



## Are Daytime Sleepiness and Sleep Quality Associated with Physiological and Psychological Stress Responses?

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### ABSTRACT

*This study focuses on investigating the relationship between sleep quality, daytime sleepiness, and physiological and psychological stress responses of university students. In this study, a correlational-predictive research method was used and five different instruments; Personal Information Form, Questionnaire for Physiological Stress Response and Questionnaire for Psychological Stress Response, Epworth Sleepiness Scale, and Sleep Quality Scale were applied. The participants consisted of 295 university students (F=229, M=66, Mean Age=21). The data was analyzed by zero-order correlations and multiple regression analysis. The results revealed that both physiological and psychological stress responses are explained by a linear combination of sleep quality and daytime sleepiness. Moreover, sleep quality negatively predicted physiological stress response while it positively predicted psychological stress response. At the same time, daytime sleepiness positively predicted physiological stress response while it negatively predicted psychological stress response. These findings speculate about the nature of the relationships determined in the study.*

**Keywords:** Sleep quality, Day-time sleepiness, Psychological stress response, Physiological stress response, Stress, Regression

### INTRODUCTION

University students experience different stressful situations during their lives and sometimes the effects of these experiences might cause incurable health problems. Hence being aware of the degree of stress responses and predictors of the stress among the university students might provide a step to apply appropriate action for helping them. As closely related two variables with stress, daytime sleepiness and poor sleep quality are frequent among university students [1]. For the relationship between stress, daytime sleepiness, and poor sleep quality, we know that stress is an important reason for poor sleep quality and daytime sleepiness. Due to stress-dependent poor sleep quality and daytime sleepiness might be important reasons for accidents and long-term health deficiencies [2]. Daytime sleepiness and poor sleep quality are not just affected by stress and output of stress experiences, they also might be a reason for stress experienced in a cyclic process (stress-poor sleep quality+day-time sleepiness-stress) [3-5]. Also, the relationship of stress with poor sleep quality and daytime sleepiness should be examined by separating response types given during stressful situations because stress responses are represented in two different stages. According to Ursin and Eriksen, the psychological stress response is first observed and then physiological stress response is seen [6]. In the literature, the direction of the relationship and degree of the stress response among university students are not studied well enough. However, there is a need to make a detailed analysis about the relationship between stress responses (physiological and psychological stress responses, sleep quality, and daytime sleepiness. In this way, the nature of the relationship might be made clearer. The purpose of this study is to investigate the relationship between sleep quality, daytime sleepiness, and physiological and psychological stress responses of university students.

### Review of Literature

Lee, et al. investigated associations between sleep quality, stress, and depressive symptoms [7]. They studied with

103 female university students and they found that university students have high stress. Moreover, poor sleepers experienced more daytime sleepiness. Also, their findings showed that stress and poor sleep quality are important predictors of depressive symptoms as a kind of psychological stress response. By focusing on the other type of stress response (physiological stress response), Vincent, et al. investigated the association of physiological stress responses with sleep quality and daytime sleepiness [8]. The participants involved 31 individuals between the ages of 10-17. The findings revealed that sleep quality was not associated with stress response while daytime sleepiness was significantly associated with stress response in a negative direction. Kashani, Eliasson, and Vernalis also investigated the association of stress levels with daytime sleepiness and sleep quality [9]. Their sample involved 350 individuals at the mean age of 54. The findings revealed that individuals with high stress demonstrated greater daytime sleepiness and poor sleep quality.

Alotaibi, et al. examined the relationship of stress with sleep quality and daytime sleepiness [10]. Their sample consisted of 282 university students. Their findings revealed that the stress level of the participants is significantly associated with sleep quality. They stated that the more poor sleep quality the student's experience, the more they experience stress. However, they did not find any significant relationship between daytime sleepiness and stress levels. Similarly, Isac and Abraham investigated the relationship between daytime sleepiness and stress levels of nursing students [11]. Their findings showed that there is a high prevalence of daytime sleepiness among nursing students and there is a slight but positive association between daytime sleepiness and stress levels.

