BACHELOR THESIS

# The Mediating Effect of Distress and Eustress on the Association Between Sleep and Depression

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**Abstract**

In this research, the mediating effect of eustress and distress on the association between sleep and depression was examined. It was expected that both eustress and distress are mediators in that association. Participants (N = 159) were asked to fill out an online questionnaire measuring their sleep quality, levels of eustress and distress and depressive symptoms in this descriptive research. In order to analyse the obtained data, the mediation analysis designed by Preacher and Hayes was used. Both hypotheses were rejected based on the finding that sleep was not significantly associated with eustress and distress. However, it was found that eustress was negatively and distress was positively associated with depression.

Keywords: Sleep, Distress, Eustress, Depression

## 1. Introduction

One out of three people are affected by a sleep disorder at some point in their life (American Sleep Association, 2018). This is a large number of people being sleep deprived on a daily basis. Sleep deprivation is a serious problem, since a lack of sleep could lead to multiple physical and mental problems, such as the development of depressive symptoms, heart disease, and high blood pressure, but also to a reduction of public safety when people are not optimally alert while in traffic (Chang, Wu, Lin, Chang, & Yen, 2019; Division of Sleep Medicine at Harvard Medical School, 2007). So, sleep is associated with all these different stressors. For this research it was analysed whether the association between sleep and depression was mediated by eustress and distress. Where most research is only done in the negative aspects of stress, called distress, there are also positive reactions to stress, which is called eustress (Li, Cao, & Li, 2016; Quinones, Rodríguez-Carvajal, & Griffiths, 2017). It was examined whether sleep leads to depressive symptoms through the experience of eustress and distress, where eustress could reduce depressive symptoms and distress could enhance the experience of depressive symptoms.

### 1.1 Sleep

Sleep is a part of the daily rhythm humans have, which is called the circadian cycle. Generally, the circadian cycle is a biological period of approximately 24 hours, which is driven by the circadian clock (Edgar et al., 2012). The three most significant indicators for the rhythm are the amount of melatonin released by the pineal gland, the minimum body temperature and the plasma level of cortisol ((Adam, 2017; Benloucif et al., 2005). If the circadian cycle is disturbed, the release of melatonin and other sleep inducing hormones is irregular as well (Brzezinski, 1997). This will result in a shifted sleeping pattern. These shifted sleep cycles can lead to a sleep disruption or deprivation, which comes with some serious consequences.

One of those consequences is for example that sleep disturbance affects behavioural alertness and other aspects of the cognitive performance, such as the working memory and attention span (Banks & Dinges, 2007; Baynard, 2005). Furthermore, physiological impairments are also found as a consequence of sleep deprivation, such as a reduced glucose tolerance, increase in BMI (body index) and obesity (Gangwisch, Malaspina, Boden-Albala, & Heymsfield, 2005; Spiegel, Leproult, & Van Cauter, 1999; Taheri, Lin, Austin, Young, & Mignot, 2004). In addition, increased blood pressure is a possible consequence caused by a lack of sleep (Tochikubo, Ikeda, Miyajima, & Ishii, 1996). Even an enlarged risk of mortality could be a result of sleep deprivation (Kripke, Garfinkel, Wingard, Klauber, & Marler, 2002;

Tamakoshi & Ohno, 2004). So, it is shown that there are multiple physiological consequences that are considered to be unhealthy for the human body (Banks & Dinges, 2007).

Besides physiological consequences, there are psychological consequences of sleep deprivation as well. In fact, it is indicated that disrupted sleep leads to a reduction in productivity and absenteeism (Gaultney & Collins-McNeil, 2009). In addition, lack of sleep is associated with a reduction in self- control and enhanced rumination (Liu et al., 2018). Moreover, research has proven that sleep deprivation is associated with a reduction in stress management skills (Killgore et al., 2008). This implies that the impulses caused by the stressors are more difficult to cope with when sleep deprived. Also, this same research indicated that intrapersonal functioning, such as self- actualisation, is reduced when facing sleep deprivation, just as the interpersonal functioning, such as empathy and interpersonal relationships. Also, adaptive coping skills are influenced, which means that the capability of positive thinking and action orientation are reduced as well (Killgore et al., 2008). Finally, research has shown that sleep deprivation could lead to an increase in depressive symptoms (Chang et al., 2019). So sleep disruption can start depressive symptoms in people who did not experience them before that.

