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Predictors of sleep quality: Depression, anxiety, and sleep self-efficacy

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Abstract

The objective of the current study was to examine the relationship between depression, anxiety, sleep self-efficacy, and sleep quality among college students by using both objective measures and self-reported data. Participants included 27 undergraduate students from a small liberal arts college who wore ActiGraph wristbands for a period of seven nights. Participants also completed anxiety, depression, sleep self-efficacy, and subjective sleep quality scales. Results indicated that higher sleep self-efficacy scores were associated with lower anxiety and depression scores. Higher subjective sleep quality was associated with higher sleep self-efficacy scores and lower depression and anxiety scores. This study supports the need for emphasis on the importance of improving subjective sleep quality which in turn may influence mental health issues.

Predictors of Sleep Quality: Depression, Anxiety, and Sleep Self-Efficacy

Poor sleep quality and sleep disorders pose a significant problem in the United States. In 2014, the National Sleep Foundation reported that almost half of Americans are affected by poor sleep at least once a week, and the impact of sleep deprivation on cognition and daily functioning has been studied extensively across many populations (Pilcher & Huffcutt, 1996). Up to 60% of college students have reported sleeping poorly (Lund, Reider, Whiting, & Prichard, 2010), which has been shown to have a negative impact on students' academic endeavors (Chiang, Arendt, Zheng, & Hanisch, 2014). Academic pursuits are further hindered by mental health issues in college students. In 2003, roughly 50% of college students qualified for at least one disorder according to the DSM-IV (Blanco et al., 2008). The purpose of the current study was to examine relationships between college students' sleep quality, anxiety, depression, and sleep self-efficacy – that is, an individual's confidence that they can sleep well.

Self-efficacy plays a significant role in an individual's ability to successfully tackle a problem and has been shown to be relevant to sleep – a daily task that can present significant difficulty to a large population of people (Suh et al., 2012; Lund et al., 2010). Bandura's theory of self-efficacy (1977) suggests that an individual's expectations and perceptions of a task significantly influence the quality of a person's effort at a task, and therefore impacts their ability to perform that task. Bandura's (1977) study utilized behavioral tasks of varying difficulty to demonstrate the impact of self-efficacy, where tasks were ordered according to the amount of effort required to complete them. Higher self-efficacy was correlated with greater perseverance at tasks and therefore greater success at those tasks.

While Bandura (1977) studied general self-efficacy, Rutledge, Guardia, and Bluestein (2013) specifically depicted the relationship between sleep self-efficacy and overall sleep

quality. Rutledge et al. (2013) included participants with clinically significant insomnia. Results indicated that insomnia severity, dysfunctional beliefs, and depressive symptoms all negatively correlated with sleep self-efficacy. These outcomes support Bandura's theory (1977) and suggest that patients with a stronger belief in their treatment are more likely to see positive results. Furthermore, Rutledge et al. (2013) provided support for the link between low sleep self-efficacy and depression – depression sufferers were more likely to have lower self-efficacy, inhibiting improvement of sleep quality. Lund and colleagues (2010) demonstrated the prevalence of poor sleep in college students aged between 17 and 24 years. The study indicated that physical and psychological health problems were more common (i.e., 60% of the sample) in students with poorer sleep quality. Poor sleepers also reported more negative moods, including higher rates of fatigue, tension, confusion, anger, and depression. The study also indicated that poor sleep was best explained by perceived stress. This was consistent with findings by Buboltz and colleagues (2009), in which 60% of 742 undergraduate students at public universities reported occasional sleep problems, and over half reported morning tiredness.

Cognitive functioning is also known to be markedly different in poor sleepers (Harvey, 2000; Suh et al., 2012), which is particularly relevant for college students. Harvey (2000) hypothesized that pre-sleep worries and concerns would be more prevalent in insomniacs as opposed to their well-sleeping counterparts. Participants included 30 people, who met the diagnostic criteria for insomnia as stated in the DSM-III, as well as 30 controls. The primary sleep complaint of the experimental group were delays in sleep-onset; participants with other primary sleep concerns were excluded. Researchers found that compared to good sleepers, insomniacs had a higher propensity for worrying and cognitive interference – defined as how often participants' thoughts kept them awake on a typical night in the previous month.