As seen from the literature summarized above, the reported relationships between sleep quality, daytime sleepiness, physiological and psychological stress responses of university students change in different studies in terms of direction and magnitude. Also, there is no strong understanding of the relationship due to limitations regarding the sample size of the studies and correlational findings. Moreover, the relationship is not examined from another side in line with the cyclic process (stress-poor sleep quality+day-time sleepiness-stress) nature of the variables. In other words, sleep quality and daytime sleepiness are not thought of as predictors of stress response in the literature. Therefore, the purpose of this study is to investigate the relationship between sleep quality, daytime sleepiness, and physiological and psychological stress responses of university students.

## MATERIALS AND METHODS

In line with the purpose of this study, the correlational-predictive research method was used in this study. Relationships between four different variables are examined and the nature of the relationships was investigated by regression analysis [12]. The variables in the study were sleep quality, daytime sleepiness, psychological stress response, and physiological stress response. For the research questions, daytime sleepiness and sleep quality were set as predictor variables while psychological stress response and physiological stress response were set as predicted variables.

### Participants

Two hundred and ninety-five university students from three different universities (six different departments) participated in the study. The number of participants females (n=229) was pretty higher than the number of male participants (n=66). By convenient sampling, the participants were determined and asked for their voluntary participation in the study in pandemic conditions. The mean age of the participants was 21. The majority of the participants (94%) reported that they would not have any illness and not have used any medicine. They also were not doing regular physical exercises (71%) and they were regularly fed (53%). Over 88% of the participants would not use cigarettes or alcohol. 20 of the participants were overweight. The researcher applied the instruments to the participants after their consent and ethical approval.

### Instruments

In this study, five different instruments were used. As the first instrument, the personal information form was a questionnaire asking about gender, age, university, department, grade, length, weight, health situation, smoking, and alcohol consumption. The second instrument was the "Sleep Quality Scale" which involved originally 7 items with three choices (2 for no problem in sleep, 1 for ignorable problem in sleep, 0 for existence of a problem in sleep). Meijer and van den Wittenboer developed the original scale, then Onder, et al., adapted it into Turkish population [13,14]. The more the scores on the scale are, the better the quality of sleep is. The third instrument involved the "Epworth Sleepiness Scale" which was an 8-item instrument with Likert type (0 for never doze, 1 for slight chance of dozing,

2 for moderate chance of dozing, and 3 for high chance of dozing). Johns developed the original scale, but Izci, et al. adapted it for the Turkish population [15,16]. The higher scores on the scale are, the more sleepiness during the daytime is experienced.

The fourth instrument is a 9-item questionnaire asking about the frequency of different physiological responses under the different stress conditions. The choices for the items are 1 for never, 2 for sometimes, 3 for frequently, and 4 for always. One example of a physiological response to stress condition is “my blood pressure increases when I am under stress”. The fifth instrument involved a 10-item questionnaire asking about the frequency of different psychological responses under the different stress conditions. The choices for the items are 1 for never, 2 for sometimes, 3 for frequently, and 4 for always. One example of a psychological response to stress conditions is “I feel anxious when I am under stress”. Despite the previous validity and reliability evidence regarding the instruments, the researcher investigated the validity and reliability of the scores on the instruments with the participants of this study. Table 1 represents the results of factor analysis and Cronbach Alpha values.

**Table 1 Results of explanatory factor analysis and Cronbach Alpha values on sleep quality scale, Epworth day-time sleepiness scale, physiological response to stress questionnaire, and psychological response to stress questionnaire**