**1.2 Stress**

Stress was defined differently by several different people. The first one to define the concept stress was Hans Selye in 1974. Selye (1974) defined stress as 'the nonspecific response of the body to any demand'. Lazarus (1966) had a different view in which he claimed that stress is rather an interaction between a person and his or her environment. The foundation of the concept stress is based in the definition of appraisal. In general, appraisal is the process of classifying a certain situation including its different facets (Lazarus & Folkman, 1984). In addition, it expresses the special and changing relationship that takes place between someone and his or her environment while taking into account ones' distinctive characteristics and the reaction with the ones of the environment (Lazarus & Folkman, 1984). Another perspective on appraisal is given by Grinker and Spiegel (1945). They claimed that appraisal of a certain encounter requires certain aspects, like judgment, mental activity, discrimination and choice of activity where all of those characteristics are based on previous experiences. Usually, stress is viewed as a negative aspect of life including the negative effects of stress on daily functioning or overall happiness. Those negative forms of stressors are categorised as ''distress'' by Selye 1987. On the other side, there is eustress. Eustress is defined as good stress, which enhances overall health and positive feelings, but also increases commitment and efficacy (Li et al., 2016; Quinones et al., 2017). Another definition of eustress focuses on

the positive outcomes of the stress response on stressful encounters (Suedfeld, 1997). Eustress was positively associated with physical health, job performance and psychological well- being (Simmons & Nelson, 2007). Lazarus (1993) claimed that distress is more related with physical impairments and negative feelings, whereas eustress is associated with a healthy physical state and positive feelings.

Two different factors influence the eustress and distress responses, namely the characteristics of the stressor and the individuals interpretation. Characteristics of the stressors that influence eustress and distress responses are for example the timing, power and source of the stressor, and the perceived control and desirability with regards to the stressor (Le Fevre, Matheny, & Kolt, 2003; Lovallo, 1997). Secondly, the individuals interpretation depends on personal characteristics and their sensitivity and vulnerability to particular situations (Lazarus & Folkman, 1984). However, there are personal characteristics that influence the perception of stress as well, such as hope, optimism and self- determination (Peterson, 2000; Ryan & Deci, 2000; Snyder, 2000).

Sleep could influence the individual's interpretation of stressors by depleting recourses in coping with stress, which leads to an adapted coping style (Sadeh, Keinan, & Daon, 2004). Furthermore, research found that a lack of sleep can deplete recourses, which are essential in coping with stress, such as stress management or self- regulation (Hamilton, Nelson, Stevens, & Kitzman, 2007). This may result in a rather negative perspective of the situation, which might lead to an increase in perceived distress. On the contrary, a proper night rest, which is consistent and sufficient, would provide people with better recourses to cope with different stressors more efficiently by for example an increase in self- regulatory abilities (Barber, Munz, Bagsby, & Powell, 2010; Drake, Roehrs, & Roth, 2003). This way, people may perceive those stressors as rather positive, which could lead to an increase in eustress.

### 1.3 Depression

The experience of distress on the long term or in high doses could lead to depressive symptoms (Apóstolo, Figueiredo, Mendes, & Rodrigues, 2011; Dahlin, Joneborg, & Runeson, 2005; Kim & Shin, 2004)**.** Depressive symptoms are a reduction in ability to concentrate, depressed mood, fatigue and even suicidal thoughts (American Psychiatric Association, 2013). This is a serious issue, because depression could lead to an increased risk of many physical negative outcomes, such as stroke, obesity and cardiovascular disease (Penninx, Milaneschi, Lamers, & Vogelzangs, 2013). In addition, it has been proven that depression is the most common psychiatric disorder on an international level, which makes it a crucial issue (Penninx et al., 2013).

