Communication

Subjective Sleepiness Dynamics Dataset (SSDD) Presentation: the Study of Two Scales Consistency

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Abstract: While the first references to the system of sleepiness assessment are associated with medical research and the study of the effects of drugs on sleep, currently subjective sleepiness assessment is widely used across fundamental and practically oriented studies. The Stanford Sleepiness Scale (SSS) and the Karolinska Sleepiness Scale (KSS) are often used as ground truth in sleepiness research. Only a few studies applied both scales and practically none aimed at studying their consistency and specific features. The present study is devoted to analyzing the dynamics and consistency of subjective sleepiness as measured by the KSS and the SSS in the adult population. A particular task of the paper is to present the Subjective Sleepiness Dynamics Dataset (SSDD) with the evening and morning dynamics of situational subjective sleepiness. A total of 208 adults took part in the experiment. The results of the study revealed that sleepiness generally increased from evening till night and was maximal at early morning. The SSS score appeared to be more sensitive to some factors (e.g., the presence of sleep problems). The SSS and KSS scores were strongly consistent with each other. The KSS showed a generally more even distribution than the SSS. SSDD continues to be collected, we are going to equalize the sample by sex, we are actively adding older people. We plan to collect a sample of 1,000 people. Currently SSDD contains a lot of information that can be used for scientific research.

Keywords: sleepiness; dataset; KSS; SSS; dynamics; sleep; drowsiness

1. Introduction

1.1. History of Sleepiness Research
The first references to the system of sleepiness assessment are associated with medical research and the study of the effects of drugs on sleep [1; 2]. In 1973, the Stanford Sleepiness Scale (SSS) was proposed, called a new approach to sleep assessment, and has become the gold standard for many studies of sleep states [3; 4; 5]. The SSS is a self-assessment scale that is used to quantify and situationally assess progressive stages of sleepiness [6]. In 1990, the Karolinska Sleepiness Scale was proposed [7], which is also often used as a ground truth in sleepiness research. The next round of sleep studies is associated with the introduction of the Epworth Sleepiness Scale (ESS) into research practice [8]. The ESS is a simple, self-administered questionnaire that measures the subject’s general (not situational) level of daytime sleepiness. Another scale of daytime sleepiness the Sleep-Wake Activity Inventory (SWAI) was created in 1993 [9]. These scales were used in medical research: the analysis of the role of dental devices for snoring treatment [10], the problem of excessive daytime sleepiness in people with Prader-Willi syndrome [11], etc. The scales are still used in most studies on sleep and sleepiness.

In the 1990s some studies combined EEG data during sleep and driving, information on breathing and oxyhemoglobin levels, body temperature, and the SSS scores [12]. In the late 1990s, the focus of research shifted from analyzing the feasibility of measuring driver sleepiness to finding means of influencing sleep and wakefulness processes. Maycock G. (1996) evaluated the effects of caffeine, short-term sleep, cold air currents directed in the face, and listening to the radio as countermeasures for falling asleep. In addition to EEG data, the KSS and the ESS were used [13]. De Valck E., Cluydts R. focused on evaluating the effects of slow-release caffeine as a countermeasure against the expected decrease in activity [14].

Russo M. et al. (2003) proposed the use of eye movement analysis to monitor vigilance in driver aptitude testing. Their study found a relationship of the SSS scores with saccadic velocity, initial pupil diameter, latency, and amplitude of pupil constriction [15]. Johns M.W. (the ESS creator) et al. proposed a new method for drowsiness detections in driving using infrared reflectance oculography [16; 17]. Interactive media were proposed as a tool to improve the performance of drowsy drivers [18].

In the 2010s, sociological studies on drowsiness emerged [19]. Vennelle M. et al. (2010) showed an association between high levels of daytime sleepiness and the number of accidents among bus drivers [20]. Pytlkóen M. et al. (2015) evaluated the effectiveness of measures to control drowsiness during and beyond designated rest breaks [21]. It was shown that accounting for individual differences increases the accuracy of sleepiness detection [22].

In recent years, there was a trend to use machine learning technologies both for data processing and for distinguishing physiological states. For example, Awais M. et al. (2017) combined meaningful features of EEG and ECG and used classification based on support vector machine (SVM) to detect sleepiness (assessed by the SSS) [23]. Chen J. et al. (2019) used a multi-channel network method based on phase lag index to detect driver fatigue from EEG measures [24]. The most recent research concern not only the detection of sleepiness state, but also its prediction. For example, a model has been developed to track signs of sleepiness from video [25].

1.2. History of Sleepiness Research

Sleepiness and sleep are studied using a wide range of methods. Physiological methods involved registration of various physiological signals in the process of falling asleep and sleep itself. The most common methods include electroencephalography (EEG) [26; 27; 29; 30; 31; 32; 37; 38], electrocardiography (ECG) [38], analysis of the heart rate variability [50], electrooculography (EOG) [38; 48], polysomnography (a combination of EEG, ECG, and EOG) [28; 35; 36; 42; 44], fMRI [29], respiratory monitoring [31], and skin temperature measurement [34]. Behavioral methods can be divided into active methods, which require subjects to act consciously in response to stimuli, and passive methods, which do not involve any
external stimuli. Passive behavioral methods include movement registration (actigraphy) [34; 36; 41; 46; 47; 48]. Active methods include cognitive tasks that are set before the subject falls asleep [30], such as action in response to a sound signal [31], decision making [42], psychomotor alertness [45; 46; 49; 50], and replacement of letters and numbers [45; 49].

Self-report methods represent scales and questionnaires that collect subjective information about the subject’s state. Researchers often use sleep logs [26; 33; 42; 46; 47], questionnaires and scales to rule out disorders that contradict the model of a particular study (e.g., Beck Depression Inventory (BDI), State-Trait Anxiety Inventory (STAI)), Multidimensional Fatigue Inventory (MFI) [33], KSS [42; 43; 44; 45; 46; 47; 48; 49; 50], and the SSS [51; 52; 53; 54].

Ogilvie R.D. (2001) notes that the understanding of sleep as behavior (underlying sleep research originally) remains useful even now, after the emergence of high-tech ways to collect physiological data [40]. Prerau M.J. et al. (2014) proved this postulate by experiment, showing that the results of behavioral tasks during the period of falling asleep, although highly unsynchronized with the data of physiological methods on the timeline, but allow a broader view of such phenomenon as falling asleep. The research group proposed a model of processing various (both objective and subjective) information collected during falling asleep, in accordance with which it is possible to determine the sleep coefficient, reflecting the process of falling asleep as a heterogeneous, multilayer, and dynamic phenomenon [28]. Thus, the question arises about the selection of suitable self-report methods for such complex studies, which are closely connected with the subjective dimension of behavioral methods.

1.3. KSS and SSS applications in contemporary studies

Currently, the two questionnaires are most common as sleepiness ground truth: the KSS and the SSS. Of the 66 sleep-related publications analyzed, 40 studies used the SSS, 25 used the KSS, and the authors of one study used both scales simultaneously [80]. Most of the researchers combined the optimal set of available methods in their experiments, from physiological to self-report related, without ignoring the information provided by the questionnaires.

Further, we grouped the publications into major themes to see how wide the range of research studies is where such self-report data are used.

