# Psychoactive Substance Use and Wakefulness in Young Adults

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**Abstract**

Excessive daytime sleepiness (EDS) is one of the most prevalent sleep-related problems, known for causing impairments in functioning which often leads to decreased occupational performance and is one of the leading contributors to motor vehicle accidents. Certain substances are known to induce EDS or to worsen its symptoms in users. In this study, the severity of psychoactive substance use (SPSU) and EDS in a sample of 137 young adults were examined with the goal of determining the correlational relationship between EDS, SPSU, and caffeine consumption. A questionnaire was created in order to assess these variables, including an adaptation of the Epworth Sleepiness Scale (ESS) and the Tobacco, Alcohol, Prescription medications, and other Substances (TAPS) Tool. Calculation of the correlations was facilitated by regression analyses of the variables. In the general sample, caffeine consumption was positively correlated to SPSU, and EDS was neither correlated to general SPSU, nor did it show a correlation to caffeine consumption. However, a weak positive correlation between employment types and SPSU was found. Contrary to the hypotheses, SPSU or caffeine consumption could not predict EDS in the general population.

## Introduction

With an estimated prevalence of 18-20% within the general population, excessive daytime sleepiness (EDS) is one of the most common sleep-related health problems (Pagel, 2009; Slater, & Steier, 2012). EDS is defined as the heightened potential to fall asleep or dose off during the daytime (NHS, 2021). In a recent study by Gandhi et al. (2021), EDS was reported to cause symptoms of functional impairment in 15.6% of the general population and a decrease in cognitive abilities, often resulting in significantly lower academic performance and graduation rates in students (Pagel et al., 2007). Furthermore, compromised professional performance has been reported in several occupational fields (Grunstein, & Banerjee, 2007; Chen et al., 2008). Generally, EDS also correlates to poor general health (Sforza et al., 2002).

Determinants of EDS have been studied extensively. Some common causes include sleep deprivation, obstructive sleep apnoea (Young et al., 1997), sleep disorders and other psychological and medical conditions – e. g. chronic pain or depression – as recorded by the American Academy of Sleep Medicine in the International Classification of Sleep Disorders (ICSD-3; 2014). Additionally, the use of certain medication and substances is a prevalent contributor to EDS (Auger & Morgenthaler, 2005; pp. 175–182). Numerous studies have further reported on the significant negative effect of sleep deprivation on attention, working memory and other cognitive functions (Frenda & Fenn, 2016; Alhola & Polo-Kantola, 2007).

Furthermore, the nature of sleep is often socially driven and highly influenced by the environment of the individual (see Figure 1), as Grandner (2017) illustrates in his adaptation of the socio-ecological model (Bronfenbrenner, 1979). Therefore, sleeping behaviours are largely subject to societal and interpersonal factors. Unfortunately, especially in Western populations, the dire effects of sleep deprivation and daytime sleepiness are often underrepresented in education and social norms (Grandner, 2017). Alarmingly, this is despite daytime sleepiness being one of the leading contributing factors to motor vehicle accidents, as previous studies have shown (National Sleep Foundation, 2008; NTSB, 1995).

Over the past decades, sleep duration in adults has decreased significantly (Bixler, 2009) and the average sleep duration of Americans in 2015 was 6 or fewer hours (Ford et al., 2015), contrasting the recommended average of at least 7 hours per night (Watson et al., 2015). This is further reflecting a societal neglect of the importance of maintaining cognitive awareness and functioning throughout the day by managing a healthy sleep schedule.

**Figure 1.**

*Socio-Ecological Model of Sleep (Grandner, 2017)*


*Note.* This figure demonstrates the three influencing factors of individual sleep quality. The societal level and its elements have an indirect effect on sleep quality by influencing the social level together with its components, which in turn influences the individual level and its parts. Each of these levels affect the quality and quantity of individually experienced sleep.

Although sleep deprivation and low sleep quality are some of the most common causes of sleepiness and are thus largely focused on by research, it is imperative to take into consideration alternative causes that may affect a person's level of wakefulness positively or negatively such as psychoactive substance use (PSU). Psychoactive (or psychotropic) substances are drugs or other substances which affect mental processes such as perception, mood, or emotions (World Health Organization, 2019). Due to these alterations to the central nervous system (CNS), some psychoactive substances can have a very high potential for dependence and addiction. Psychotropic substances range from prescribed medications to caffeine and alcohol intake, as well as recreational drug use such as cannabis, amphetamines, etcetera.

Substances that have been shown to affect wakefulness levels in consumers consist not only of sleep medications and hormones like melatonin, which can be taken for sleep

problems, but also, due to side-effects, of prescribed medications with psychoactive effects such as mood stabilisers and antihistamines (National Health Service, 2020). Additionally, caffeine consumption can achieve a temporary effect of wakefulness due to the blockage of adenosine receptors in the brain (López-Cruz et al., 2018), leading in the long-term to tiredness and sleep disturbances. Furthermore, the use of stimulants and recreational drugs such as amphetamines and methylphenidate, increases alertness, attention, and energy (National Institute on Drug Abuse, 2014). On the contrary, CNS-depressants tend to induce sleepiness and fatigue by increasing the activity of gamma-aminobutyric acid (GABA) (National Institute on Drug Abuse, 2021).