Research has shown that the presence of distress implies that positive well-being is absent for a while, which is a high risk factor for depression (Wood & Joseph, 2010). Eustress on the other hand is associated with psychological well-being (Simmons & Nelson, 2007). Psychological well- being is the opposite of depression, so this excludes eustress as a risk factor for depression and indicates that distress is a factor that is associated with depression.

**1.4 Current Research**

It is expected that sleep and depression are related to one another and that distress and eustress are involved in this association (Chang et al., 2019). Also, a distinction between distress and eustress is not researched yet in association with sleep and depression. Therefore it was necessary to conduct a research in which this is examined. The main question that this research aimed to answers is: Can distress and eustress explain the effect of sleep on depression? Supposedly, the variable distress strengthens the correlation between sleep and depression. If sleep disturbances decrease the ability of people adapting to their stressors the level of distress will be higher and thus the chance of experiencing depressive symptoms will be enhanced (Apóstolo et al., 2011; Killgore et al., 2008; Kim & Shin, 2004; Sadeh et al., 2004). On the other hand, a good night rest will lead to eustress and therefore the capacity to adapt to their stressors will be more efficient (Le Fevre et al., 2003; Li et al., 2016). If one is able to handle stressors better or more efficiently, the risk of developing depressive symptoms should decrease. Based on this information, the following hypotheses were formulated (see figure 3):

H1: Sleep quality is negatively associated with depression and this effect is mediated by levels of eustress.

H2: Sleep quality is negatively associated with depression and this effect is mediated by levels of distress

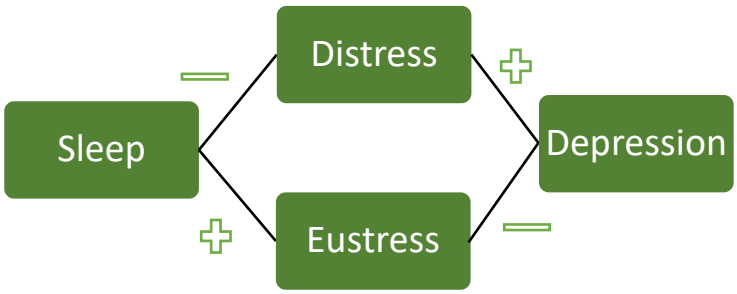


*Figure 1.* Mediation Model

## 2. Methods

### 2.1 Participants

For this research**,** 159 students (27 men; 132 women; *M* age 20,85 years; *SD*= 2,00 ) filled out an online questionnaire of whom 138 were German, 16 were Dutch and 5 of different nationalities. Of all participants, 88 were in a relationship, 69 were single and 2 of them were married. In order to be able to participate in our research process and to ensure its relevance, individuals had to fulfill certain criteria namely, a minimum age of 18 years old, an electronic device available and proficient English skills.

### 2.2 Materials

This presented study has been part of a bigger research. This survey was composed of three already existing and validated questionnaires, which were used to answer this research question measuring sleep, depression and distress/eustress. Other questionnaires that were included in the entire questionnaire were the Big Five Inventory (only Extraversion) (John & Srivastava, 1999), Multidimensional Perfectionism Scale (Hewitt & Flett, 1990) and Stress Mindset Measure (Crum, Salovey, & Achor, 2013).

Perceived Stress Scale

As a mean of measuring distress and eustress experienced in the past month, the 10 - item Perceived Stress Scale was used (Cohen, Kamarck, & Mermelstein, 1983; Lee, 2012). The intended purpose of this questionnaire is to measure stress in general, however, it was concluded that the two- dimensional model was a better fit than the unidimensional model (Nielsen et al., 2016; O'Sullivan, 2010; Simmons & Nelson, 2007; Yokokura et al., 2017). The items of the PSS can be answered with a 5-point Likert scale from 1 (never) to 5 (very often). All four positively formulated items measure eustress, for example 'In the last month, how often have you felt confident about your ability to handle your personal problems?', whereas the six negatively/ reversed formulated items measure distress, for instance 'In the last month, how often have you felt that you were unable to control the important things in your life?'. The mean scores of all items per variable are calculated. The psychometric properties of the test were evaluated as acceptable regarding the reliability. It was found that the test- retest reliability for the individual subscales was significant, $r = .66$, $r = .50$ (Cohen et al., 1983). The Cronbach's alpha of this test for eustress ($\alpha = .82$) and distress ($\alpha = .84$) were good.