The scales were used to study sleepiness itself and its various aspects in relation to gender, age, educational status, body weight, and sleep latency [54], the relationship between subjective and objective sleepiness [77], to assess the level of subjective sleepiness in sleep studies at different times of the day, and the effect of work schedule on sleep, vigilance, and performance [46; 47; 55; 56; 57; 58]. The relationship between subjective sleepiness levels and ocular behavior was also investigated [76].

The SSS and the KSS are used in studies of various aspects of sleep duration [45], as well as the influence of both real [44] and perceived duration [37] on cognitive abilities, sleepiness, and work task performance in people of different ages [48]. Various external factors, such as the effect of light on alertness and sleep, as well as the sleepiness of drivers on shift schedules, were also studied [72; 73; 74]. The data on the level of subjective sleepiness established using the KSS and the SSS are used in evaluating the effect on cognitive abilities (decision-making, sustained attention, and memory) of such factors as sleep deprivation, restorative sleep, and subjective sleep duration, including in people with epilepsy [42; 46; 59; 60; 61].

A separate group of studies was devoted to age-related changes in various aspects of sleep and sleepiness, such as: subjective sleepiness [75], age-related increased tendency to daytime sleep and decreased SWS sleep stage [43], the effect of sleep loss on driving efficiency in people of different age [48] and on eye behavior indicators [76], age-related features of sleepiness response to various substances [63]. The influence of various substances on sleepiness and alertness levels is a relevant topic for practical application. The SSS and the KSS were used to assess the effect of caffeine [49; 64], in the studies of medical
drugs potentially causing drowsiness [63] or affecting driving performance [65], and in the study of the relationship between apnea symptomatology and diurnal cytokine cycles [66]. The KSS and the SSS were used in a comprehensive study of apnea: the risks of sleep apnea in patients with acute stroke [67], the association of apnea with disease [68], and the effect on alertness while driving [69].

The KSS and the SSS appear to be irreplaceable in the most voluminous group of studies related to driving characteristics, behavior, and driving state. Traditionally, these studies concern the influence of sleepiness and fatigue on the driving performance [48; 79; 83; 85; 86], the development of drowsiness detection systems [76; 78; 80; 81; 82] and systems to prevent loss of control due to sleepiness or fatigue [18; 84], the influence of various substances [64; 65], health features [69], or other factors [70; 74] on the sleepiness in driving.

Finally, much attention has been paid to the characterization of the scales themselves: the study of the psychometric properties of the scale [51], for example, its sensitivity to short-term partial sleep deprivation and further oversleeping [52], to cultural differences [53; 71], and in the creation of new scales [62]. There is evidence for the dynamics of subjective sleepiness as assessed by the KSS from 19:55 to 23:00 and from 07:05 to 08:10. The sleepiness graph shows an increase in the KSS score from evening to bedtime, and the KSS score is approximately equal to the one at 19:55 at the time of awakening [88]. The design of the mentioned study is rather similar to that presented in the current paper. Also, in [89] the KSS scores are presented for 24h monitoring.

Since the KSS and the SSS are often used as ground truth in articles on sleepiness studies, with very few articles with applying both scales [e.g., 87] and practically none aimed at studying their consistency and specific features, the present article is devoted to studying the dynamics and consistency of subjective sleepiness as measured by the KSS and the SSS in the adult population. A particular task of the paper is to present a dataset with the evening and morning dynamics of situational subjective sleepiness as measured by the KSS and the SSS, sociodemographic characteristics of respondents, including the presence of chronic conditions, caffeine consumption, the presence of sleep problems, driving experience, sleep and wakefulness patterns, subjective sleep characteristics, and the ESS scores. Additionally, heart rate data were recorded (i.e., pulse, RR-intervals, electrocardiogram - ECG), but this paper is dedicated to only self-report data description.

2. Materials and Methods

2.1. Participants

A total of 208 native Russian people took part in the experiment. The data of 15 participants were excluded from the analysis because they didn’t manage to perform the procedures correctly (the common problem was missing the time for cyclic tests that aim at assessing the subjective sleepiness dynamics).

The remained sample consisted of 58 males aged 30±11 and 153 females aged 32±12. Detailed description of the sample characteristics according to the data collected is given in 3.1.

2.2. Web System for Data Collection

An automated system was developed to collect and process the data. The system was designed as a web-service (web-application), implemented in PHP programming language - based on the modern microframework ‘CodeIgniter’ (version 4). MariaDB was chosen as a data storage tool.

The system provides several important functionalities:

1. The ability for a subject to choose a convenient time for testing, receiving and handing over the heart rate sensor. The system considers all existing sensor pickup and drop-off records (given the number of sensors available) and allows the subject to sign up for only available dates when the sensor will be available for pickup.
2. Passing all stages of testing and recording results online. All steps are strictly programmed based on the conditions necessary to complete the full test cycle correctly. All stages are performed sequentially until the current stage is passed; the next stage is available for passing. In cyclic tests (the SSS and the KSS) the system automatically blocks the possibility of retaking until the specified amount of time has elapsed.

3. Possibility (for system administrators) to unload user test results in CSV format for further analysis and processing. Separately implemented the possibility of unloading the results only for the ESS.

2.3. Subjective sleepiness scales

The SSS points were taken from the original research [3] (the number of points assigned is indicated in brackets):
- Feeling active and vital; alert; wide awake (1 point);
- Functioning at a high level, but not at peak; able to concentrate (2 points);
- Relaxed; awake; not at full alertness; responsive (3 points);
- A little foggy; not at peak; let down (4 points);
- Fogginess; beginning to lose interest in remaining awake; slowed down (5 points);
- Sleepiness; prefer to be lying down; fighting sleep; woozy (6 points);
- Almost in reverie; sleep onset soon; lost struggle to remain awake (7 points).

The KSS points were also taken from the original research [7] but with the addition of the 10th item ('Extremely sleepy, can't keep awake' [91]) (the number of points assigned is indicated in brackets):
- Extremely alert (1 point);
- Very alert (2 points);
- Alert (3 points);
- Rather alert (4 points);
- Neither alert nor sleepy (5 points);
- Some signs of sleepiness (6 points);
- Sleepy, but no effort to keep awake (7 points);
- Sleepy, but some effort to keep awake (8 points);
- Very sleepy, great effort to keep awake, fighting sleep (9 points);
- Extremely sleepy, can't keep awake (10 points).

The translation of KSS and SSS into Russian is given in Table A1 and Table A2.

2.4. Study design

To attract respondents, announcements were created and placed on the news resources of Lobachevsky University and of the region. Potential respondents were invited to fill out a Google form where they indicated their name, gender, age, and contact information. Then Cyberpsychology Lab employees contacted respondents to make an appointment, or respondents themselves marked the day of coming to the laboratory in the Web System to receive instructions and equipment (Samsung Smartphone and Polar H10 sensor).

On the day of the experiment, the experimenter with administrator privileges in the Web System created an account with a login (participant’s email) and a system-generated password. The credentials and Web System address were automatically sent to the participant’s email). Each participant was given a printed copy of the experiment instruction, and the Samsung smartphone with the Polar H10 heart rate sensor.
At 19:40 the participants put on the Polar H10 heart rate sensor and connected it to Polar Sensor Logger App.