Recreational substance use is especially prevalent in young people. This is a relatively ubiquitous observation and generally counts for most countries and drugs. Recreational substance use is especially prevalent in young people, a relatively ubiquitous observation that generally counts for most countries and drugs. The United Nations Office of Drugs and Crime in the World Drug Report (2018) found that in the prior year, European people aged 15 to 24 years old, followed closely by 25- to 34-year-olds, consumed the widest range and largest amount of drugs in both the past year and month. In the U.S., 18- to 25-year-olds displayed drug use that significantly outnumbered the younger and older sample. Especially college students, usually being young adults, tend to display a high rate of psychoactive substance use, although their non-college attending peers are more likely to develop substance use disorders (Skidmore et al., 2016).

In a study by Boys et al. (2001), it was found that generally, most common motivations for illicit substance use among young adults in the UK include using to relax, to become intoxicated, especially using stimulants in order to stay awake, to enhance an activity, and to alleviate depressed mood. Frequent responses also indicated using cannabis for sleep, and stimulants to induce euphoria or to feel better, as well as to decrease boredom.
When it comes to the consumption of party drugs such as alcohol, peer pressure is a significant determinant for college students (Bosari & Carey, 2016) since young people surrounded by their peers tend to be prone to this phenomenon.

Some students revert to substance use for different reasons such as managing the workload associated with their study. Whether it is Ritalin, Adderall, or other stimulants, it is estimated that up to 20% of college students abuse ADHD prescription stimulants mostly to help them focus and study (Kennedy, 2018; Marraccini, et al., 2016), thereby often neglecting healthy sleep hours (Stein et al., 2012). Especially in individuals who do not display symptoms of ADHD, this can additionally induce states of paranoia, euphoria, and heightened

energy (National Institute on Drug Abuse, 2012). However, also considered a stimulant, caffeine is generally the most widely used substance used to counteract sleepiness (López-Cruz et al., 2018), popularly consumed in the form of, for example, coffee or energy drinks among young adults. Caffeine generally displays weaker effects on the CNS, but the nature of symptoms is comparable to those of prescription or illicit stimulants, involving for example insomnia, restlessness, nervousness, and increased heart rate, which can increase significantly when interacting with other stimulants (WebMD, n.d.).

As outlined, prevalent motivations of substance use include staying awake, focusing, and counteracting general sleepiness, especially with caffeine and illicit or prescription stimulants. A busy daytime schedule, including extensive work- or study-hours could therefore lead to increased stimulant use. Furthermore, one of the most common reasons for general psychoactive substance use is relaxation. The desire for relaxation is a common response to stress and therefore also expected to be related to a busy daytime schedule.

Summarising the previous sections, EDS is highly prevalent and can have severe negative effects on daily cognitive and motor-functioning. One important determinant of EDS is substance use, which is widespread in young adults. Consequently, in this study, the goal was to determine the relationship between EDS and the severity PSU in young adults. Based on past literature, it is hypothesised that PSU severity has a positive correlation with EDS in young adults. Additionally, taking into consideration that caffeine is the most widely used substance and is well-known to cause sleep disturbances, it is expected that it also positively correlates with EDS, and will hence be included in the analyses. Finally, as it is expected that daytime tasks like study, work, and sleep schedules may also possibly contribute to the correlation between EDS and PSU, this factor was included in the analyses as a control.

# Methods

## Participants

The goal was to recruit approximately 140 participants in order to gain a large and extensive sample for research and to control for expected dropouts, as well as incomplete or unusable responses. For these reasons, a self-administered online questionnaire was chosen and developed to facilitate reaching a high quantity of participants. Additionally, online recruitment made it possible to ensure complete anonymisation of responses and made data collection less obtrusive, which is beneficial when handling personal and sensitive data like drug and medication abuse, as was the case in this study.

In order to specifically target young adults, for the participant recruitment convenience sampling was applied and the questionnaire was published on the platform Sona Systems. Offering the opportunity to participate and gain 0.25 of the credits necessary to complete a study programme ensured the participation of part-time and full-time students at the University of Twente, which tend to consist largely of young adults. To furthermore ensure sample variation and to include different employment groups such as part-time and full-time workers, as well as trainees and unemployed persons, the questionnaire was also linked and advertised on the researcher's private account on the social media network Instagram. The eligibility requirements for participation included sufficient knowledge of the English language, and a minimum and maximum age of 18 and 30 years respectively, as the target group of young adults is defined in this study. In total, 149 responses were recruited, 108 by the use of Sona systems and 41 by the use of social media.

## Materials

The questionnaire that was used for data collection contained 26 ordered items in total (Appendix A) and was administered online. To proceed to said items, the participant had to agree to the Information and Consent form (Appendix B) provided at the beginning of the questionnaire. The first three items consisted of demographical questions about nationality, gender, and age, followed by an item about the current employment status.

### *Employment status*

Employment status was categorised into four main groups. Respondents indicating no work- or study-hours at the time of participating were labelled as unemployed. Participants indicating only study-hours were labelled as student, whereas participants who only indicated working hours were categorised as worker. The fourth group was student-worker hybrid, which was applied when an individual indicated both study- and work-hours.