Insomniacs experienced worrying thoughts for an extended period of time and found the thoughts to be more preoccupying when compared to the good sleepers. In the experimental group, 77% indicated cognitive interference as a primary factor in poorer sleep quality, supporting the notion that cognitive processes have some impact on sleep.

Suh and colleagues (2012) expanded on the relationship between cognition and sleep disturbance by exploring cognitive predictors of multiple symptoms of insomnia: difficulty with sleep initiation, maintenance, and early morning awakenings. The study consisted of a multiple symptom group and a single symptom group. Measures for potential predictors of insomnia symptoms included indices for insomnia severity, content of thoughts, dysfunctional attitudes toward sleep, sleep self-efficacy, depression, and morningness-eveningness preference. Sleep self-efficacy served as a significant predictor of multiple insomnia symptoms. Of the patients who scored lower sleep self-efficacy, 73.4% of the sample were also a part of the multiple insomnia symptom subgroup. These participants had longer sleep onset latency and showed worse depression symptoms.

Bluestein, Rutledge, and Healey (2010) demonstrated a correlation between insomnia severity and depression, as well as dysfunctional beliefs and sleep self-efficacy. The study consisted of adult participants with diagnosed insomnia. Health, depression, dysfunctional beliefs, and self-efficacy correlated significantly with insomnia severity – lower self-efficacy and higher depressive scores predicted insomnia severity the best. Nyer and colleagues (2013) additionally demonstrated the relationship between depressive symptomology, intense anxiety, and sleep disturbance. The study's sample consisted of 287 students who indicated significant depression symptoms as determined by a score of 13 or greater on the Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). Of this sample 220 participants

also indicated disturbed sleep. Results showed that the group with both depressive symptoms and sleep disturbance experienced a higher level of impairment (both physical and cognitive) as well as increased anxiety.

Although some studies regarding sleep, anxiety, and depressive symptomatology utilize measures such as the EEG to record sleep (e.g., Riemann, Berger, & Voderholzer, 2001) the bulk of research relies on self-reported sleep questionnaires. Self-report can be easily influenced by factors outside of the researchers' control, such as the honesty of participants, subjective understandings about a question, or the reliability of a participant's memory. Furthermore, mere expectations about an event or situation can alter a participant's self-report. For example, O'Donnell, Silva, Münch, Ronda, Wang, and Duffy (2009) compared the objective and subjective sleep measures of older adults. Responses from 24 older adult subjects (age ranged from 55-74 years old) were collected over the course of 32 days of inpatient participation void of time-telling devices and windows. Sleep was monitored using an EEG as well as post-sleep questionnaires that asked participants to self-report sleep quality. O'Donnell et al. (2009) found that the association between subjective and objective sleep measures were modest. Participants were recorded as rating their baseline sleep as "good", despite the fact that the objective measure indicated poor sleep quality. This is consistent with research by Buysse, Reynolds, Monk, Hoch, Yeager, and Kupfer (1991) who theorized that the perception of sleep by older adults may be altered by gradual sleep quality changes associated with aging. Similarly, self-report data collected from college students may be affected by general expectations about being in college – poor sleep may be considered commonplace and may, therefore, be misinterpreted as "good" sleep. The current study will seek to explore this potential problem by utilizing both objective and subjective sleep quality measures.

The aforementioned studies have demonstrated the effects of anxiety, depression, and sleep self-efficacy on overall sleep quality. However, most of these studies are similar in that they utilized questionnaires to measure these variables. The present study contributes to this field by utilizing a questionnaire, as well as a sleep monitor that objectively measures each participant's quality of sleep. The device used in this study–the ActiGraph wGT3X-BT–has been shown to be similar in accuracy to polysomnography (PSG; a well-established measure of sleep) for measuring the sleep quality of non-clinical patients (Quante et al., 2018). The benefit of utilizing both a questionnaire and an objective sleep measure is the potential to indicate which method is more closely related to sleep self-efficacy, anxiety, and depression.