At 19:50 the participants entered the Web System and filled out personal information. The fields were as following:

- Gender, age, height, and weight;
- Presence of chronic diseases. If yes, which ones?
- Do you drive a car regularly?
- If yes, what is your driving record?
- How many cups of coffee do you usually drink per day?
- How many cups of coffee have you had today?
- Do you smoke?
- How long have you smoked?
- Do you classify yourself as:
  — An owl
  — A lark
  — It’s difficult to answer
- What time do you usually get up on weekdays?
- What time do you usually get up on weekends?
- What time do you usually go to bed on weekdays?
- What time do you usually go to bed on weekends?
- Does your sleep pattern meet your current resting needs?
- Do you have any sleep problems? If so, describe.

At 20:00 the participants filled out the ESS, the SSS and the KSS. Afterwards, the participants were instructed when they needed to pass the SSS and the KSS again (in 30 minutes after the filling out of the current SSS and KSS). So, the SSS and the KSS were cyclic (period = 30 minutes). The cycle was interrupted when the participants pointed in the Web System that they went to bed. They also pointed the specific time, which could further be used in analysis.

At 06:00 the participants fulfilled: the KSS and the SSS, Levin’s questionnaire for scoring subjective sleep characteristics [90]; not obligatory field about their dreams.

The study design and procedure were approved by the Ethics Committee of Lobachevsky State University, and all participants or their legal representatives provided written informed consent in accordance with the Declaration of Helsinki.

As the main goal of this paper was to study the SSS and the KSS consistency, heart rate data, the ESS data, as well as subjective sleep characteristics, and dreams descriptions analysis are not presented in the current paper.

2.5. Data Analysis

The independent t-test was used to assess the differences in the SSS and KSS scores according to different factors within the selected time points. Pearson correlation coefficient was used to assess the correlations between the SSS and KSS scores. Data preprocessing and statistical analysis were carried out in Python using a web-based interactive computing platform Jupyter Notebook.

2. Results

2.1. SSDD Descriptive Analysis
Table 1 contains the information about age-gender distribution in SSDD.

Table 1. The count of males and women according to different age ranges.

| Age range | Males | Females |
|-----------|-------|---------|
| 25-35     | 18    | 34      |
| < 25      | 21    | 45      |
| > 35      | 19    | 54      |
| Total     | 58    | 133     |

Figure 1 represents the time points fill out for cyclic tests (the SSS and the KSS) for each of 191 participants.

As it can be seen in Figure 1, at 20:00 and at 06:00 all the subjects filled out the SSS and the KSS. Since the subjects went to sleep at different time (see Figure 2), some of them have absent data even starting at 20:30.

Figure 2. Pie charts illustrating the distribution of the time the subjects (males and females) went to bed at the day of experiment.
The data in Figure 2 demonstrate, that males and females have relatively similar distributions. Nevertheless, the most frequent answer for males is 00:30 and for females – 23:00. But at the same time, 23:00 is the second ranged answer for males.

Given the fact that many subjects went to bed relatively early, for further analysis of cyclic tests (the SSS and the SSS) we decided to find such a time point, till which we’d like to have maximum of data present and to further drop the subjects with absent data at this time point. Table 2 demonstrate the ratios of absent data for each time point.

Table 2. The absent cases ratio for each time point.

| № | Time  | Absent cases ratio | № | Time  | Absent cases ratio |
|---|-------|--------------------|---|-------|--------------------|
| 1 | 20:00 | 0%                 | 9 | 0:00  | 80%                |
| 2 | 20:30 | 4%                 | 10| 0:30  | 87%                |
| 3 | 21:00 | 6%                 | 11| 1:00  | 92%                |
| 4 | 21:30 | 12%                | 12| 1:30  | 96%                |
| 5 | 22:00 | 22%                | 13| 2:00  | 98%                |
| 6 | 22:30 | 32%                | 14| 2:30  | 99%                |
| 7 | 23:00 | 52%                | 15| 3:00  | 99%                |
| 8 | 23:30 | 65%                | 16| 6:00  | 0%                 |

The data in Table 2 demonstrate that at 22:00 there was 22% data loss which means that 22% of subjects went to bed before this time. In order to process the data statistically, we decided to take only those subjects who filled in the SSS and the KSS at least up to 22:00 time point. Therefore, the data of 149 subjects were taken to the stage of cyclic tests analysis (2.2 – 2.4).

Also, we checked the distribution of time when the subject generally wakeup (see Figure 3).

Figure 3. Pie charts illustrating the distribution of weekly and weekend general wake up time.

This information will be further user to see the SSS and the KSS dynamics in terms of the pattern of the scores change at different time points.

2.2. SSS Scores Analysis

Figure 4 demonstrates the average, upper and lower quartiles values, and outliers for the SSS scores according to different factors (Gender, Sleep problems, Sleep mode comfort, Weekly general wakeup) within each time point. Table 3 contains the information about the significance of differences according to the independent t-test.
Figure 4. Boxplots illustrating the distribution of the SSS values according to different factors (a) Gender, (b) Sleep problems, (c) Sleep mode comfort, (d) Weekly general wakeup) within each time point. Green triangles stand for the mean values.

Table 3. Independent t-test and p-values when comparing the SSS scores according to different factors (Gender, Sleep problems, Sleep mode comfort, Weekly general wakeup) within each time point. Grey color stands for significant differences (p < 0.05).

| Time point | 20:00 | 20:30 | 21:00 | 21:30 | 22:00 | 06:00 |
|------------|-------|-------|-------|-------|-------|-------|
| Gender (males vs females) |       |       |       |       |       |       |
| t          | -1.18 | -1.14 | -0.49 | -0.27 | -1.17 | -1.55 |
| p          | 0.241 | 0.257 | 0.625 | 0.79  | 0.245 | 0.124 |
| Sleep problems (yes vs no) |       |       |       |       |       |       |
| t          | 2.7   | 2.1   | 1.37  | 1.11  | 0.67  | -1.79 |
| p          | 0.008 | 0.037 | 0.172 | 0.268 | 0.504 | 0.076 |
| Sleep mode comfort (yes vs no) |       |       |       |       |       |       |
| t          | -3.93 | -3.87 | -3.63 | -2.1  | -2.5  | 0.14  |
| p          | 0.000 | 0.000 | 0.000 | 0.037 | 0.014 | 0.888 |
| Weekly general wakeup (later than 7:00 vs earlier than 7:00) |       |       |       |       |       |       |
| t          | 1.16  | -1.89 | -1.64 | -2.46 | -2.92 | 1.77  |
| p          | 0.25  | 0.061 | 0.103 | 0.015 | 0.004 | 0.079 |

As it can be seen from Figure 4, the general pattern is the growth of the SSS values from 20:00 to 06:00. The data in Table 3 indicate, that gender doesn’t affect the SSS scores, while the presence of sleep problems, the comfort of sleep mode, and weekly general wakeup time affect the SSS scores. Subjects with sleep problems had lower SSS scores at 20:00 (p = 0.008) and 20:30 (p = 0.037). SSS scores were lower at 20:00 (p = 0.000), 20:30 (p = 0.000), 21:00 (p = 0.000), 21:30 (p = 0.037), and 22:00 (p = 0.014) in people who reported about the comfort of their sleep mode. Subjects who usually wake up later than 07:00 had lower SSS scores at 21:30 (p = 0.015) and 22:00 (p = 0.004).

2.3. KSS Scores Analysis
Figure 5 demonstrates the average, upper and lower quartiles values, and outliers for the KSS scores according to different factors (Gender, Sleep problems, Sleep mode comfort, Weekly general wakeup) within each time point. Table 4 contains the information about the significance of differences according to the independent t-test.