Pittsburg Sleep Quality Index

The PSQI is constructed based on 19 individual items divided into seven categories, sleep disturbances, subjective sleep quality, sleep latency, habitual sleep efficiency, sleep duration, daytime dysfunction and the usage of sleep medication, and the main purpose of the questionnaire is to obtain a clear perception of the sleep pattern a person has been through in the past month (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). In the original questionnaires the five first items measuring the participant's sleeping pattern were open ended questions. However, in this research, 4- and 6 – point Likert scales were used to answer all questions. One example item is 'How long (in minutes) has it taken you to fall asleep each night? Next, ten possible reasons for sleep disturbance were asked, such as 'During the past month**,** how often have you had trouble sleeping because you cannot get to sleep within 30 minutes'. Also, participants were asked to rate their own overall sleep quality. Not all items were needed in the analysis, so those items concerning time going to and getting out of bed, were left out. Considering the different Likert scales in this questionnaire, the single 6- point Likert item was divided by 1.5 in order to establish the same weight for all items and then a mean score was calculated. The psychometric properties of the PSQI were examined. The internal consistency of the questionnaire has shown to be decent ($\alpha = .78$) (Beaudreau et al., 2012). Finally, the content and construct validity were both perceived as adequate (Mollayeva et al., 2016). For this research a Cronbach's alpha of .82 was reached.

Center for Epidemiological Studies Depression Scale

The CES-D scale measures depressive symptoms experienced the past week before the moment of measuring (Radloff, 1977). This questionnaire consists of 20 items, which had to be answered using a 4- point Likert-scale. The CES-D has proven to be a proper measure for non- clinical samples (Radloff, 1977). An example of a question was to indicate how often during the past month 'I felt that everything I did was an effort.' Analysing the psychometrics of the CES-D, it becomes clear that this questionnaire obtained a Cronbach's alpha of .85 among the general population (Radloff, 1977). Radloff demonstrates a sensitivity of .95 and a specificity of .29. Thus, the reliability and validity of this test are decent. The internal consistency obtained an excellent value with this research sample ($\alpha = .93$).

## 2.3 Procedure

The final questionnaire has been inserted in Qualtrics, a qualitative research software. After ethical approval by the supervisor and the BMS ethics committee of the University of Twente, the questionnaire was published online on the Sona platform of the University of Twente. Participants were selected since they needed to have a Sona account which was only provided for students by the University of Twente. In addition, the questionnaire was spread by the researchers using social media, such as Whatsapp. So, selective and convenience sampling was used to obtain as many participants as possible.

Firstly, the participants were asked to fill out the informed consent. In the latter, the information concerning time needed to complete the survey was mentioned just as a general explanation of the research topic. Moreover, the anonymity of the participants were emphasized and contact details of the researchers was shared in case of uncertainties or questions. Agreeing to the informed consent was necessary in order to continue the questionnaire. Then, some of the questions concerning demographics were asked covering gender, age, nationality, followed by the individual questionnaires.
The questionnaire had been online for 4 weeks. Finally, the participants were thanked for their participation and provided with contact information of the researchers in case of remaining questions. Participation was rewarded with 0.5 Sona credits.

## 2.4 Analysis

IBM SPSS Statistic 26 was used for the statistical data analysis. Firstly, all incomplete questionnaires were excluded from the data. Next, descriptive statistics such as means, standard deviations, and correlations were computed. The method by Preacher and Hayes (2008) was used in order to conduct a mediation analysis. A regression analysis is conducted using PROCESS. Sleep is the independent, also exogenous, variable, depression is the dependent, also endogenous, variable and distress and eustress function as mediators.

## 3. Results

The descriptive statistics and correlations of all variables are presented in table 1. The theoretical range is between 1 and 4. The mean score for sleep is located in the middle of the possible scores, indicating that the participants' sleep obtained a neutral score. Furthermore, the level of distress is way above the median, implying that the level of distress generally is rather high among participants. In addition, the level of eustress is higher than the median as well implying high levels of eustress among participants. Finally, the self- reported depression scores are considerably high. Cutoff scores that are indicated by Radloff (1977) imply that moderate depressive symptomatology has been established based on the mean score.