***Excessive daytime sleepiness***

To assess excessive daytime sleepiness, the *Epworth Sleepiness Scale (ESS)* (Johns, 1991) was included with minor adjustments by the researcher (see Appendix A). This scale consists of 8 items that are rated on a four-point Likert scale from 0 to 3 with higher scores indicating more sleepiness (e. g., "How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired?" – e. g. item 6: "Sitting and talking to someone"). Item 2 of the ESS "Watching TV" was adjusted by adding "/Netflix etc." to adapt it to the generational shift from television to streaming services. The total scores can be scored into four categories: normal (0-10), mild (11-14), moderate (15-17), and severe daytime sleepiness (18-24).The psychometric properties of the ESS include an average Cronbach's alpha of 0.82 (Johns,1992; Hagell & Broman, 2007), indicating high internal consistency, and an intraclass correlation coefficient (ICC) varying between 0.81 and 0.93 (e. g. Gibson et al. 2006; Izci et al. 2007; van der Heide et al. 2015), which indicates high reliability as well.

***Substance use***

The last section of the online questionnaire was aimed at measuring the variable psychoactive substance use. This part held 10 items, each targeting a subcategory of legal, illicit, or prescription substance use (e. g. item 2a "In the **past 2 weeks**, how many tobacco containing cigarettes (or other tobacco containing products – please specify) did you smoke *on average in a day*?"). The categorisation of the psychoactive substance use section was adapted from the *Tobacco, Alcohol, Prescription medications, and other Substance (TAPS) Tool – Part 2* from the NIDA Clinical Trials Network (McNeely et al., 2016). The TAPS shows high sensitivity and specificity in identifying substance use disorders (SUDs) in all substance categories (McNeely et al., 2016). Several items were slightly adjusted to tailor it to the time-frame (2 weeks instead of 3 months) and the aims of this study, such as using European brand names in addition to the American ones and the metric system instead of the imperial system. Finally, an item on caffeine consumption was added to the beginning of this section (see Appendix A), for which the response options were means of caffeine consumption along with their usual European serving sizes (Bühler et al., 2014).

***Data collection and analysis***

The platform Qualtrics.com was used for the questionnaire design and data collection, and the evaluation and data analysis were facilitated by Microsoft Excel, IBM SPSS 25, and R/RStudio. The variable PSU was transformed into "severity of psychoactive substance use"

(SPSU) by combining the amount of substances consumed over the span of two weeks and their harm to the user (see Appendix D), adapted from a study by Bonnet et al. (2020).

The means and standard deviations of the different variable measurements were calculated, and correlation analyses were conducted to investigate the relationship between SPSU, EDS, and caffeine consumption in order to investigate hypotheses 1 and 2. To investigate hypothesis 3, a regression analysis was conducted using SPSU and caffeine consumption to predict EDS. Additionally, it was controlled for possible interactions with age or gender by conducting a regression analysis assessing the correlation of SPSU and EDS in three different age ranges and by gender.

# Results

## Demographics

After the exclusion of unusable responses due to incompleteness or the rejection of the informed consent form, the number of responses totalled 137. Of these, 101 (73.7%) of which were female, 34 (24.8%) male, and 2 (1.5%) either did not indicate their gender or indicated "other". The age of the participants ranged from 18 to 30 years with a mean of 21.39 (SD = 2.48). Nationalities were predominantly European (see Table 1).

**Table 1.**

**Frequencies and percentages of nationalities**

| Nationality | Frequency | Percent |
|---|---|---|
| Brazilian | 1 | .7 |
| British | 1 | .7 |
| Bulgarian | 2 | 1.5 |
| Canadian | 1 | .7 |
| Croatian | 1 | .7 |
| Dutch | 23 | 16.8 |
| German | 85 | 62.0 |
| Greek | 1 | .7 |
| Indian | 1 | .7 |
| Italian | 1 | .7 |
| Jordanian | 1 | .7 |
| Lithuanian | 1 | .7 |
| Macedonian | 1 | .7 |
| Malaysian | 2 | 1.5 |
| Moldovan | 1 | .7 |
| N/A | 2 | 1.5 |
| Polish | 1 | .7 |
| Portuguese | 1 | .7 |
| Romanian | 3 | 2.2 |
| Russian | 1 | .7 |
| Spanish | 2 | 1.5 |
| Syrian | 1 | .7 |
| Turkish | 2 | 1.5 |
| United States of America | 1 | .7 |
| Total | 137 | 100.0 |

## Employment status

As for the variety of employment statuses within the sample, most of the respondents indicated being full-time students which was categorised by studying between 20 and 40 hours per week. Following this were full-time workers with working hours ranging between

20 and 40 hours per week. Next were those reporting enrolment in a full-time study and simultaneously working part-time, which was categorised as up to 20 hours of work per week. Even fewer of the respondents were unemployed at the time of recording. Four participants indicated studying part-time while also working a part-time job. Furthermore, three respondents were part-time workers, two were part-time students, one person reported being a full-time student with a full-time job, and another reported being a part-time student with a full-time job. The frequencies and percentages of employment statuses within the sample are summarised in Table 2.