![Figure 5](image)

**Figure 5.** Boxplots illustrating the distribution of the KSS values according to different factors ((a) Gender, (b) Sleep problems, (c) Sleep mode comfort, (d) Weekly general wakeup) within each time point. Green triangles stand for the mean values.

| Time point | 20:00 | 20:30 | 21:00 | 21:30 | 22:00 | 06:00 |
|------------|-------|-------|-------|-------|-------|-------|
| **Gender (males vs females)** | | | | | | |
| t          | -1.49 | -0.45 | -0.59 | 0.19  | -1.12 | -1.26 |
| p          | 0.139 | 0.652 | 0.558 | 0.847 | 0.265 | 0.208 |
| **Sleep problems (yes vs no)** | | | | | | |
| t          | 1.22  | 1.31  | 1.36  | 0.63  | 0.64  | -1.24 |
| p          | 0.226 | 0.177 | 0.527 | 0.526 | 0.218 |       |
| **Sleep mode comfort (yes vs no)** | | | | | | |
| t          | -2.94 | -2.93 | -3.21 | -2.59 | -1.72 | -0.99 |
| p          | 0.004 | 0.004 | 0.002 | 0.011 | 0.088 | 0.325 |
| **Weekly general wakeup (later than 7:00 vs earlier than 7:00)** | | | | | | |
| t          | 0.02  | -1.98 | -1.5  | -2.23 | -3.12 | 1.41  |
| p          | 0.982 | 0.050 | 0.136 | 0.027 | 0.002 | 0.162 |

Table 4. Independent t-test and p-values when comparing the KSS scores according to different factors (Gender, Sleep problems, Sleep mode comfort, Weekly general wakeup) within each time point. Grey color stands for significant differences (p < 0.05).

As it can be seen from Figure 5, the general pattern is the growth of the KSS values from 20:00 to 06:00 (like the ones of the SSS scores). The data in Table 4 indicate, that gender and the presence of sleep problems don’t affect the KSS scores, while the comfort of
sleep mode and weekly general wakeup time affect the KSS scores. Thus, the SSS score may be more sensitive to some factors. KSS scores were lower at 20:00 (p = 0.004), 20:30 (p = 0.004), 21:00 (p = 0.002), and 21:30 (p = 0.011) in people who reported about the comfort of their sleep mode. Subjects who usually wake up later than 07:00 had lower KSS scores at 20:30 (p = 0.050), 21:30 (p = 0.027), and 22:00 (p = 0.002).

2.4. SSS and KSS Consistency Analysis

As the SSS and the SSS have different score ranges (1-7 for the SSS and 1-10 for SSS), we transformed the scores for each time point separately with z scaling. The probability distributions of the SSS and SSS z-scores within different time points are presented in Figure 6.

Figure 6. Distribution histograms for the SSS and KSS z-scores within each time point. Lines indicate kernel density estimate plots.

The data in Figure 6 demonstrate that the general patterns of both SSS and KSS scores. The differences will be further considered in Discussion.

Table 3 contains the information about the Pearson correlations between the SSS and KSS scores within each time point.

| Time point | R   | Lower CI (p = 0.05) | Upper CI (p = 0.05) | p    |
|------------|-----|---------------------|---------------------|------|
| 20:00      | 0.75| 0.67                | 0.81                | 0.00000 |
| 20:30      | 0.82| 0.76                | 0.87                | 0.00000 |
| 21:00      | 0.82| 0.76                | 0.86                | 0.00000 |
| 21:30      | 0.81| 0.74                | 0.86                | 0.00000 |
| 22:00      | 1.00| 0.79                | 0.88                | 0.00000 |
| 06:00      | 0.89| 0.85                | 0.92                | 0.00000 |

The data in Table 3 indicate that the scores of the two scales are highly correlated.

3. Discussion

The results of the study showed that sleepiness generally increased from 20:00 to 22:00 and was maximal at 06:00. These results are consistent with the data that subjective sleepiness by KSS was higher in the morning than in the evening [59] and was maximal in the late evening [46; 83] and early morning [46]. At the same time, our data are inconsistent...
with the results that KSS sleepiness was lower in the morning (at 07:00 [88]) and at 08:00 [47]) than in the late evening. We conducted a morning measurement at 06:00 and perhaps even an hour difference led to the fact that sleepiness at 06:00 was rated high in our study.

The results of the study revealed that gender didn’t affect the SSS and KSS scores at any time point. Subjects with sleep problems had lower SSS scores at 20:00 and 20:30, while this factor didn’t affect the KSS scores at all. In people who reported about the comfort of their sleep mode, the SSS scores were lower at all the evening time points, while the KSS scores were lower at 20:00, 20:30, 21:00, and 21:30. In subjects who usually wake up later than 07:00, the SSS scores were lower at 21:30 and 22:00, while the KSS scores were lower at 20:30, 21:30, and 22:00. Thus, the SSS score may be more sensitive to some factors (e.g., the presence of sleep problems). Lower SSS and KSS values in the late evening and at night in people who usually get up later than 07:00 were probably related to the fact that they usually go to bed later. In any case, we conclude that consideration of individual differences is important in the analysis of sleepiness, and this is consistent with the findings in other studies [22].

Overall, the results of the analysis revealed that the two scales were strongly consistent with each other. Correlation analysis indicated a close relationship between the SSS and KSS scores. This once again confirms the validity of both scales.

Nevertheless, the analysis of distributions showed that despite the general trends, there were some differences between the answer proportions for the different gradations of the two scales. For all the time points, extreme small standardized values were found only for the KSS. This might be assumed to be since the original (without z standardization) KSS scores have a larger range, and this encouraged the participants to give more varied answers. But at the same time, for the time points other than 20:00, the extreme large values were observed for both scales. For time point 20:00, the large extremes occur only for the SSS. Thus, the larger range in the KSS could not affect the fact that respondents in general gave more varied responses with respect to small and large scores.

Some differences were found between the distributions of the SSS and KSS scores across time points. For 20:00, 20:30, 21:00, and 21:30 time points, the z-scores for the SSS were more skewed to the left, while the z-scores for the KSS were more evenly distributed. For the 22:00 time point, the distribution for the z-score for the SSS was skewed to the left, while the distribution for the KSS was skewed to the right. For time point 06:00, both z-score distributions were strongly skewed to the right, with a large fraction of high scores. For the same time point, the KSS z-score distribution was characterized by a low representation of mean scores (z=0) and a relatively higher representation of small and large scores.

Thus, the SSS and the KSS assess the same phenomenon, and in general the scores on the two scales match. However, the SSS appeared to be sensitive to more factors. In turn, the KSS showed a generally more even distribution than the SSS.

4. Study Limitations

Since the purpose of this article was to match the KSS and the SSS, we had to remove from the analysis those who, for some reason, could not correctly complete these cyclic tests. Nevertheless, all the participants completed the KSS and the SSS at least at the beginning of the experiment (20:00). Even though we immediately removed 15 participants, their data can still be used for other tasks, because they have all the data that were collected at the beginning of the experiment (the sociodemographic characteristics, including the presence of chronic conditions, caffeine consumption, the presence of sleep problems, driving experience, sleep and wakefulness habits, subjective sleep characteristics, the ESS results, heart rate data (pulse, RR-intervals, and ECG), and the KSS and SSS scores at 20:00. Therefore, all 208 recordings can be considered suitable material for scientific analysis.

