

## THE EFFECT OF TOTAL SLEEP DEPRIVATION ON MOOD CHANGES OF HEALTHY INDIVIDUALS

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### ABSTRACT

**Aims:** Total Sleep Deprivation is a non-pharmacologic paradigm, where a person is deprived of all stages of sleep including the REM-phase. The aim of this study is to assess the mood changes of healthy individuals in terms of energy, happiness, anxiety, subjective depression during Total Sleep Deprivation.

**Methods:** This prospective research is carried out in Trakya University Medical Faculty Department of Psychiatry in 2015 with 20 volunteers, of whom 17 of them succeeded to finish the study. The participants were applied Visual Analogue Scale hourly during the 36 hours long Total Sleep Deprivation phase.

**Results:** After Total Sleep Deprivation, subjective depression scores were found to be higher; whereas happiness, energy scores were lower in the first 24 hours. Between approximately 24th and 32nd hours the course was reversed, as subjective depression scores decreased, while happiness, energy scores increased. However, in the last 5 hours, there was a decrease in happiness, energy scores and an increase in subjective depression scores.

**Conclusion:** Although an antidepressant effect was observed in a specific time period, Total Sleep Deprivation affected the mood of healthy participants negatively.

**Keywords:** Sleep deprivation, mood, visual analogue scale

### INTRODUCTION

Total Sleep Deprivation (TSD) is a non-pharmacologic paradigm, where a person is deprived of all stages of sleep including the REM-phase (1). Many individuals including healthcare professionals, soldiers, shift workers experience TSD frequently in their daily life, which makes TSD an important concern in the field of psychiatry. Many studies have shown TSD affects the mood on healthy individuals; however affected aspects of the mood are still being investigated (2).

Since the first report of mood improvement after a TSD in 1971(3), sleep deprivation has been used both for experimental purposes to widen the knowledge regarding the pathophysiology of depression, mechanisms under the mood change; and for the therapeutic purposes for people with depression (4). A meta-analysis conducted by Wu et al. (5) showed, out of 1700 people under depression, 50 to 60% of them are affected positively by

TSD. To be able to enlighten the effect of TSD on depressive patients, diverse studies were carried out targeting healthy participants in order to obtain comparable data (6).

Therefore, in this study we aimed to assess the alterations at mood in terms of energy, subjective depression, happiness and anxiety of medical student volunteers from Trakya University Medical Faculty during a 36-hour-lasting TSD by applying Visual Analogue Scale (VAS).

### MATERIAL AND METHODS

The methodology of this research is the same as the one used in the study of Çınar et al. (2016) (7). However additionally in this study, the mood alterations of the healthy participants were assessed by administering (VAS) hourly during the entire TSD phase. VAS provided mea-

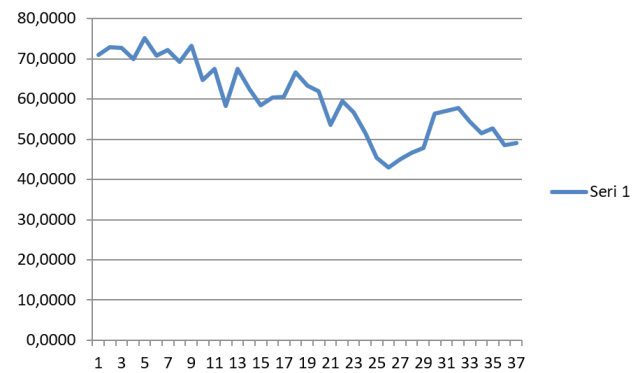
surements of the energy, happiness, subjective depression and anxiety levels of the participants by giving scores to the answers; which the volunteers responded subjectively. The scores were out of 100 points and the results were recorded for every hour for every participant.

In addition to the statistical analysis conducted in the study of Çınar et al. (7) the mean VAS scores of the participants for each hour were calculated and demonstrated in figures to observe the alterations regarding every lasting hour. The certain turning points were marked and compared to each other using non-parametric Wilcoxon signed rank test. The p-value was set at <0.05 for 2 tailed statistical significance. However, the VAS scores and the results obtained from the Wilcoxon signed rank test have never been published.

## RESULTS

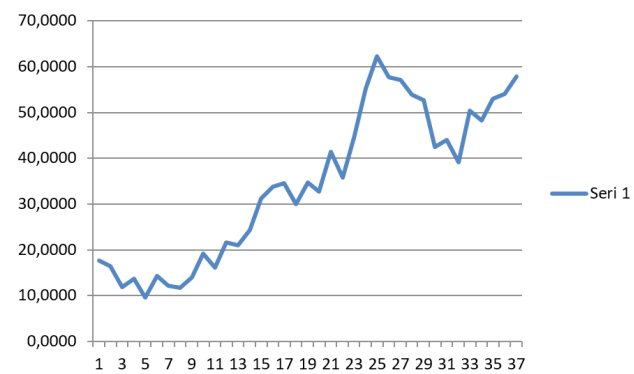
Out of total 19 participants 17 of them completed the study; whereas 2 of them failed to finish, one due to sleeping, one due to hypotension followed by nausea. The mean age of the participants who succeeded to finish the study was  $19.82 \pm 1.015$  (18-22), while the mean body-mass index  $22.5 \text{ kg/m}^2$ . 10(55.8%) participants were female, while 7(41.2%) of them were male.