**Table 2**.

**Frequencies and percentages of employment statuses**

| Employment status | Frequency | Percent |
|---|---|---|
| Full-time student | 100 | 73.0 |
| Full-time worker | 12 | 8.8 |
| Full-time worker, full-time student | 1 | .7 |
| Part-time student | 2 | 1.5 |
| Part-time student part-time worker | 4 | 2.9 |
| Part-time student, fullworker | 1 | .7 |
| Part-time worker | 3 | 2.2 |
| Part-time worker, full-time student | 8 | 5.8 |
| Unemployed | 6 | 4.4 |
| Total | 137 | 100.0 |

The employment variable was then transformed into two different ordinal variables for feasibility in regression analysis. For the first variable, *employment by hours* (see Table 3), five categories were established: unemployed, part-time hours – consisting of part-time students and part-time workers. The second category, full-time hours, consisted of full-time students, full-time workers, and hybrids who work part-time and study part-time. The fourth category – more than full-time – consisted of hybrids working a full-time job and being enrolled in a part-time study, and hybrids studying full-time and having a part-time job. The fifth category – double full-time – consisted of respondents working full-time and studying full-time. For the second ordinal variable, *employment by type*, respondents were categorised into four groups: unemployed, students, workers, and student-worker hybrids (see Table 4).

**Table 3.**

**Frequencies and percentages of employment subgroups by hours**

| Employment by hours | Frequency | Percent |
|---|---|---|
| **unemployed** | 6 | 4.4 |
| **Part-time** | 2 | 1.5 |
| **Full-time** | 119 | 86.9 |
| **> Full-time** | 9 | 6.6 |
| **Double full-time** | 1 | .7 |
| **Total** | 137 | 100.0 |

**Table 4.**

**Frequencies and percentages of employment subgroups by type**

| Employment by type | Frequency | Percent |
|---|---|---|
| **Unemployed** | 6 | 4.4 |
| **Students** | 102 | 74.5 |
| **Workers** | 15 | 10.9 |
| **Student-worker hybrids** | 14 | 10.2 |
| **Total** | 137 | 100.0 |

**EDS, caffeine consumption, and SPSU**

The mean total score on the ESS within the general sample was 8.38 (SD = 3.79), which is categorised as "*normal*". The scores ranged from a minimum of 0 to a maximum of 18 out of 24. The mean units of caffeine consumed per day were 2.32 (SD = 2.4) with a minimum of 0 and a maximum of 13.63 units of caffeine. The SPSU displayed a mean of 6.91 (SD = 10.41) amongst the sample size, with a minimum score of 0 and a maximum of 71.4.

**Correlations**

First, it was tested whether caffeine consumption correlates with SPSU by calculating the Pearson Correlation Coefficient. Caffeine consumption and SPSU were positively correlated ($r = .223$, $p < .05$), as illustrated in Figure 2. When testing for the relationship between ESS and SPSU within the general sample, the two variables were shown to have no significant correlation in the general population. SPSU showed no correlation to the total scores of the ESS ($r = .03$, $p > .05$), nor to the categorised results of the ESS ($r = -.011$, $p > .05$). There was no significant difference between female and male participants as can be seen

in Figure 3. Therefore, the first null-hypothesis could not be rejected. Two participants that identified as another gender or did not indicate their gender were treated as outliers and excluded from the gender variable since the sample size was too small to analyse a correlation among them.

**Figure 2**.

**Correlation between consumed units of caffeine and SPSU**

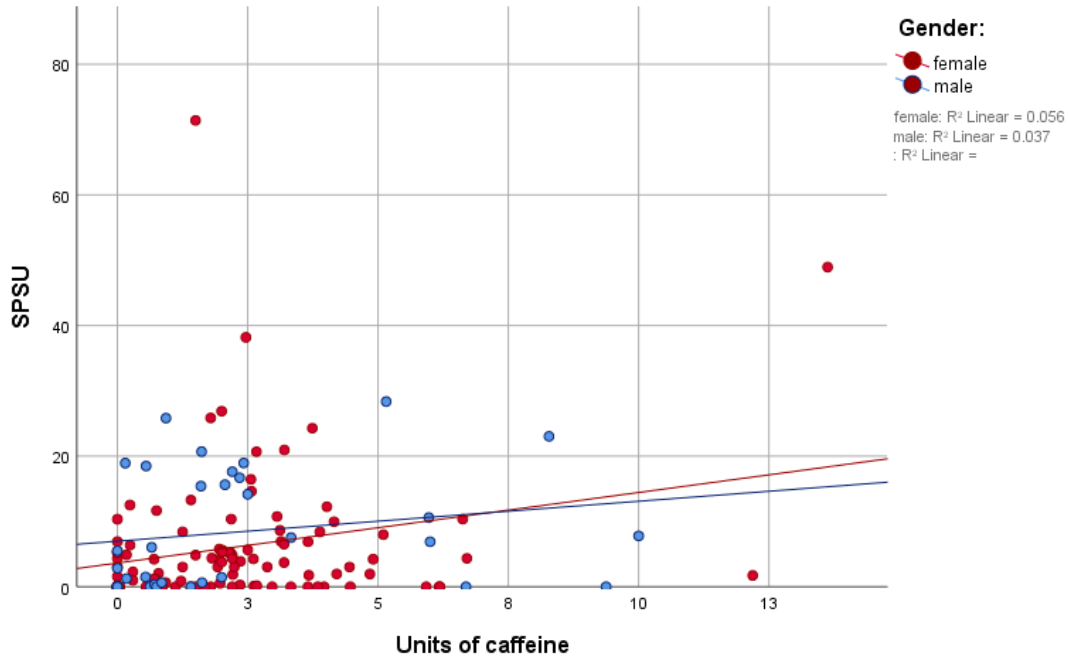
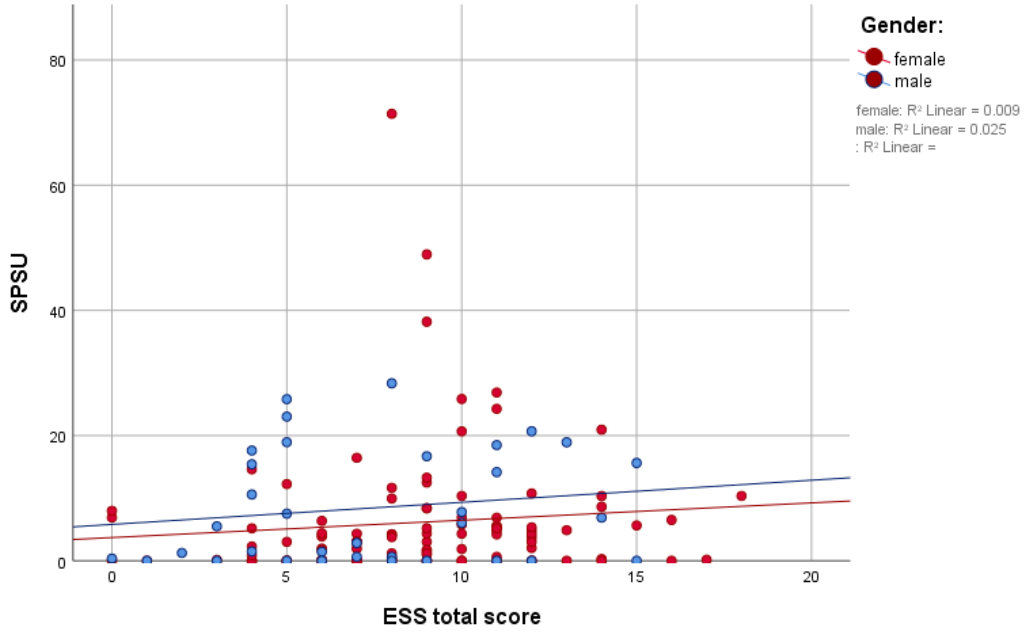