SSDD continues to be collected, we are going to equalize the sample by sex, we are actively adding older people. We plan to collect a sample of 1,000 people. Currently SSDD contains a lot of information that can be used for scientific research.
The research was done on Russian people, and further research is needed to see how our results can be applied to other nationalities. Nevertheless, even at Lobachevsky University there are a lot of foreign students from different countries, and we can do research at least on them, to diversify the SSDD.

The SSS and the KSS have not yet been properly validated on Russian sample. And this is a major task for our future research. Also, we didn’t manage to find any their Russian translation appeared in WoS/Scopus indexed journals. So, we proposed our own translation which can be further validated if needed.

5. Conclusions

1. The SSDD is a new dataset with subjective sleepiness scores combined with socio-demographic characteristics of the respondents, including the presence of chronic conditions, caffeine consumption, the presence of sleep problems, driving experience, sleep and wakefulness patterns, subjective sleep characteristics, the ESS scores, and heart rate data (i.e., pulse, RR-intervals, ECG). At the moment of publication, it includes the data of 208 participants.

2. Sleepiness generally increases from evening till night and is maximal at early morning.

3. The SSS score may be more sensitive to some factors (e.g., the presence of sleep problems), than the KSS.

4. The SSS and KSS scores are strongly consistent with each other. The KSS shows a generally more even distribution than the SSS.

Supplementary Materials: The following supporting information can be downloaded at: www.mdpi.com/xxx/s1, Table S1: Descriptive statistics of non-parametric data; Table S2: Descriptive statistics of parametric data.

Author Contributions: V.D.—experiment design and methodology, experiment administration, data analysis and preparation of first draft; I.Z.—assistance with experiment administration and data collection; I.I. and M.Zh.—literature review, N.N. and A.D.—editing and proofreading the final draft, Ya.O. and K.Z.—data collection and systematization, V.V.—Web System creation and administration, data systematization. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board of Faculty of Social Sciences of Lobachevsky State University.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.
Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Russian translation of SSS scores.

| Score | English | Russian |
|-------|---------|---------|
| 1     | Feeling active and vital; alert; wide awake | Чувствую себя живым, активным, включенными, бодрым |
| 2     | Functioning at a high level, but not at peak; able to concentrate | Ощущаю работоспособность на высоком уровне, но не на максимуме возможностей; способен концентрироваться |
| 3     | Relaxed; awake; not at full alertness; responsive | Чувствую себя расслабленным, присутствующим, воспринимающим, но не полностью включенными |
| 4     | A little foggy; not at peak; let down | Ощущаю себя немного медлительным и рассеянным |
| 5     | Fogginess; beginning to lose interest in remaining awake; slowed down | Нахожусь будто в тумане, теряю интерес к окружающему, вялый |
| 6     | Sleepiness; prefer to be lying down; fighting sleep; woozy | Ощущаю сонливость, тянет полежать, но борюсь со сном, заторможен |
| 7     | Almost in reverie; sleep onset soon; lost struggle to remain awake | Нахожусь на грани сна, почти в забытьи, бросил попытки оставаться бодрящим |

Table A2. Russian translation of KSS scores.

| Score | English | Russian |
|-------|---------|---------|
| 1     | Extremely alert | Крайне активный, включённый, жизнеспособный |
| 2     | Very alert | Очень бодрый |
| 3     | Alert | Бодрый |
| 4     | Rather alert | Скорее бодрый |
| 5     | Neither alert nor sleepy | Ни бодрый, ни сонливый |
| 6     | Some signs of sleepiness | Есть признаки сонливости |
| 7     | Sleepy, but no effort to keep awake | Сонливый, но остался воспринимающим без усилий |
| 8     | Sleepy, but some effort to keep awake | Сонливый, прикладывая усилия, чтобы не заснуть |
| 9     | Very sleepy, great effort to keep awake, fighting sleep | Очень сонное состояние, борюсь со сном, нужны большие усилия, чтобы не уснуть |
| 10    | Extremely sleepy, can't keep awake | Крайне сонливый, сил на борьбу со сном уже нет |

References

1. Barmack, J.E. Studies on the psychophysiology of boredom: Part I. The effect of 15 mgs. of benzedrine sulfate and 60 mgs. of ephedrine hydrochloride on blood pressure, report of boredom and other factors. *Journal of Experimental Psychology* 1939, 25 (5), 494-505. https://dx.doi.org/10.1037/h0054402
2. Hollister, L.E., Clyde, D.J. Blood levels of pentobarbital sodium, meprobamate, and tybamate in relation to clinical effects. *Clinical Pharmacology & Therapeutics* 1968, 9 (2), 204-208. https://dx.doi.org/10.1002/cpt196892204
3. Carskadon, M.A., Dement, W.C. Sleepiness and Sleep State on a 90-Min Schedule. *Psychophysiology* 1977, 14 (2), 127-133. https://dx.doi.org/10.1111/j.1469-8986.1977.tb0362.x
4. Moses, J., Lubin, A., Naitoh, P., Johnson, L.C. Circadian variation in performance, subjective sleepiness, sleep, and oral temperature during an altered sleep-wake schedule. *Biological Psychology* 1978, 6 (4), 301-308. https://dx.doi.org/10.1016/0301-0511(78)90032-7
5. Taub, J.M. Effects of habitual variations in napping on psychomotor performance, memory and subjective states. *International Journal of Neuroscience* 1977, 9 (2), 97-112. https://doi.org/10.3109/00207457909147225

6. Hoddes, E., Zarcone, V., Smythe, H., Phillips, R., Dement, W.C. Quantification of Sleepiness: A New Approach. *Psychophysiology* 1973, 10 (4), pp. 431-436. https://doi.org/10.1111/1469-8866.1973.tb00801.x

7. Åkerstedt, T., Gillberg, M. Subjective and objective sleepiness in the active individual. *Int J Neurosci* 1990, 52, 29-37. https://doi.org/10.3109/0020745900894241

8. Johns, M.W. A new method for measuring daytime sleepiness: The Epworth sleepiness scale. *Sleep* 1991, 14 (6), 540-545. https://doi.org/10.1093/sleep/14.6.540

9. Rosenthal, L., Roehrs, T.A., Roth T. The sleep-wake activity inventory: a self-report measure of daytime sleepiness. *Bio Psychiat* 1993, 34, 810-820. https://doi.org/10.1006/bips.1993.3223(93)90070-t

10. Castro Barbosa, R., Aloe, F., Tavares, S., Baptista Silva, A. Mandibular-Lingual Repositioning Device-MLRD: preliminary results of 8 patients with obstructive sleep apnea syndrome-OSAS. *São Paulo medical journal* 1995, 113 (3), 888-894. https://doi.org/10.1590/s1516-31801995000300002

11. Kingshott, R.N., Sime, P.J., Engleman, H.M., Douglas, N.J. Self assessment of daytime sleepiness: Patient versus partner. *Thorax* 1995, 50 (9), 994-995. https://doi.org/10.1136/thx.50.9.954

12. Maycock, G. Sleepiness and driving: The experience of UK car drivers. *Journal of Sleep Research* 1996, 5 (4), 229-231. https://doi.org/10.1046/j.1365-2869.1996.00229.x

13. Takayama, L., Nass, C. Assessing the effectiveness of interactive media in improving drowsy driver safety. *Human factors* 2008, 50(5), 772-781. https://doi.org/10.1177/001872008X312341.