According to the results of VAS applied to the study population at the each hour of the total sleep deprivation time, the mean happiness scores are demonstrated in Figure 1. The mean happiness score was 71.05 at the beginning of the test, which is negatively affected by sleep deprivation until the 26th hour ( $p=0.01$ ). On the contrary, between 26th and 32nd hours of the research the mean happiness score of the participants increased to 57.7 in spite of showing no statistical significance ( $p=0.05$ ). From the 32nd hour of total sleep deprivation until the end of the research the mean happiness score decreased to 49.06 which also was not statistically significant ( $p=0.3$ ). On the whole, the happiness score of the participants decreased from the beginning until to the end of the study ( $P=0.05$ ).



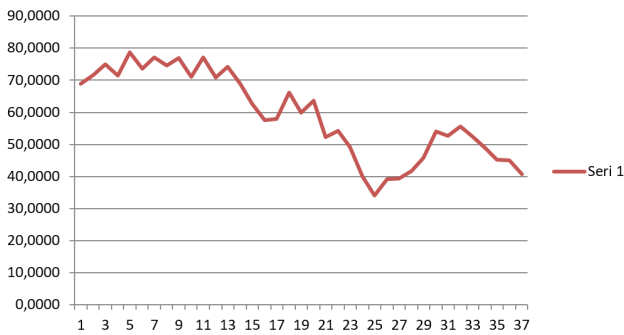
**Figure 1: The hourly distribution of mean VAS scores concerning happiness during 36 h TSD**

The subjective depression scores of the students were also analyzed (Figure 2). At the start of the research the mean subjective depression score was 17.64 out of 100 which drastically increased until the 25th hour of the study as 62.35 ( $p=0.0003$ ). Contrastively between 25th and 32nd hours it showed a decrease (Mean=39.11;  $p=0.01$ ), however from 32nd hour until the end of the experiment it increased up to 57.81 despite not being statistically significant ( $p=0.17$ ). Overall, the mean subjective depression score increased after the 36 hours of total sleep deprivation ( $p=0.0004$ ).



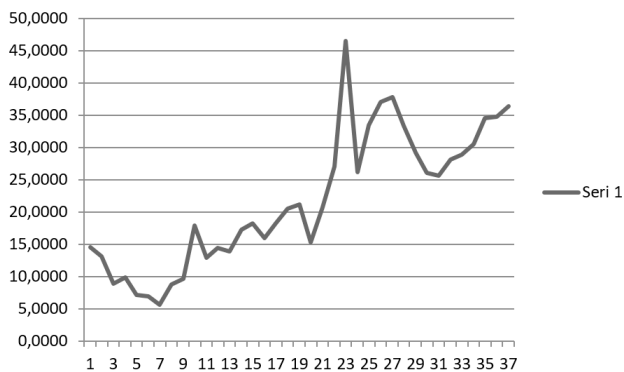
**Figure 2: The hourly distribution of mean VAS scores concerning subjective depression during 36 h TSD**

As for the mean energy scores of the participants, it showed a statistically significant reduction until the 25th hour ( $p=0.01$ ), but increased in the seven hours long following period ( $p=0.05$ ) (Figure 3). The mean energy scores at the beginning, at the 25th hour and 32nd hour were 69, 34.11, 55.64 respectively. However, after the 32nd hour until the end of the research a repetitive increase was found as the mean score at the 37th hour became 40.68 ( $p=0.03$ ). Consequently the mean energy score significantly decreased from the start to terminal point of the study ( $p=0.02$ ).



**Figure 3: The hourly distribution of mean VAS scores concerning energy during 36 h TSD**

Evaluating VAS scores enabled to demonstrate the anxiety of the participants, who were affected by TSD (Figure 4). The mean anxiety scores were 14.59, 46.53, 26.23, 37.82, 25.7 and 36.43; at the beginning, 23rd, 24th, 27th, 31st and 37th hours respectively. The mean score of anxiety increased until the 23rd hour ( $p=0.52$ ), made an apparent but statistically insignificant decrease at the 24th hour ( $p=0.814$ ) followed by an increase in the next period to 27th hour ( $p=0.018$ ), decreased repeatedly between 27th and 31st hours, consequently represented an increase ( $p=0.105$ ). Overall, the mean anxiety score of the students was found to be significantly increased ( $p=0.0003$ ).