Table 1

*Descriptive statistics & correlations*

| | N | M | SD | 1. | 2. | 3. | 4. |
|---|---|---|---|---|---|---|---|
| 1. Sleep | 159 | 1.94 | .42 | - | | | |
| 2. Distress | 159 | 3.08 | .79 | .52* | - | | |
| 3. Eustress | 159 | 3.32 | .70 | -.50* | -.65* | - | |
| 4. Depression | 159 | 1.93 | .59 | .67* | .73* | -.67* | - |

*Note. Pearson's r was calculated in order to determine the correlation between the variables.*
** $p < .001$.*

**Mediation analysis**

The total effect of sleep on depression was found to be significant, β = .38, $t$ (157) = 11.41, $p < .001$. Implying the positive association between sleep and depression. Of this effect, the direct effect appeared to be significant as well, β = .33, t (159) = 6.38, p = <.001. Sleep has found not to have a significant effect on eustress, β = -.19, t(155) = -.95, p = .34. Additionally, the effect of sleep on distress is not significant either, β = .07. t(155) = .53, p = .60. The effect of the mediators on the dependent variable, depression, was significant. It was found that eustress was negatively associated with depression, β = -.16, t(157) = -11.15, p = <.001. In addition, distress was proven to be positively associated with depression, which was significant as well, β = .29, t(157) = 12.99, p = <.001. The results can be found in figure 4. The bootstrapping confidence interval of 95% appeared to be not significant for both mediators, distress [-.05, .09] and eustress [-.03, .10] , due to the fact that zero was included in both. This implies that the indirect effect was not significant.

To conclude, since the indirect effect was found to be not significant, it can be stated that both hypotheses can be rejected. Distress and eustress do not influence the association of sleep on depression according to this research.

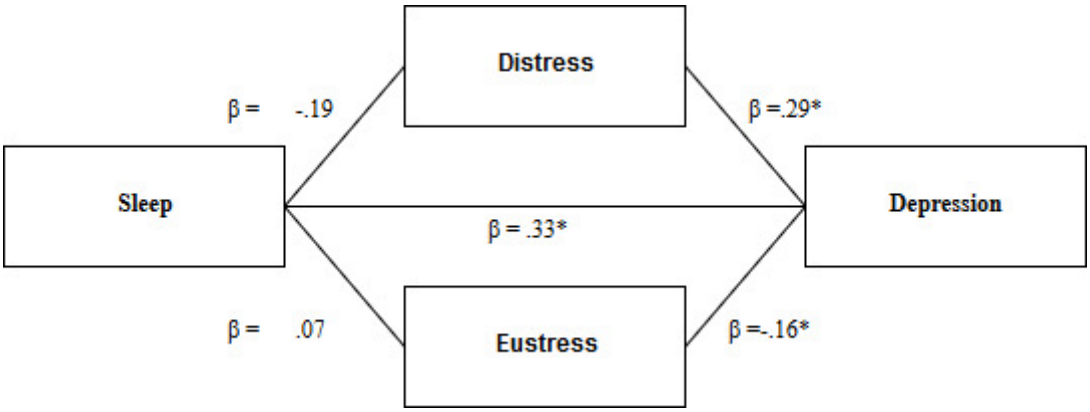


*Figure 2*. Overview results. *p < .001, Total effect β = .38.

## 4. Discussion

This researched aimed to test the mediating effect of distress and eustress on the association between sleep and depression. The first hypothesis was that sleep quality is negatively associated with depression and this effect is mediated by levels of eustress. The second hypothesis was that sleep quality is negatively associated with depression and this effect is mediated by levels of distress. Both hypotheses were rejected based on the finding that sleep was not related to eustress and distress. However, there was a direct effect found between sleep and depression and both eustress and distress were found to be associated with depression.