14. Philip, P., Sagaspe, P., Lagarde, E., Ohayon, M.M., Bioulac, B., Boussuge, J., Taillard, J. Sleep disorders and accidental risk in a large group of regular registered highway drivers. *Sleep Medicine* 2010, 11 (10), 973-979. https://doi.org/10.1016/j.sleep.2010.07.010

15. Vennelle, M., Engleman, H.M., Douglas, N.J. Sleepiness and sleep-related accidents in commercial bus drivers. *Sleep and Breathing* 2014, 18 (1), 39-42. https://doi.org/10.1007/s13235-009-0277-2

16. Bakker, B., Zablocki, B., Baker, A., Rietheimester, V., Marx, B., Iyer, G., Anund, A., Ahlstom, C. A Multi-Stage, Multi-Feature Machine Learning Approach to Detect Driver Sleepiness in Naturalistic Road Driving Conditions. **IEEE Transactions on Intelligent Transportation Systems** 2022, 23 (5), 4791-4800. https://doi.org/10.1109/TITS.2021.3090272

17. Gorsgøn, M., Scarpelli, S., Annarumma, L., D’atri A., Alfonso V., Ferrara M., De Gennaro L. The Regional EEG Pattern of the Sleep Onset Process in Older Adults. *Brain Sciences* 2021, 11 (10), 1261. https://doi.org/10.3390/brainsci11101261

18. Wyat, J.K., Bootzin, R.R., Allen, J.J., Anthony, J.L. Mesograde amnesia during the sleep onset transition: replication and electrophysiological correlates. *Sleep* 1997, 20 (7), 512-522. https://doi.org/10.1093/sleep/20.7.512

19. Prerau, M.J., Hartnack, K.E., Obregon-Henao, G., Sampson, A., Merlino, M., Gannon, K., Matt, T.B., Jeffrey, M., Purdon, P.L. Tracking the sleep onset process: an empirical model of behavioral and physiological dynamics. *PLoS computational biology* 2014, 10 (10), e1003866. https://doi.org/10.1371/journal.pcbi.1003866.

20. Hawes, S., Innes, C.R., Parsons, N., Drummond, S.P., Caeyensberghs, K., Jones, R.D., Poudel, G.R. Sleeping while awake: the intrusion of neural activity associated with sleep onset in the awake human brain. *BioRxiv* 2020. https://doi.org/10.1101/2020.06.04.133603
30. Diaz, B.A., Hardstone, R., Mansvelder, H.D., Van Someren, E.J., Linkenaer-Hansen, K. Resting-state subjective experience and EEG biomarkers are associated with sleep-onset latency. *Frontiers in psychology* 2016, 7, 492. https://dx.doi.org/10.3389/fpsyg.2016.00492

31. Ogilvie, R.D., Simons, I.A., Kuderian, R.H., MacDonald, T., Rustenburg, J. Behavioral, event-related potential, and EEG/FFT changes at sleep onset. *Psychophysiology* 1991, 28 (1), 54-64. https://dx.doi.org/10.1111/j.1469-8986.1991.tb03386.x

32. Achermann, P., Rusterholz, T., Stucky, B., Olbrich, E. Oscillatory patterns in the electroencephalogram at sleep onset. *Sleep* 2019, 42 (8), zs096. https://dx.doi.org/10.1093/sleep/zs096

33. Hermans, L.W., Leufkens, T.R., van Gilst, M.M., Weyens, T., Ross, M., Anderer, P., Vermeeren, A. Sleep EEG characteristics associated with sleep onset misperception. *Sleep Medicine* 2019, 57, 70-79. https://dx.doi.org/10.1016/j.sleep.2019.01.031

34. Kralü, K., Cajochen, C., Werth, E., Witz-Justice, A. Functional link between distal vasodilation and sleep-onset latency? *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology* 2000, 278 (3), R741-R748. https://dx.doi.org/10.1152/ajpregu.2000.278.3.R741

35. Dorokhov, V.B., Taranov, A.O., Sakharov, D.S., Gruzdева, S.S., Arsenyev, G.N., Lign, N.V., Tkachenko, O.N. Sleep latency in poor nappers under exposure to weak 2-Hz and 8-Hz electromagnetic fields. *Biological Rhythm Research* 2021, 1-9. https://dx.doi.org/10.1080/09291016.2021.1962087

36. Gorgoni, M., Bartolacci, C., D’Atri, A., Scarpelli, S., Marzano, C., Moroni, F., De Gennaro, L. The spatiotemporal pattern of the human electroencephalogram at sleep onset after a period of prolonged wakefulness. *Frontiers in Neuroscience* 2019, 312. https://dx.doi.org/10.3389/fnins.2019.00312

37. Šušmáková, K. Correlation dimension versus fractal exponent during sleep onset. *Measurement science review* 2006, 6 (4), 58-62.

38. Vecchio, F., Miraglia, F., Gorgoni, M., Ferrara, M., Iberite, F., Bramanti, P., Rossini, P.M. Cortical connectivity modulation during sleep onset: a study via graph theory on EEG data. *Human Brain Mapping* 2017, 38 (11), 5456-5464. https://dx.doi.org/10.1002/hbm.23736

39. Marzano, C., Moroni, F., Gorgoni, M., Nobili, L., Ferrara, M.; De Gennaro, L. How we fall asleep: regional and temporal differences in electroencephalographic synchronization at sleep onset. *Sleep Medicine* 2013, 14 (11), 1112–1122. https://dx.doi.org/10.1016/j.sleep.2013.05.021

40. Ogilvie, R.D. The process of falling asleep. *Sleep Med Rev* 2001, 5, 247–270. https://dx.doi.org/10.1053/smrv.2001.0145

41. Bochkarev, M.V., Korostovtseva, L.S., Medvedeva, E.A., Sviryaev, Yu.V. Actigraphy for estimation of the characteristics of sleep and wake—rhythm. *Profilakticheskaya Meditsina* 2019, 22(2), 95-100. https://dx.doi.org/10.17116/profmed20192202195

42. Rabat, A., Gomez-Merino, D., Roca-Paixao, L., Bougd, C., Van Beers, P., Dispersyn, G., Chennouri, M. Differential kinetics in alteration and recovery of cognitive processes from a chronic sleep restriction in young healthy men. *Frontiers in Behavioral Neuroscience* 2016, 10, 95. https://dx.doi.org/10.3389/fnbeh.2016.00095

43. Dijk, D.J., Groeger, J.A., Stanley, N., Deacon, S. Age-related reduction in daytime sleep propensity and nocturnal slow wave sleep. *Sleep* 2010, 33 (2), 211-223. https://dx.doi.org/10.1093/sleep/33.2.211

44. Yamazaki, E.M., Antler, C.A., Lase, M., Roca, P., Sviryaev, Yu.V. Actigraphy for estimation of the characteristics of sleep and wake—rhythm. *Profilakticheskaya Meditsina* 2019, 22(2), 95-100. https://dx.doi.org/10.17116/profmed20192202195

45. Hilditch, C.J., Centofanti, S.A., Dorrian, J., Banks, S. A 30-minute, but not a 10-minute nighttime nap is associated with sleep inertia. *Sleep* 2016, 39 (3), 675-685. https://dx.doi.org/10.5665/sleep.5550