In the current study we hypothesized that i) as anxiety and depressive symptomatology increase, both the subjective and objective measures of overall sleep quality would decrease; ii) as sleep self-efficacy decreased, both the subjective and objective measures of overall sleep quality would decrease; iii) that higher sleep self-efficacy and lower depression and anxiety symptoms would significantly predict better sleep quality.

Method

Participants

Participants included undergraduate students over the age of 18 from a liberal arts college. Students were invited to participate through emails sent to undergraduate students via both professors and the researchers. The study consisted of 27 participants (85% female, n = 23). The mean age was 19.74 years (*SD* = 1.65), and 70% were freshmen (n = 13). Caucasians accounted for 70% of the sample (n = 19). Demographic information collected also included gender, age, expected graduation year, and ethnicity (see Table 1). Participants were additionally asked to indicate napping habits, caffeine consumption, tobacco and alcohol use, as well as use

of over-the-counter sleep aids (see Table 1). Participants diagnosed with a sleeping disorder were excluded on the basis of separating out the clinical population.

Materials

Sleep quality. Sleep quality was recorded using both objective and subjective measures. The ActiGraph (ActiGraph, n. d.) is a medical grade wristband that provided an objective measure for total sleep time, sleep latency and efficiency, as well as wake after sleep onset. Self-reported sleep was recorded using the Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). The PSQI (Buysse et al., 1989) is a 9-question survey that measures 7 areas of sleep including sleep quality, latency, duration, efficiency, disturbances, daytime dysfunction, and use of sleep medication. Poorer sleep was indicated by a score of 5 or greater on the PSQI – the PSQI has a Cronbach's alpha of 0.83, indicating good reliability (Buysse et al., 1989).

Anxiety. The Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988) is a 21-question inventory with a Cronbach's alpha of .91 that indicates how severe a symptom of anxiety has been for a participant during the past month. Total scores can range from 0 to 63, with 21 and lower indicating very low anxiety, and scores exceeding 36 indicating potentially severe anxiety.

Depression. Self-reported depressive symptomology was measured with the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977), a 20-item questionnaire that asks participants how often during the past week they have experienced depressive symptoms. Total scores can range from 0 to 60 – more symptomology is indicated by a higher score. The CES-D has good reliability, with a Cronbach's alpha of .76.

Sleep Self-Efficacy. Self-efficacy for sleep was measured using the Sleep Self-Efficacy

Scale (SES; Lacks, 1987). The scale consists of 9 items that measure sleep self-efficacy by asking participants to indicate how confident they feel about accomplishing sleep-related behaviors. Higher scores indicate higher self-efficacy and can range from 9 to 45. The SES (Lacks, 1987) has a Cronbach's alpha of .89.

Procedure

The study took place over the course of seven days with two in-person sessions at the beginning and end of the week-long time period. During the first session, participants completed an informed consent form as well as a demographic questionnaire. Participants also received an ActiGraph wGT3X-BT wristband with instructions to wear the wristband for the next seven consecutive nights. The second session took place after the seven nights of wearing the ActiGraph. Participants returned the ActiGraph and completed four questionnaires: the CES-D (Radloff, 1977), BAI (Beck et al., 1988), SES (Lacks, 1987), and the PSQI (Buysse et al., 1989). The order of questionnaires was counterbalanced by reversing the order for half of the participants. Each session took approximately 10 minutes to complete.