Distress and eustress were both not significantly associated with sleep in this research, which was contradicting the hypotheses based on researches that found that sleep can influence the experience of stressors (Killgore et al., 2008; Sadeh et al., 2004). This finding implies that the quality of sleep does not influence the experience of distress or eustress. The difference in findings can be explained by the fact that other researches made use of different samples and selection and different methods to measure sleep, such as daily logs and actigraphy (Killgore et al., 2008; Sadeh et al., 2004). Those aspects could be an explanation for the difference in outcomes, due to the fact that they may provide more accurate measurements of sleep.

Analysing the other part of the hypotheses, it was found that both mediators, distress and eustress, were associated with the dependent variable, depression. In this case, distress appeared to be positively associated with depression, whereas eustress was negatively associated with depression. This was in line with findings of previous research in which it was supported that the experience of distress could lead to more depressive symptoms (Apóstolo et al., 2011; Dahlin et al., 2005; Kim & Shin, 2004). Furthermore, it is supported that eustress is not a risk factor for the experience of depressive symptoms. This can be explained by the fact that eustress is associated with psychological well- being, which is the contrary of depression (Simmons & Nelson, 2007). Findings of this research might suggest that depression can be reduced by an increased level of eustress. It is crucial to distinguish between eustress and distress. For instance during therapy a focus on eustress could help reduce depressive symptoms and increase psychological well-being (Simmons & Nelson, 2007).

### 4.1 Strengths

There are certain aspects of this research that are considered to be strengths. First of all, only existing questionnaires were used to obtain data. These well-known questionnaires were tested many times, which results in reliable and valid means for data collection. Furthermore, research into the differentiation between eustress is distress instead of just analysing

stress as one concept is rather innovative and contributes to existing literature. Also, analysing the moderate, negative correlation between eustress and distress, it can be concluded that they stand proof for one another, since they are opposites.

### 4.2 Limitations and further research

There are some limitations that could be improved on for further research. Firstly, the sample was rather based on only female, German students, which was not intended. Research has shown that German students in particular are rather vulnerable when it comes to the burden caused by psychological strains and generally the level of substance usage is rather high, which might affect sleep (Nagel, John, Scheder, & Kohls, 2019; Stock, 2017). This does not immediately imply that it would change the outcomes of the research, but since substance usage was not tested in the questionnaire, it would be helpful to add an item concerning substance usage, e.g. usage of alcohol, codeine, caffeine and antidepressants. Even if students would have taken coffee with a high doses of caffeine, their perception on sleepiness could have been influenced.

In addition, self-report is easy and quick, but the downside is that people tend to overestimate their own performance when sleep deprived (Banks & Dinges, 2007). This implies that people are not fully able to rate their own sleep quality, which will influence the results. In order to avoid this issue, further research could measure sleep using electronic devices, such as fitbits, smartwatches and smartphones, in order to collect data as objective and exact as possible without extra costs.

Furthermore, it was found that coping style is crucial in analysing the association between sleep and stress (Sadeh et al., 2004). Sleep influences coping by forming a buffer against psychological strain (Barber et al., 2010). The used coping style would influence the perceived level of stress (Barber et al., 2010; Drake et al., 2003). It is important to analyse coping style, since that factor lies between sleep and stress and possibly could influence their association.

Moreover, participants were rewarded with Sona credits, of which fifteen are obligatory for UT Psychology students to obtain. Compared to research where participants volunteered completely to participate, it could be that these participants were not fully motivated to participate in a study, but rather to obtain their own credits without taking the time to complete the survey, which might lead to higher risk of reading or interpretation mistakes for instance (Killgore et al., 2008). However, it is not known which studies the participants follow and whether they receive Sona points or not. This could be an inequality in reward, which

might have influenced the participant's motivation, so for further research this could be tracked in order to verify that.

### 4.3 Conclusion

As a results of this research, it became evident that there is a direct association between sleep and depression. However, no support is found that eustress and distress explain that association. This implies that eustress and distress are not mediators in this association. Nevertheless, knowing the differentiation between distress and eustress and their different impact on depression, this can be applied when treating or avoiding depression using therapy. Further research on this topic would be necessary to explain the effect of eustress and distress.

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