Scales	Number of Items	Items per Factor	Factors' Name	KMO and Bartlett's Test Results	Range of Factor Loadings	Explained Variance by Factors	Cronbach Alpha
Sleep Quality Scale	4	4	Sleep Quality	KMO=0.70 X <sup>2</sup> /df=246.29/6 p<0.05	0.66-0.79	55%	0.72
Epworth Sleepiness Scale	5	2	Sleepiness While Being Physically Active	KMO=0.70 X <sup>2</sup> /df=247.07/10 p<0.05	0.73-0.80	66%	0.70
		3	Sleepiness While Being Physically Inactive		0.82-0.83		0.59
Physiological Response to Stress Questionnaire	9	3	Physiological Response to Stress in Digestive System	KMO=0.88 X <sup>2</sup> /df=957.83/36 p<0.05	0.76-0.83	60%	0.79
		6	Physiological Response to Stress in Other Systems		0.66-0.75		0.83
Psychological response to Stress Questionnaire	10	4	Psychological Response to Stress (Motivational Changes)	KMO=0.88 X <sup>2</sup> /df=1673.06/45 p<0.05	0.63-0.81	65%	0.77
		6	Psychological Response to Stress (Behavioral Changes)		0.67-0.83		0.90

Table 1 showed that both construct validity and reliability values are acceptable to use the instruments for research-based decisions. Especially explained variances are important indicators of measurement of focus variables in the study. The values for the explained variances are higher than 0.50 for all instruments.

### Data Analysis

In data analysis, two different analysis techniques (zero-order correlations (Pearson) and multiple regression analysis (Enter method) with random effects model) were applied to the data. For multiple regression analysis, Bonferroni adjustment was used to control Type-I error rate inflation. Since the researcher made the regression analysis in two separate analyses, the Bonferroni adjustment decreased the alpha level to 0.025.

## RESULTS

The researcher examined the association of daytime sleepiness and sleep quality with physiological and psychological stress responses. Before the regression analyses, descriptive values were represented and zero-order correlations between the variables were reported. Descriptive findings and zero-order correlations are shown in Table 2.

**Table 2 Results on descriptive values and zero-order correlations (n=295)**

Variables	Variables		Descriptive Values (means and standard deviations)
	Physiological stress response	Psychological stress response	
Sleep Quality	r= -0.21	r=0.29	1.12 (0.38)
	p=0.00*	p=0.00*	
Day-time Sleepiness	r=0.28	r= -0.18	0.66 (0.48)
	p=0.00*	p=0.00*	
Descriptive Values (means and standard deviations)	2.09(0.67)	2.40(0.68)	
*: means significant relationship at the level of 0.05			

In Table 2, it is seen that all of the zero-order correlations are statistically significant. When we looked at the relationship in detail, it is seen that sleep quality and daytime sleepiness are significantly related to the physiological and psychological stress responses in the opposite direction. As shown in the table, the more the sleep quality is, the less the physiological stress responses are experienced. Also, the less the sleep quality problem is, the less the psychological stress responses are experienced. Moreover, the more daytime sleepiness is experienced, the more physiological stress responses are also experienced. At the same time, the more daytime sleepiness is experienced, the less psychological stress responses are also experienced. After this analysis, multiple regression analyses were conducted and the results of the analyses are reported below.

#### Multiple Regression Equations

Physiological stress response= $B_0+B_1$  Sleep Quality+ $B_2$  Day-time Sleepiness

Psychological stress response= $B_0+B_1$  Sleep Quality+ $B_2$  Day-time Sleepiness

For the first equation, sleep quality and daytime sleepiness were significantly related to physiological stress response ( $R^2=0.11$ ,  $F(2; 292)=17.43$ ,  $p<0.025$ ). The regression equation involving weights ( $B_s$ ) can be seen in the following equation:

Physiological stress response= $2.21-0.31$  Sleep Quality+ $0.35$  Day-time Sleepiness

The multiple correlation coefficient ( $R=0.33$ ) indicates that 10.89% of the variation in physiological stress response could be calculated by a linear combination of sleep quality and daytime sleepiness. A follow-up analysis of the partial correlations indicated that the first significant predictor is daytime sleepiness and it accounted for 7% of the variance in physiological stress response. The second significant predictor is sleep quality and it accounted for 3% of the variance in physiological stress response.