Results

The descriptive report of the sample can be found in Table 1. Three outliers in objective sleep duration were excluded due to the extreme nature of the scores. Correlations were conducted to determine any association between anxiety, depression, sleep self-efficacy, and objective and subjective sleep scores. It was found that sleep self-efficacy scores were negatively correlated with both anxiety scores, $r(25) = -0.57$, $p = 0.002$ (see Figure 1), and depression scores, $r(25) = -0.40$, $p = 0.041$ (see Figure 2). Objective sleep scores obtained through the ActiGraph wGT3X-BT did not correlate with anxiety, depression, or sleep self-efficacy scores. Subjective sleep quality was negatively correlated with sleep self-efficacy scores, $r(22) = -0.70$,

$p < 0.001$ (see Figure 3). Subjective sleep scores were also positively correlated with depression scores, $r(22) = 0.52$, $p = 0.010$, and anxiety scores, $r(22) = 0.54$, $p = 0.006$. A multiple regression was conducted using depression, anxiety, and sleep self-efficacy scores as predictor variables to predict subjective sleep quality. Lower depression and anxiety scores, and higher sleep self-efficacy predicted better subjective sleep quality, $R = 0.75$, $Adj\ R^2 = 0.49$, $F(3,20) = 8.30$, $p = 0.001$; subjective sleep quality was best predicted by sleep self-efficacy (see Table 2). See Table 3 for descriptive statistics for all variables.

Discussion

The purpose of the current study was to focus on anxiety, depression, and sleep self-efficacy to better understand the relationships these variables have with sleep quality in college students. It was hypothesized that as anxiety and depression symptoms increased and sleep self-efficacy decreased, both the objective and subjective measures of overall sleep quality would also decrease. It was also hypothesized that sleep self-efficacy would be negatively correlated with depression and anxiety symptoms, and that sleep self-efficacy, anxiety and depression scores would significantly predict sleep quality. Results supported all hypotheses except the hypothesis that objective sleep measures would be associated with anxiety, depression, and sleep self-efficacy.

Sleep Self-Efficacy

The confidence in being able to accomplish something (i.e., self-efficacy) has been tied closely to perception. For instance, individuals who perceive that stress affects health have been shown to have an increased risk of premature death (Keller et al., 2012). Therefore, it can be argued that perception is a powerful determinant for our behavior, and thus perceived sleep quality (A.K.A: self-reported sleep) is at least as important as objective sleep quality.

In the current study, sleep self-efficacy scores were negatively correlated with both anxiety and depression scores, indicating that lower sleep self-efficacy was associated with more anxiety and depression symptoms. This is consistent with previous research (Suh et al., 2012; Rutledge et al., 2013; Nyer et al., 2013). These results suggest that individuals experiencing anxiety and depression symptoms may benefit from evaluating their perceptions about sleep. In the same way, individuals experiencing poor sleep may benefit from evaluating any anxiety and depression symptoms. Future research should be done to determine methods of improving sleep self-efficacy in tandem with anxiety and depression symptoms.

Sleep Quality

The hypothesis that worse sleep self-efficacy, anxiety, and depression symptoms would be related to worse objective and subjective sleep quality was partially supported. Subjective sleep quality was negatively correlated with sleep self-efficacy scores and positively correlated with depression and anxiety scores. This suggests that according to subjective sleep quality measures, worse sleep is related to lower sleep self-efficacy, and higher depression and anxiety symptoms. The hypothesis that depression, anxiety, and sleep self-efficacy would predict sleep quality was also supported for subjective sleep. Similar relationships were not found for objective sleep measures, which is consistent with previous research (Suh et al., 2012; Nyer et al., 2013; O'Donnell et al., 2009). In addition, Buysse et al. (1991) theorized that the perception of older adults may be altered by gradual sleep quality changes associated with aging that alter their expectations about what good sleep is. The results of the current study indicate that a similar phenomenon may be occurring in college students. Because college students may expect to get less sleep, they may be more willing to describe poor sleep as good sleep, so long as it is less poor than what they are used to.

