strategies of concept of Self-control)

Sr9- To have a regular sleep-wake schedule, I had principles about screen time (for example, watching TV) ((Based on the concept of the Task strategies of concept of Self-control)

Sr10- I controlled negative thoughts and feelings before going to sleep ((Based on the concept of the Task strategies of concept of Self-control)

Sr11- I identified the obstacles to having a regular sleep-wake program and thought of ways to solve them ((Based on the concept of the of self- instruction)

Sr16- If my regular sleep-wake schedule got in trouble, I changed my effort ((Based on the concept of the Task strategies of interest incentives)

Sr17- To adhere to a regular sleep-wake schedule, I thought about its positive effect on my mental and physical health and academic success (Based on the concept of self-consequences)

Sr18- To follow a regular sleep-wake schedule I encouraged myself or rewarded myself ((Based on the concept of self-consequences)

Sr20- I recorded my sleep and waking hours (Based on the concept of self-recording)

Sr23- I solved the problems of the environment (such as sound, light and heat) that prevented me from following the sleep schedule (Based on the concept of environmental structuring)

Sr24- If my sleep schedule was having trouble, I asked my family for help to solve it (Based on the concept of help-seeking)

Sr25- Having a regular waking sleep schedule was important to me ((Based on the concept of the concept of Self-motivation beliefs)

Sr28- The positive effect of a regular sleep schedule on my life has increased my satisfaction with myself (Based on the concept of self-consequences)

-Outcome expectation of sleep behavior self-regulation and enough

Sleep:

Oe6-Adequate sleep is the best way to restore my energy

Oe9- I think getting enough sleep increases my physical strength

Oe10-I think getting enough sleep makes me feel better mentally

Oe12-Adequate and regular sleep at night increases my alertness the next day

Oe15- Adequate and regular sleep at night improves my mood and improves me communicate with others

-self-efficacy of Sleep-related tasks:

Se1- sleep before school at 12 o'clock during school days

Se2-I not go to bed feeling upset, worried or angry

Se3- I will not let sleep deprivation last night affect my plans for the next day

Se4-I go to bed at a set time every night

Se5- I wake up at a certain time every day.

Se6-Do not drink a drink before bed.

Se7- Do not put your phone or tablet next to the bed.

Se8- Do not do activities that involve the mind before going to sleep (such as playing a computer game).

Se9-Do not use the bed for anything other than sleeping (such as doing homework)

## Figures

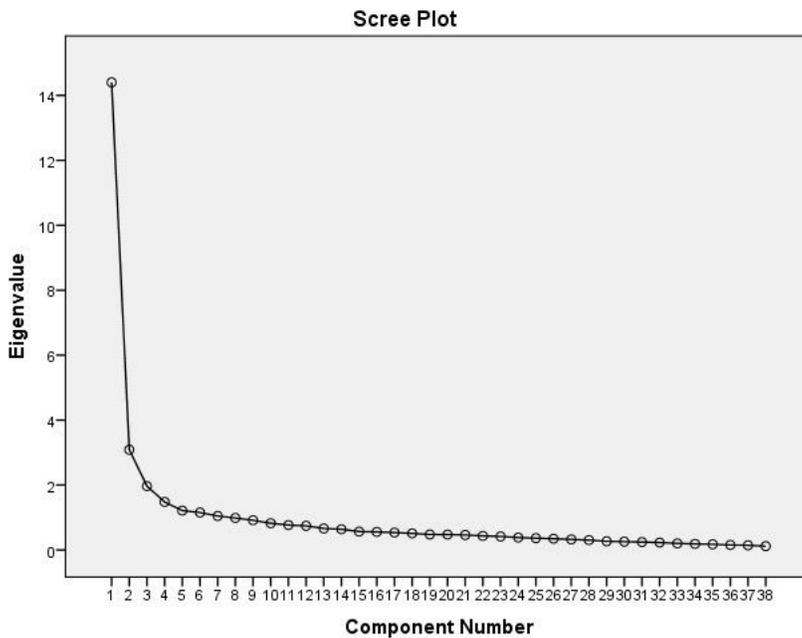


Figure 1

Scree Plot of EFA

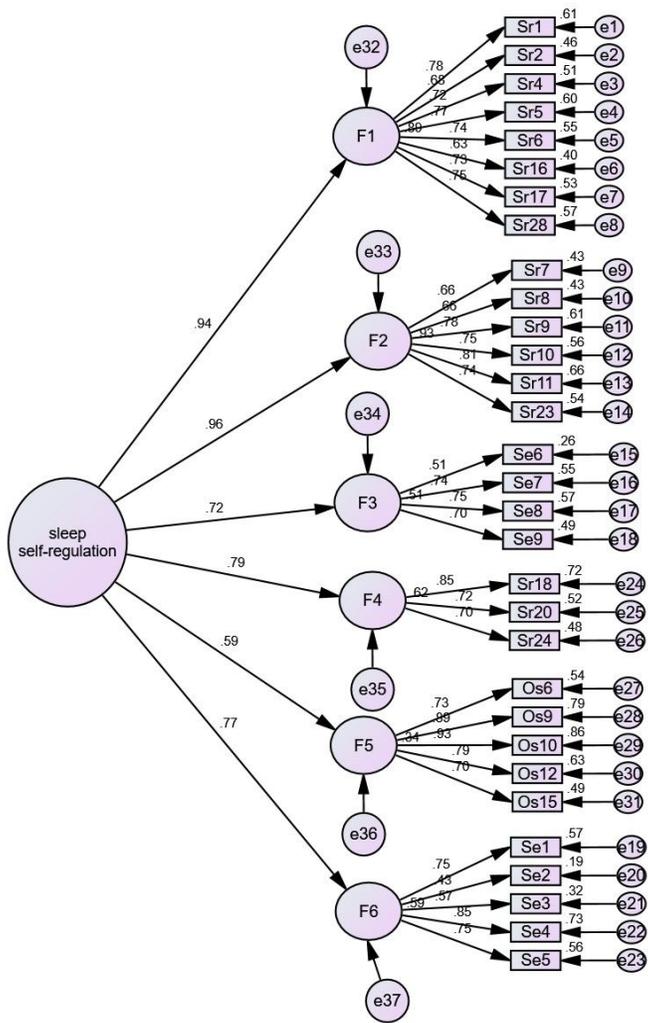


Figure 2

path model and loading of CFA The results obtained from confirmatory factor analysis: six-factor solution using of the sample B (n = 200).