**Figure 3**.

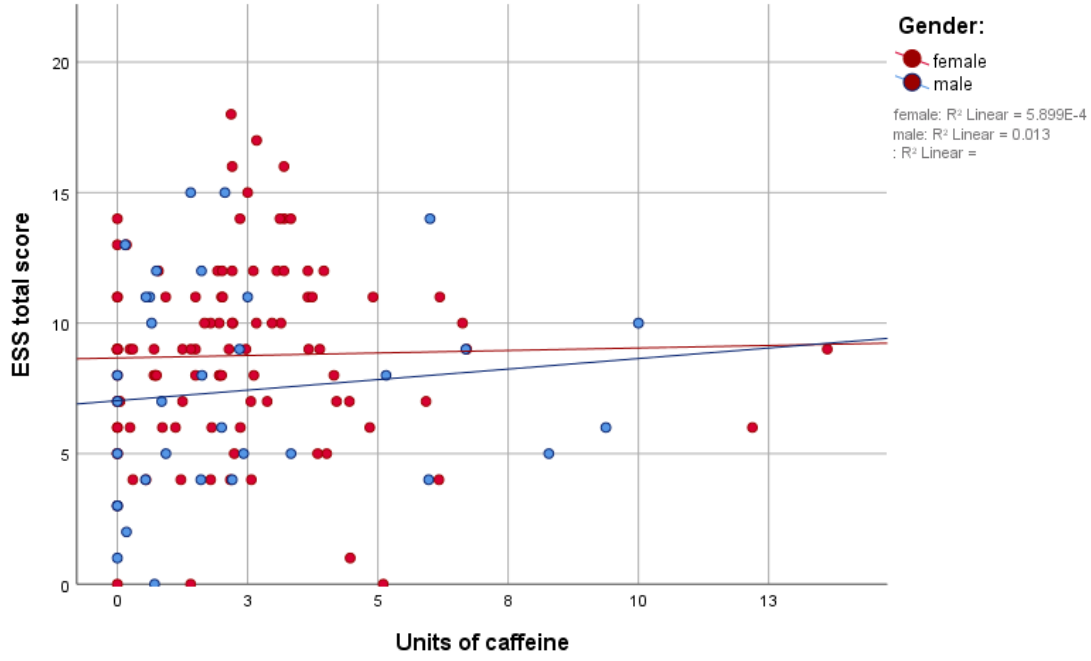
**Correlation between the total score of the Epworth Sleepiness Scale and SPSU**



Even though the correlation was slightly stronger, caffeine consumption and EDS also showed no significant relation among the general sample ($r$ = .038, $p$ > .05), as shown in Figure 4. Hence, the second null-hypothesis could not be rejected either. This held true for both female ($r$ = .024, $p$ > .05) and male ($r$ = .114, $p$ > .05) respondents.

**Figure 4**.

**Correlation of caffeine consumption and EDS as assessed by the total score on the ESS**




Examining the relationship of employment status with EDS has shown that among all employment groups, there is no significant correlation. First, respondents were categorised per employment hours. For this categorisation the relationship between the ESS total score and employment hours was insignificant ($r$ = .131, $p$ > .05). The mean total ESS scores per subgroups of employment by hours are illustrated in Figure 5.