These results also suggest that an individual's perception of sleep is more relevant to anxiety and depression symptoms, rather than how much sleep an individual is actually getting. Depression and anxiety were measured using self-reports, which indicate an individual's *perception* of anxiety and depression. If an individual does not *feel* as though they have gotten enough sleep, they may exhibit irritability, depression, and anxiety symptoms regardless of whether they actually received an adequate amount of sleep. These results reiterate the need to examine treatments for poor sleep, which should include methods of improving an individual's perception of sleep and not just the overall time a person is sleeping. Research conducted in the future should look at the possibility of other objective measures that may correlate more closely with subjective sleep quality (e.g., circadian rhythm indicators; Buysse et al., 1991; Campbell, Gillin, Kripke, Erikson, & Clopton, 1989).

Limitations and Strengths

The current study has a few limitations, including a relatively small sample size of twenty-seven participants. Typical self-report limitations (such as dishonesty, level of understanding, memory, and bias) are also applicable to the current study, which may have accounted for the disparity between objective and subjective results. Since participants were not restricted to a sleep lab while wearing the ActiGraph wGT3X-BT, it is not possible to ascertain the exact conditions nor number of days of wearing the wristband across participants (e.g., some may have forgotten to wear the wristband on some nights, allowed a friend to wear the wristband, etc.). Additionally, the study may have been improved with the use of electronic self-scoring versions of the questionnaires, which would have eliminated any potential errors from manual scoring and may have resulted in more complete responses from participants (Wood, Nosko, Desmarais, Ross, & Irvine, 2006). Conversely, the study added to the field of sleep

research by focusing on a sample of college students that was not restricted to a clinical population. Additionally, unlike previous studies, the current study utilized both objective (i.e., the ActiGraph) and self-report data to illustrate the differences in reporting styles; this was indicated by the fact that sleep self-efficacy, anxiety, and depressive symptoms were more closely related to subjective measures than the ActiGraph data. The benefit of utilizing both a questionnaire and an objective sleep measure in this study is that it shed light on subjective sleep being more closely related to sleep self-efficacy.

Conclusion

This study demonstrated the importance of an individual's perceptions of sleep. Although objective sleep data may be useful in other contexts, subjective data is more relevant when it comes to anxiety and depression symptoms – symptoms that comprise two common mental health problems in both teens and adults (World Health, 2017). The perception of a good night's sleep may be related to an individual's perception of depression and anxiety symptoms. It is one's perceived sleep quality that is more closely related to anxiety and depression, which are also dependent on one's perception of and reactivity to life events. The implication of the current study is that support and guidance may change the way we perceive our sleep quality (i.e., increase our self-esteem), and could potentially help alleviate other mental health symptoms. While the health centers of colleges and universities may provide a plethora of information regarding anxiety and depression, more emphasis should be placed on the importance of subjective sleep when considering these symptoms.

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Table 1. *Demographic Variables of the Sample*

Variable	Mean (SD)	N	Percentage
Gender			
Males		3	11%
Females		24	89%
Ethnicity			
Caucasians		19	70.4%
Hispanic		2	7.4%
Black or African American		2	7.4%
Asian or Pacific Islander		2	7.4%
Multiracial		2	7.4%
Age	19.7 (1.65)		
Nappers		21	78%
Nap Frequency	2.3 (2.04)		
Caffeine User		22	81.5%
Caffeine Consumption Frequency	2.81 (2.46)		
Number of Caffeinated Drinks	1.22 (0.82)		
Smoker		1	4%
Alcohol (never)		13	48%
Monthly or less		4	15%
2 to 4 times per month		7	26%
2 to 3 time per week		3	11%
Number of Alcoholic Drinks in a day	1.07 (1.23)		

Number of OTC Sleep Aid Use per week	1.05 (2.22)		
OTC Sleep Aid Non-use		20	74%
Number of hours each week doing homework	11.8 (8.86)		
Number of hours each week in class	14.07 (4.51)		
Number of hours each week doing extracurricular activities	4.27 (5.53)		
Number of hours each week working	6.48 (8.94)		

Table 2. *Regression slopes of predictor variables in predicting PSQI scores*

	Beta	p-value
Sleep Self-Efficacy	-0.55	0.01
Depression	0.27	0.18
Anxiety	0.06	0.77