**Figure 4: The hourly distribution of mean VAS scores concerning anxiety during 36 h TSD**

## DISCUSSION

Comparing the mean VAS scores of the 17 participants pointed out, that energy and happiness levels decreased in the first approximately 24 hours, while subjective depression levels increased at this time period. However, during the next 7 hours; the course was reversed, as energy and happiness levels increased, while

subjective depression levels decreased ( $p=0.05$ ,  $p=0.05$ ,  $p=0.01$  respectively). This might be considered as the antidepressant effect of TSD. Nevertheless, at the following 5 hours period this effect is seemed to disappear, as energy and happiness levels lowered, when subjective depression levels risen. Evaluating the whole TSD period showed, TSD affected the mood of the healthy students negatively regarding the reduction of energy, happiness scores and the increase of subjective depression scores in comparison with the first and last hours of the research ( $p=0.02$ ,  $p=0.05$ ,  $p=0.0004$ ). The anxiety scores changed remittently during the research, but in general seemed to increase ( $p=0.003$ ).

Our study is concluded with the fact, long term sleep deprivation affects the mood negatively, which is also consistent with the literature. In the study carried out by Liu et al. (8) it was found out that 72 hours of TSD lowered positive emotions but increased negative mood on male astronauts. Also, Bernier et al. (9) investigated the change after TSD at brain chemistry and mood among both healthy and depressed participants, thus observed significant alteration only in the depressed group. Similarly, Dorsey et al. (10) reached the conclusion that no significant change seemed on brain chemistry of healthy individuals after a one night of total sleep deprivation. Also, in the study carried out by Sagaspe et al. (11) self-reported anxiety increased after 36 hours of TSD measured by STAI questionnaire. Moreover, in the study conducted by Klumpers et al. (12) VAS scores on energy decreased just as in our study, but on the other hand they detected no significant change in mood.

Although it is not specified the minimal amount of sleep deprivation required to obtain antidepressant effect, the typical TSD therapy consists of 36-hour-lasting from the morning of the first day until the evening of the second day (13). We followed this procedure in our study as well, predicting the length of the TSD would be sufficient to detect any effect on the participants. However still, sample size of the study was small and this was the limitation factor in our study.

Although antidepressant effect is also observed in specific time periods, our study is concluded with the fact that TSD alters the mood negatively in healthy individuals. Further studies conducted with bigger populations are necessary to determine the specific effects of TSD on people with no mood disorders in order to widen the knowledge regarding the use of TSD in psychiatry.

**Ethics Committee Approval:** This study was approved by Scientific Researches Ethics Committee of Trakya University Medical Faculty.

**Informed Consent:** Written informed consent was obtained from the participants of this study.

**Conflict of Interest:** The authors declared no conflict of interest.

**Financial Disclosure:** The authors declared that this study received no financial support.

## REFERENCES

1. Arbey Z. Define what is meant by total and partial sleep deprivation. Available from URL: <https://tr.scribd.com/document/26767457/Define-What-is-Meant-by-Total-and-Partial-Sleep-Deprivation> (12 February 2010).
2. Wehrens SMT, Hampton SM, Kerkhofs M et al. Mood, alertness, and performance in response to sleep deprivation and recovery sleep in experienced shiftworkers versus non-shiftworkers. *Chronobiology International* 2012;29(5):537–48.
3. Pflug B, Tölle R. Therapie endogener depressionen durch schlafentzug. *Nervenarzt* 1971;42:117–24.
4. Wirz-Justice A, Van den Hoofdakkerb RH. Sleep deprivation in depression: what do we know, where do we go? *Biological Psychiatry* 1999;46(4):445–53.
5. Wu JC, Bunney WE. The biological basis of an antidepressant response to sleep deprivation and relapse: review and hypothesis. *Am J Psychiatry* 1990;147(1):14–21.
6. Beutler LE, Cano MC, Miro E et al. The role of activation in the effect of total sleep deprivation on depressed mood. *Journal of Clinical Psychology* 2003;59(3):369–84.
7. Çınar RK, Görgülü Y, Çalıyurt O et al. Transient changes in inflammatory and oxidative stress markers with total sleep deprivation. *Sleep and Biological Rhythms* 2016;14(4):387–96.
8. Liu Q, Zhou R, Liu L et al. Effects of 72 hours total sleep deprivation on male astronauts' executive functions and emotion. *Compr Psychiatry* 2015;61:28–35.
9. Bernier D, Bartha R, Devarajan S et al. Effects of overnight sleep restriction on brain chemistry and mood in women with unipolar depression and healthy controls. *J Psychiatry Neurosci* 2009;34(5):352–60.
10. Dorsey CM, Lukas SE, Moore CM et al. Phosphorus31 magnetic resonance spectroscopy after total sleep deprivation in healthy adult men. *Sleep* 2003;26(5):573–7.
11. Sagaspe P, Sanchez-Ortuno M, Charles A et al. Effects of sleep deprivation on color-word, emotional, and specific stroop interference and on self-reported anxiety. *Brain and Cognition* 2006;60:76–87.
12. Klumpers USM, Veltman DJ, Tol MJ et al. Neurophysiological effects of sleep deprivation in healthy adults, a pilot study. *PLoS One* 2015;10(1):e0116906.
13. Dopierala E, Rybakowski J. Sleep deprivation as a method of chronotherapy in the treatment of depression. *Psychiatr Pol* 2015;49(3):423–33.