**Figure 5**.

**EDS as assessed by mean total ESS scores by hours of employment**

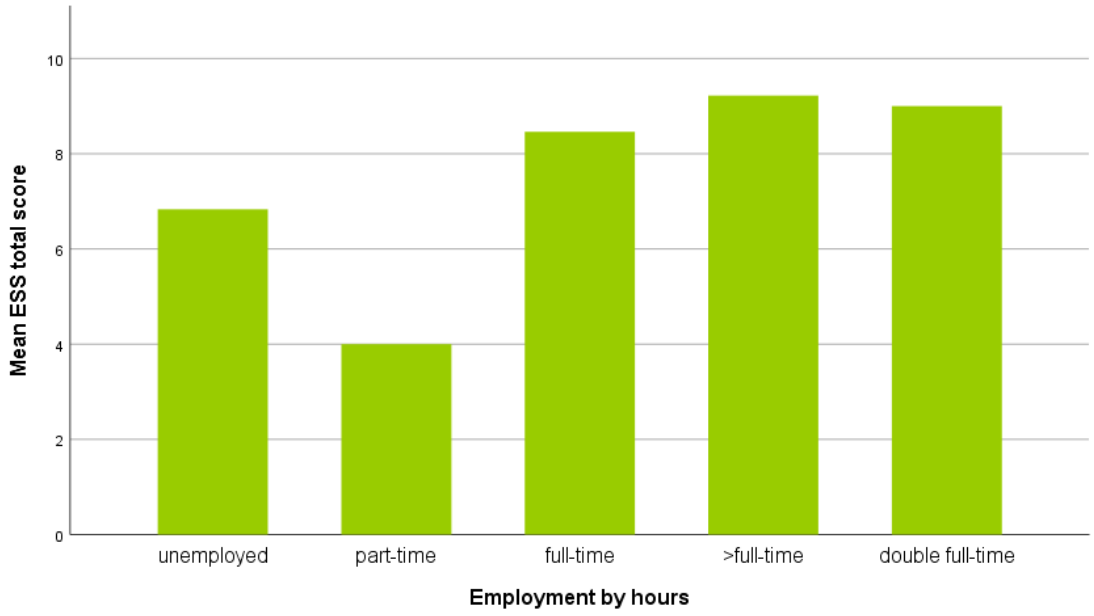
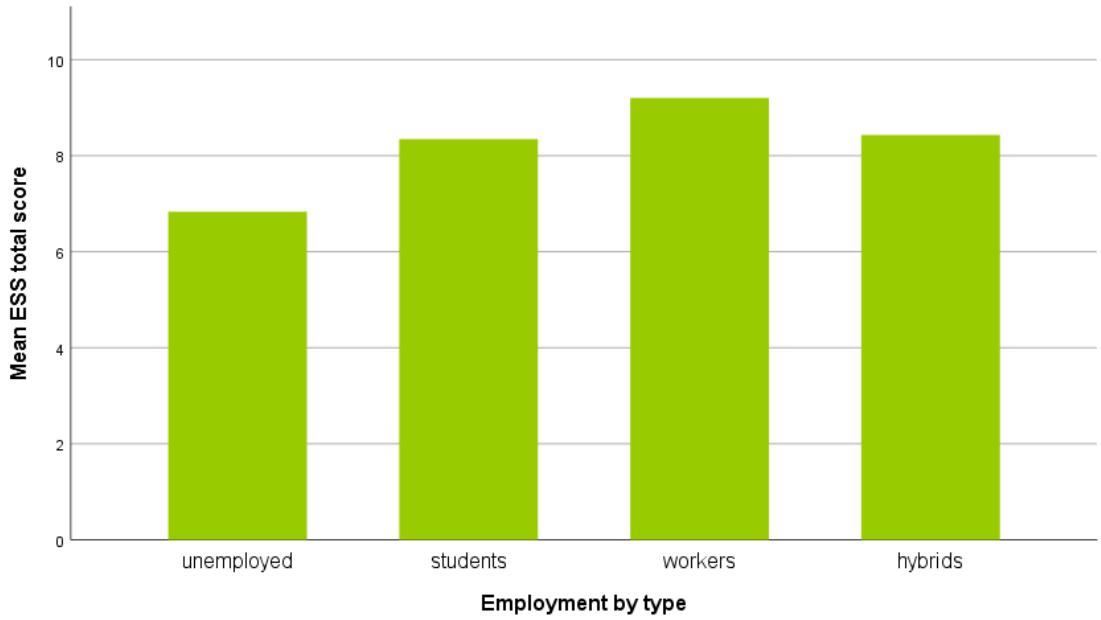



**Figure 6**.

**EDS as assessed by mean total ESS scores by type of employment**




Next, in order to see if either the type of employment or employment by hours correlate with SPSU, units of caffeine consumed, or EDS, an analysis was next carried out for these variables. The Pearson Correlation Coefficients are summarised in Table 5. Means of

the total ESS score by employment type are shown in Figure 6. The Pearson Correlation Coefficient once again showed no significant correlation between these categories and ESS total scores ($r$ = .064, $p$ > .05). The same procedure was carried out for the relationship of SPSU and employment hours. No significant correlation could be found between employment hours and SPSU ($r$ = .105, $p$ > .05) or units of caffeine consumed ($r$ = -.013, $p$ > .05), neither was there a correlation between employment types and units of caffeine consumed ($r$ = .025, $p$ > .05). However, there was a moderate positive correlation of employment types with SPSU ($r$ = .212, $p$ < .05). The SPSU mean by employment type and employment hours is displayed in Figure 7.