Note: PSQI = Pittsburgh Sleep Quality Index

Table 3. *Descriptive statistics of independent and dependent variables*

	N	*Mean*	*Standard Deviation*
Pittsburgh Sleep Quality Index (PSQI)	24	7.38	3.87
Objective Average Sleep	24	7.28 hr	1.33 hr
Sleep Self-Efficacy	27	28.41	8.25
Depression Score	27	19.33	7.33
Anxiety Score	27	14.60	10.82

Note: Higher PSQI scores indicates worse sleep quality

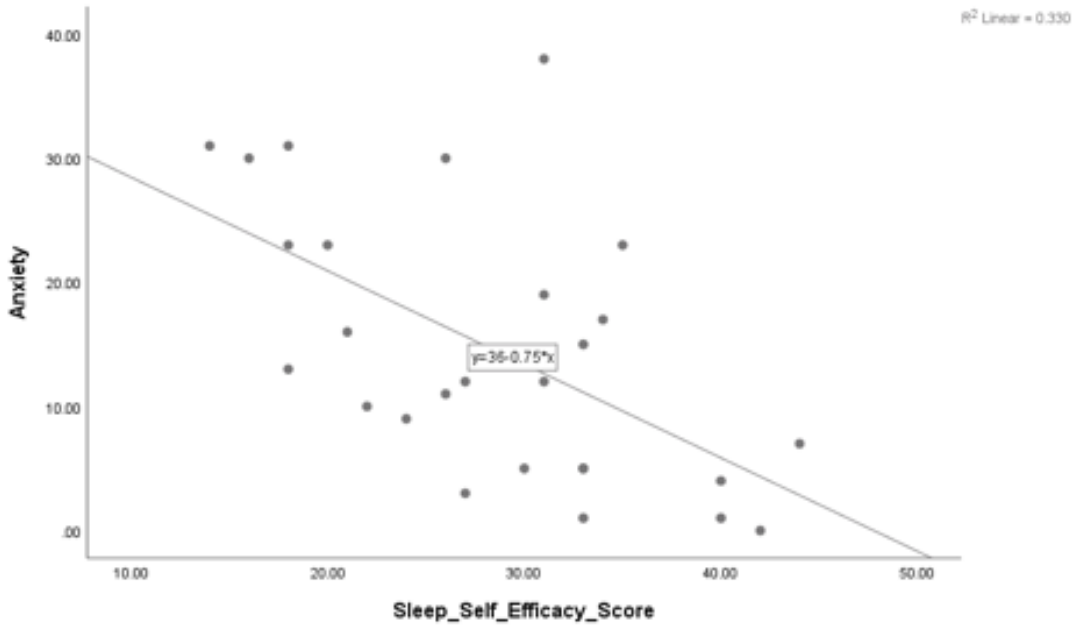