46. Abrahamsen, A., Weihe, P., Debes, F., van Leeuwen, W.M. Sleep, sleepiness, and fatigue on board Faroese fishing vessels. *Human Psychopharmacology* 2015, 30 (8), 677-685. https://dx.doi.org/10.1093/hp/47.8.677

47. Flaa, T.A., Bjorvatn, B., Pallesen, S., Zakariassen, E., Harris, A., Gatterbauer-Trischler, P., Waage S. Sleep and sleepiness measured by diaries and actigraphy among Norwegian and Austrian helicopter emergency medical service (HEMS) pilots. *International journal of environmental research and public health* 2022, 19 (7), 4311. https://dx.doi.org/10.3390/ijerph19074311

48. Cal, A.W., Manousakis, J.E., Singh, B., Kuo, J., Jeppe, K.J., Francis-Pester, E., Anderson, C. On-road driving impairment following sleep deprivation differs according to age. *Scientific reports* 2021, 11 (1), 1-13. https://dx.doi.org/10.1038/s41598-021-99133-y

49. Hansen, D.A., Ramakrishnan, S., Satterfield, B.C., Wesensten, N.J., Layton, M.E., Reifman, J., Van Dongen, H. Randomized, double-blind, placebo-controlled, crossover study of the effects of repeated-dose caffeine on neurobehavioral performance during 48 h of total sleep deprivation. *Psychopharmacology* 2019, 236 (4), 1313-1322. https://dx.doi.org/10.1007/s00213-018-5140-0

50. Henelius, A., Sallinen, M., Huotilainen, M., Müller, K., Virkkala, J., Puumaläki, K. Heart rate variability for evaluating vigilance attention in partial chronic sleep restriction. *Sleep* 2018, 37 (7), 1257-1267. https://dx.doi.org/10.5665/sleep.3850

51. Maclean, A.W., Fekken, G.C., Saskin, P., Knowles, J.B. Psychometric evaluation of the Stanford sleepiness scale. *Journal of Sleep Research* 1992, 1 (1), 35-39. https://dx.doi.org/10.1111/j.1365-2869.1992.tb00006.x

52. Herscovitch, J., Broughton, R. Sensitivity of the Stanford sleepiness scale to the effects of cumulative partial sleep deprivation and recovery oversleeping. *Sleep* 1981, 4 (1), 83-92. https://dx.doi.org/10.1093/sleep/4.1.83

53. Izquierdo-Vicario, Y., Ramos-Platon, M.J., Conesa-Peraldeja, D., Lozano-Parra, A.B., Espinar-Sierra, J. Letter to the editor. Epworth Sleepiness Scale in a Simple of the Spanish Population. *Sleep* 1997, 20 (8), 676-677. https://dx.doi.org/10.1093/sleep/20.8.676

54. Kim, H., Young, T. Subjective daytime sleepiness: dimensions and correlates in the general population. *Sleep* 2005, 28(5), 625-634. https://dx.doi.org/10.1093/SLEEP/28.5.625
55. Ganesan, S., Magee, M., Stone, J.E., Mulhall, M.D., Collins, A., Howard, M.E., Sletten, T.L. The impact of shift work on sleep, alertness and performance in healthcare workers. *Scientific reports* 2019, 9 (1), 4635. https://dx.doi.org/10.1038/s41598-019-40914-x

56. Chandrakumar, D., Dorrian, J., Banks, S., Keage, H.A., Coussens, S., Gupta, C., Centofanti, S.A., Stepień, J.M., Loetscher, T. The relationship between alertness and spatial attention under simulated shiftwork. *Scientific reports* 2020, 10 (1), 14946. https://dx.doi.org/10.1038/s41598-020-71800-6

57. Zahrane, M.A., Alaeddini, F., Payandemehr, P., Saadat, S., Sotoodehnia, M., Bahreini, M. The influence of shift work on the psychomotor capabilities of emergency medicine residents. *Journal of the American College of Emergency Physicians Open* 2021, 2 (6), e12601. https://dx.doi.org/10.1002/emp2.12601

58. Howard, S.K., Gaba, D.M., Smith, M.R., Zarcone, V.P. The risks and implications of excessive daytime sleepiness in resident physicians. *Academic Medicine* 2017, 92 (10), 1019-1025. https://dx.doi.org/10.1097/00001888-201710000-00015

59. Maurer, L., Zitting, K.M., Elliott, K., Czeisler, C.A., Ronda, J.M., Duffy, J.F. A new face of sleep: the impact of post-learning sleep on recognition memory for face-name associations. *Neurobiology of learning and memory* 2015, 126. P. 31-38. https://dx.doi.org/10.1016/j.nlm.2015.10.012

60. Rahman, S.A., Rood, D., Trent, N., Solet, J., Langer, E.J., Lockley, S.W. Manipulating sleep duration perception changes cognitive performance—an exploratory analysis. *Journal of sleep research* 2020, 32, 109992. https://dx.doi.org/10.1111/jsr.12992

61. Vascouto, H.D., Thais, M.E.R.D.O., Osório, C.M., Ben, J., Claudino, L.S., Hoeller, A.A., Hans, J.M., Wolf, P., Lin, K., Walz, R. Is self-report sleepiness associated with cognitive performance in temporal lobe epilepsy? *Arquivos de Neuro-Psiquiatria* 2018, 76, 575-581. https://dx.doi.org/10.1590/0004-282X20180089

62. Bailes, S., Libman, E., Baltzan, M., Amsel, R., Schondorf, R., Fichten, C.S. Brief and distinct empirical sleepiness and fatigue scales. *Journal of Psychosomatic Research* 2006, 60 (6), 605-613. https://dx.doi.org/10.1016/j.jpsychores.2005.08.015

63. Staskin, D.R., Harnett, M.D. Effect of triclocarban chloride on somnolence and sleepiness in patients with overactive bladder. *Current Urology Reports* 2004, 5 (6), 423-426. https://dx.doi.org/10.1007/s11934-004-0064-0

64. De Valck, E., De Groot, E., Cluydts, R. Effects of slow-release caffeine and a nap on driving simulator performance after partial sleep deprivation. *Perceptual and motor skills* 2003, 96 (1), 67-78. https://dx.doi.org/10.2466/pms.2003.96.1.67

65. Suhner, A., Schlagenhauf, P., Tschopp, A., Hauri, B., Trachsel, M., Trachsel, M., Rack, B., Steffen, R. Impact of melatonin on driving performance. *Journal of travel medicine* 1998, 5 (1), 7-13. https://dx.doi.org/10.1111/j.1365-8305.1998.tb00448.x

66. Yang, H., Engeland, C.G., King, T.S., Sawyer, A.M. The relationship between diurnal variation of cytokines and symptom expression in mild obstructive sleep apnea. *Journal of Clinical Sleep Medicine* 2020, 16 (5), 715-723. https://dx.doi.org/10.5664/jcsm.8332

67. Kojic, B., Dostovic, Z., Ibrahimagic, O.C., Smajlovic, D., Hrdzic, R., Iljazovic, A., Salihovic, D. Risk Factors in Acute Stroke Patients With and Without Sleep Apnea. *Medical Archives* 2021, 75 (6), 444. https://dx.doi.org/10.5455/medarch.2021.75.444-450