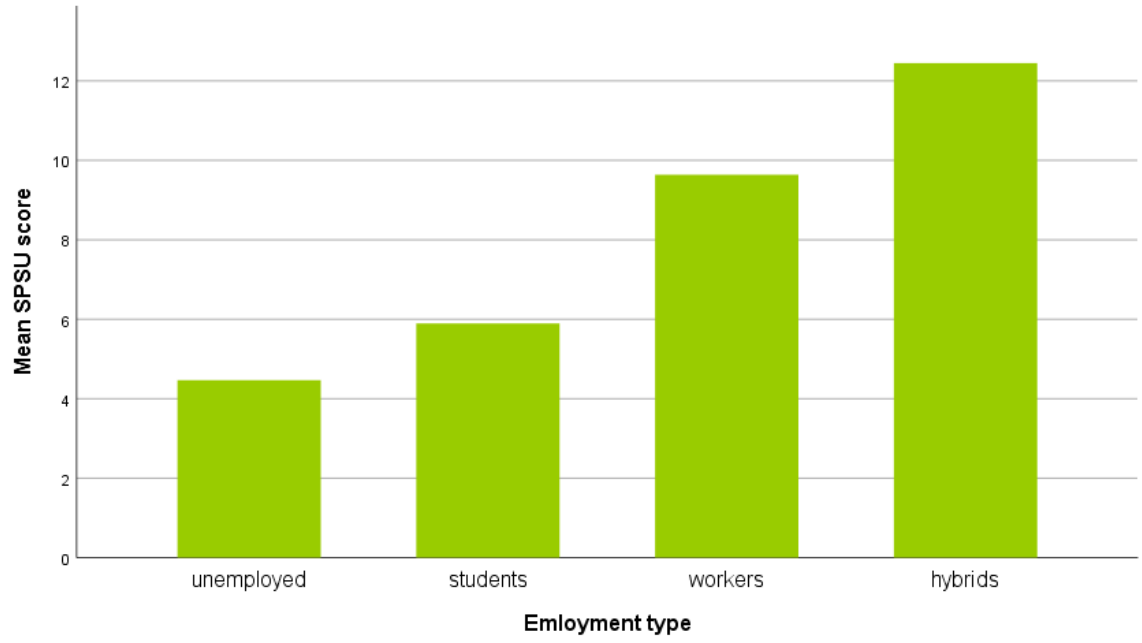
**Table 5**.

**Correlations between employment by type/hours and SPSU, units of caffeine, as well as EDS, as assessed by total scores on the ESS**

| Employment | | SPSU | Units of caffeine | ESS total score |
|---|---|---|---|---|
| **Employment by type** | Pearson Correlation | .212 | .025 | .064 |
| | Sig. (2-tailed) | .013 | .771 | .461 |
| | N | 137 | 137 | 137 |
| **Employment by hours** | Pearson Correlation | .105 | -.013 | .131 |
| | Sig. (2-tailed) | .223 | .881 | .126 |
| | N | 137 | 137 | 137 |

**Figure 7**.

**Mean SPSU scores by type of employment**



Since the categorisation of employment by type showed correlation to SPSU, this variable was chosen for a regression analysis to examine the correlation of EDS and SPSU for each subgroup. A visual representation of these correlations is displayed in Figure 8. The calculation of the Pearson Correlation Coefficient showed that there was no significant correlation for students ($r$ = .095, $p$ > .05) or workers ($r$ = -.121, $p$ > .05), however a strong significant negative correlation was found in the unemployed subgroup ($r$ = -.588, $p$ < .05) and a moderate negative relationship in the hybrid group ($r$ = -.309, $p$ < .05). These values are summarised in Table 6.