Figure 1. Association between sleep self-efficacy score and anxiety

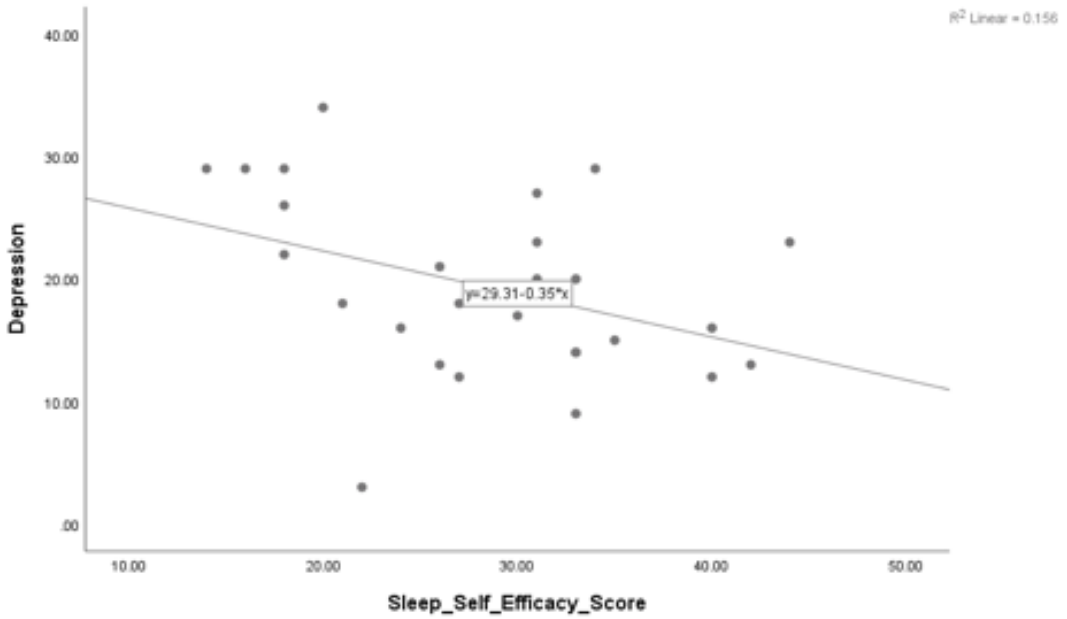

Figure 2. Association between sleep self-efficacy score and depression

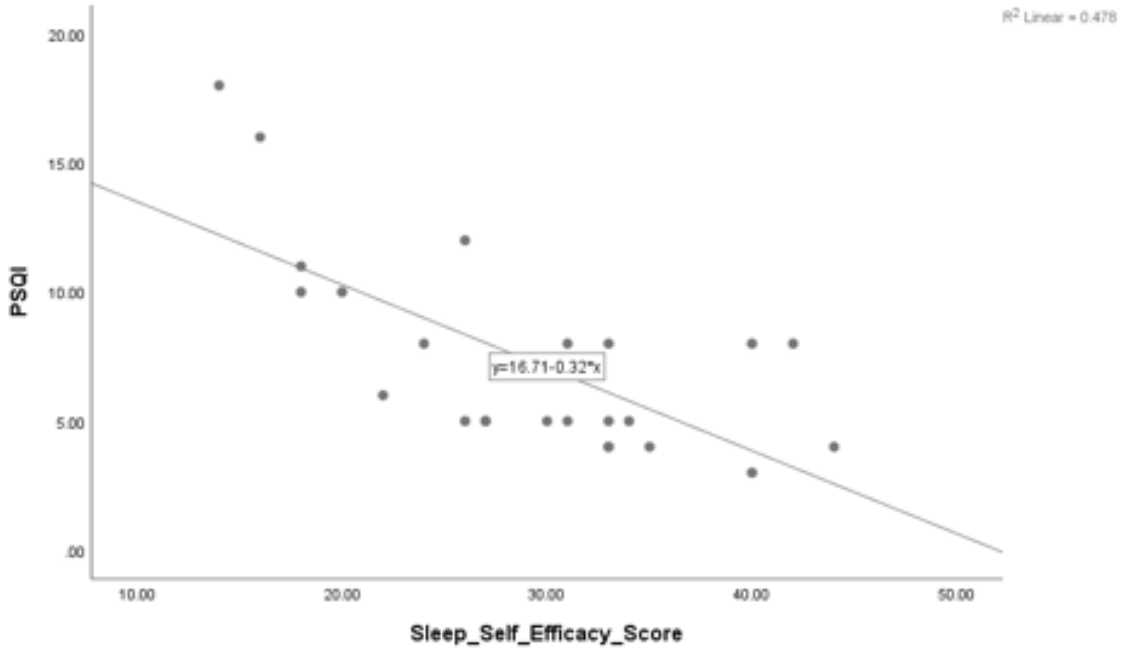

Figure 3. Association between sleep self-efficacy score and Pittsburgh Sleep Quality Index (PSQI; subjective sleep) score

Note: Higher PSQI scores indicates worse sleep quality