68. Kang, H.H., Lim, C.H., Oh, J.H., Cho, M.J., Lee, S.H. The influence of gastroesophageal reflux disease on daytime sleepiness and depressive symptom in patients with obstructive sleep apnea. *Journal of Neurogastroenterology and Motility* 2021, 27 (2), 215. https://dx.doi.org/10.5056/jnm20071

69. Tippin, J., Sparks, J.D., Rizzo, M. Visual vigilance in drivers with obstructive sleep apnea. *Journal of sleep research* 2009, 18 (2), 143-151. https://dx.doi.org/10.1111/j.1365-2869.2009.00705.x

70. Bener, A., Yildirim, E., Cutken, T., Lajunen, T. Driver sleepiness, fatigue, careless behavior and risk of motor vehicle crash and injury: Population based case and control study. *Journal of Traffic and Transportation engineering (English edition)* 2017, 4 (5), 496-502. https://dx.doi.org/10.1007/s41707-005

71. Malacarne, F., Rosenthal, L., Castaño, V.A., Campos, R.M., Vergara, P., Resendiz, M., Javier Aguilar, R.A.-R., Bliwise, D.L. A factor replication of the Sleep-Wake Activity Inventory (SWAI) in a Mexican population. *Sleep 1997*, 20 (2), 111-114. https://dx.doi.org/10.1093/sleep/20.2.111

72. Mason, I.C., Grimaldi, D., Reid, K.J., Warlick, C.D., Malkani, R.G., Abbott, S.M., Zee, P.C. Light exposure during sleep impairs cardiometabolic function. *Proceedings of the National Academy of Sciences* 2022, 119 (12), e2113290119. https://dx.doi.org/10.1073/pnas.2113290119

73. Yang, M., Ma, N., Zhu, Y., Su, Y.C., Chen, Q., Hsiao, F.C., Zhou, G. The acute effects of intermittent light exposure in the evening on alertness and subsequent sleep quality. *International journal of environmental research and public health* 2018, 15 (3), 524. https://dx.doi.org/10.3390/ijerph15030524

74. Leger, D., Philip, P., Jamier, A., Metlaine, A., Choudat, D. Effects of a combination of napping and bright light pulses on shift workers' sleepiness at the wheel: a pilot study. *Journal of sleep research* 2009, 18 (4), 472-479. https://dx.doi.org/10.1111/j.1365-2869.2008.00676.x

75. Kim, H., Young, T. Subjective daytime sleepiness: dimensions and correlates in the general population. *Sleep 2005*, 28 (5), 625-634. https://dx.doi.org/10.1093/SLEEP/28.5.625

76. Wang, Y., Xin, F., Bai, H., Zhao, Y. Can variations in visual behavior measures be good predictors of driver sleepiness? A real driving test study. *Traffic injury prevention* 2017, 18 (2), 132-138. https://dx.doi.org/10.1080/15389588.2016.1203425

77. Short, M., Lack, L., Wright, H. Does subjective sleepiness predict objective sleep propensity? *Sleep 2010*, 33 (1), 123-129. https://dx.doi.org/10.1093/sleep/33.1.123
78. Gaspa, J.G., Brown, T.L., Schwarz, C.W., Lee, J.D., Kang, J., Higgins, J.S. Evaluating driver drowsiness countermeasures. Traffic injury prevention 2017, 18 (sup1), S58-S63. https://dx.doi.org/10.1080/15389588.2017.1303140

79. Wang, L., Pei, Y. The impact of continuous driving time and rest time on commercial drivers’ driving performance and recovery. Journal of safety research 2014, 50, 11-15. https://dx.doi.org/10.1016/j.jsr.2014.01.003

80. He, J., Choi, W., Yang, Y., Lu, J., Wu, X., Peng, K. Detection of driver drowsiness using wearable devices: A feasibility study of the proximity sensor. Applied ergonomics 2017, 65, 473-480. https://dx.doi.org/10.1016/j.apergo.2017.02.016

81. Li, R., Chen, Y.V., Zhang, L. A method for fatigue detection based on Driver’s steering wheel grip. International Journal of Industrial Ergonomics 2021, 82, 103083. https://dx.doi.org/10.1016/j.ergon.2021.103083

82. Hu, X., Eberhart, R., Foresman, B. Modeling drowsy driving behaviors. In Proceedings of 2010 IEEE International Conference on Vehicular Electronics and Safety. 15-17 July 2010. pp. 13-17. https://dx.doi.org/10.1109/ICVES.2010.5550949

83. Smith, S.S., Horswill, M.S., Chambers, B., Wetton, M. Hazard perception in novice and experienced drivers: The effects of sleepiness. Accident Analysis and Prevention 2009, 41 (4), 729-733. https://dx.doi.org/10.1016/j.aap.2009.03.016

84. Chang, Y.L., Feng, Y.C., Chen, O.T.C. Real-time physiological and facial monitoring for safe driving. In Proceedings of the 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC). 16-20 August 2016. pp. 4849-4852. https://dx.doi.org/10.1109/EMBC.2016.7591813

85. Chai, R., Ling, S.H., San, P.P., Naik, G.R., Nguyen, T.N., Tran, Y., Ashley, C., Hung, T., Nguyen, H.T. Improving EEG-based driver fatigue classification using sparse-deep belief networks. Frontiers in neuroscience 2017, 11, 103. https://dx.doi.org/10.3389/fnins.2017.00103

86. Yao, Y., Zhao, X., Du, H., Zhang, Y., Zhang, G., Rong, J. Classification of fatigued and drunk driving based on decision tree methods: a simulator study. International journal of environmental research and public health 2019, 16 (11), 1935. https://dx.doi.org/10.3390/ijerph16111935

87. He, J., Choi, W., Yang, Y., Lu, J., Wu, X., Peng, K. Detection of driver drowsiness using wearable devices: A feasibility study of the proximity sensor. Applied ergonomics 2017, 65, 473-480. https://dx.doi.org/10.1016/j.apergo.2017.02.016

88. Höhn, C., Schmid, S.R., Plamberger, C.P., Bothe, K., Angerer, M., Gruber, G., Pletzer, B., Hoedlmoser, K. Preliminary Results: The Impact of Smartphone Use and Short-Wavelength Light during the Evening on Circadian Rhythm, Sleep and Alertness. Clocks&Sleep 2021, 3, 66–86. https://dx.doi.org/10.3390/clocksleep3010005

89. Milej, A.A., Kecklund, G., Åkerstedt, T. Comparing two versions of the Karolinska Sleepiness Scale (KSS). Sleep Biol Rhythms 2016, 14 (3), 257-260. https://dx.doi.org/10.1007/s41105-016-0048-8

90. Levin, Ia.I., Eligulashvili, T.S., Posokhov, S.I., Kovrov, G.V., Bashmakov, M.Y. Farmakoterapiia insomnii: rol’ Imovana. In Sleep disorders; Aleksandrovskii Iu.A., Vein A.M. Eds.; Med. inform. Agentstvo: Saint Peersburgh, Russia, 1995, pp. 56–61.

91. Shahid, A., Wilkinson, K., Marcu, S., Shapiro, C.M. Karolinska Sleepiness Scale (KSS). In: Shahid, A., Wilkinson, K., Marcu, S., Shapiro, C. (eds) STOP, THAT and One Hundred Other Sleep Scales. Springer: New York, USA, 2011. https://dx.doi.org/10.1007/978-1-4419-9893-4_47