For the second equation, sleep quality and daytime sleepiness were significantly related to psychological stress response ( $R^2=0.11$ ,  $F(2; 292)=17.97$ ,  $p<0.025$ ). The regression equation involving weights ( $B_s$ ) can be seen in the following equation:

Psychological stress response= $1.98+0.50$  Sleep Quality- $0.20$  Day-time Sleepiness

The multiple correlation coefficient ( $R=0.33$ ) indicates that 10.8% of the variation in psychological stress response could be calculated by a linear combination of sleep quality and daytime sleepiness. A follow-up analysis of the partial correlations indicated that the first significant predictor is sleep quality and it accounted for 7% of the variance in psychological stress response. The second significant predictor is daytime sleepiness and it accounted for 3% of the variance in psychological stress response.

#### DISCUSSION

The findings of this study revealed that both sleep quality and daytime sleepiness significantly predicted psychological and physiological stress responses. For the physiological stress responses, an increase in daytime sleepiness might increase physiological stress responses while the increase in sleep quality might decrease physiological stress

responses. For the psychological stress responses, an increase in daytime sleepiness might decrease psychological stress responses while the increase in sleep quality might increase psychological stress responses. The findings are very interesting in terms of different relationship patterns for physiological and psychological stress responses.

Fragmented sleep and following daytime sleepiness are known as a result of stress experience [17]. However, the reverse relationship was found in this study as hypothesized. Since the nature of the relationship between daytime sleepiness and physiological stress is cyclic, daytime sleepiness also might cause a physiological stress response. Because awareness about sleepiness and postponing sleep for an appropriate time might also be a reason to feel stress in the physiological system of the body. Kashani, et al. also revealed that stress levels correlated with daytime consequences of disturbed sleep [9]. Also, Isac and Abraham found a positive association between daytime sleepiness and stress levels without indicating any direction [11]. As another finding of the study, poor sleep quality might also be a reason for stress responses. Poor sleep quality might be a cause of sleep deprivation feelings leading to stress experience. Herewati and Gayati found that university students who suffered from poor sleep quality experience more stressful feelings [18]. Freitas, et al. also evaluated stress symptoms and daytime sleepiness of air traffic control officers (n=52) [19]. The findings showed that only 62% of the participants representing stress symptoms showed physiological stress responses. Hence it can be said that poor sleep quality is both a reason and output of stress responses in line with the cyclic nature of the relationship.

For the results on the psychological stress response, it is seen that increase in daytime sleepiness might decrease psychological stress responses. In opposite to the physiological stress response, daytime sleepiness might be a reason for feeling psychological well due to attention focusing on sleep deprivation without thinking about other factors causing stress. Since the effect of sleep deprivation on the psychological state of individuals is well-documented [20]. A similar effect might also be expected from sleep deprivation reflecting daytime sleepiness in this study. For the other finding (increase in sleep quality might increase psychological stress responses), the basic reason might be anxiety about holding or increasing sleep quality during daily life. Since living with plans in today's world develops expectations about the quality of life such as good-quality sleep and making regular exercise. But we know that expectations about something might be a reason to develop anxiety and stress [21]. Hence it can be said that the physiological mechanisms and psychological mechanisms of stress responses in different sleep quality and daytime sleepiness conditions are not directly linked to each other. Freitas, et al.'s findings showed that the majority of the stress responses of university students involve physiological stress responses and psychological stress responses are among the remained part [19]. Hence every stressful condition cannot stimulate a psychological stress response while it stimulates a physiological stress response.

## CONCLUSION

In conclusion, it can be said that physiological mechanisms and psychological mechanisms of stress responses in different sleep quality and daytime sleepiness conditions should be separated from each other, and stress responses should be studied by examining both physiological stress responses and psychological stress responses separately. This finding makes this study important and informing. But at the same time, there are some limitations in the study. First, the sample size is limited to 295 university students. In the following studies, there is a need to increase the sample size to increase the power of statistical analysis. Second, data analysis is limited to multiple regression analysis; however, future studies might use path analysis for the detail of the relationships.

## DECLARATIONS

### Conflict of Interest

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

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