**Figure 8**.

**Scatterplot of the correlation between EDS and SPSU by employment type**

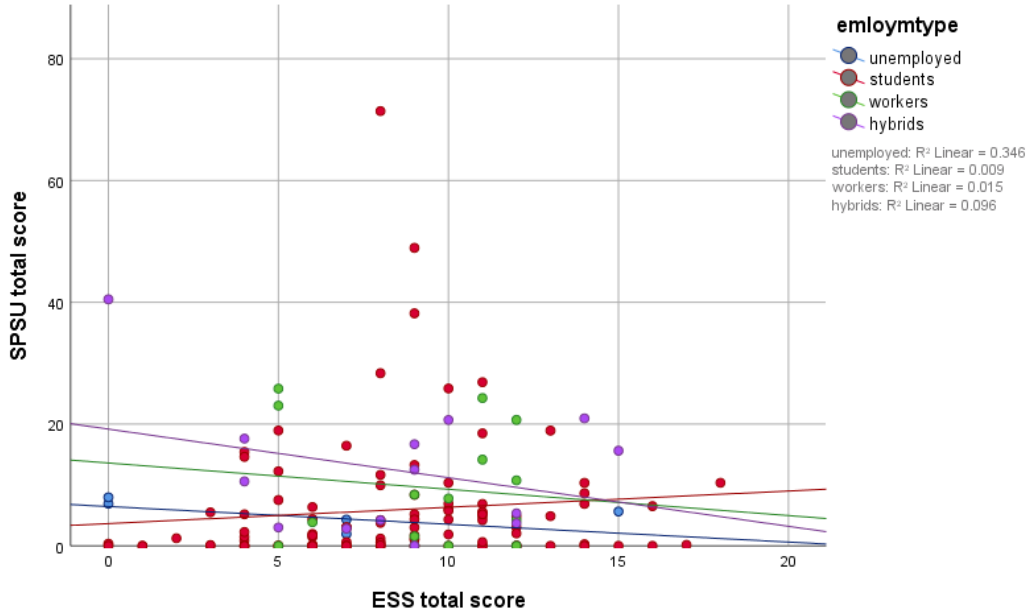



**Table 6**.

**Correlation between EDS and SPSU by employment type**

| **Employment Type** | | | **SPSU score** |
|---|---|---|---|
| **Unemployed** | ESS score | Pearson Correlation | -.588 |
| | | Sig. (2-tailed) | .219 |
| | | N | 6 |
| **Students** | ESS score | Pearson Correlation | .095 |
| | | Sig. (2-tailed) | .343 |
| | | N | 102 |

| | | | |
|---|---|---|---|
| **Workers** | ESS score | Pearson Correlation | -.121 |
| | | Sig. (2-tailed) | .668 |
| | | N | 15 |
| **Hybrids** | ESS score | Pearson Correlation | -.309 |
| | | Sig. (2-tailed) | .282 |
| | | N | 14 |

Finally, it was examined whether there is a correlation between SPSU and EDS by age. For that purpose, respondents were categorised into age ranges of 18 to 21 years, 22 to 26 years, and 27 to 30 years. As can be seen in Table 7, among the youngest age range, the correlation was $r = .04$ ($p > .05$), among the mid-range, the correlation was $r = .001$ ($p > .05$), and within the oldest range, the correlation was $r = -.15$ ($p > .05$). Hence, no significant correlations could be found in either of the age ranges.

**Table 7.**

**Correlations of SPSU and EDS, as assessed by the total score on the ESS, by age range**

| **Age range** | | | **SPSU score** |
|---|---|---|---|
| **18-21** | ESS total score | Pearson Correlation | .040 |
| | | Sig. (2-tailed) | .730 |
| | | N | 75 |
| **22-26** | ESS total score | Pearson Correlation | .001 |
| | | Sig. (2-tailed) | .995 |
| | | N | 57 |
| **27-30** | ESS total score | Pearson Correlation | -.150 |
| | | Sig. (2-tailed) | .810 |
| | | N | 5 |

**Regression**

Multiple linear regression was used to test whether SPSU, employment types, age, or gender, predicted EDS. The fitted regression model was: EDS = 5.747 + .230 (age) * -1.884 (gender) * .018 (SPSU). The overall regression was statistically insignificant ($R^2 = .052$, $F(3, 133) = 2.409$, $p = .041$).

It was found that SPSU did not significantly predict EDS ($\beta = .48$, $p = .575$).

Furthermore, it was found that age did not significantly predict EDS ($\beta$ = -.239, p = .106). And finally, it was shown that gender did not significantly predict EDS either ($\beta$ = .048, p = .011).

## Discussion

The purpose of this research was to examine the relationship between excessive daytime sleepiness and the severity of psychoactive substance use in young adults. Analyses of the sample produced interesting results. Contrary to what was hypothesised, it was found that there was no significant correlation between excessive daytime sleepiness and substance use, or caffeine consumption in the general sample. This was observed independently of age or gender. When the sample was split into groups of different employment types, however, it was observed that there were negative correlations of EDS and SPSU in both unemployed people and hybrids, that is people working a job while also being enrolled in a study. Furthermore, a positive correlation was found between caffeine consumption and the consumption of other psychotropic substances in the general population, implying that these variables are tightly associated with each other.

Although extensive past research has shown strong effects of certain drugs on wakefulness levels of users, there are several possible explanations as to why no positive correlation was observed between EDS and SPSU or caffeine consumption Since the study did not distinguish between different types of psychoactive drugs – only the amount being consumed on average per day as well as their respective harm to the user – drug categories could potentially be a confounding variable in this relationship. For example, although the stimulant caffeine is known for causing sleep disturbances, its effect of alertness and wakefulness generally wear out over time and allow the consumer to sleep normally if consumed early enough before sleep. On the other hand, sleep medication or CNS-depressants that have an inhibitory effect on the nervous system generally have a sedative effect, and when taken for sleep problems such as insomnia, can facilitate a healthier sleep and in turn diminish fatigue and tiredness. Each of these substance groups show strong effects on sleep and wakefulness levels, however, depending on the context and time of use, can have polarising outcomes.

These outcomes are furthermore dependent on the regularity, frequency, and duration of use which would pose the possibility of more confounding variables. The tool that was developed measured the average amount of use of each substance per day over the past two weeks. This is beneficial when researching the quantity and harm of the drug consumed over time, but nevertheless made it impossible to assess whether a respondent has, for example, consumed this made it impossible to assess whether a respondent has for instance consumed seven alcoholic drinks at one event or approximately half a drink each day. Frequency and regularity may therefore have a hidden effect on EDS, which cannot be assessed by means of

this study. Additionally, it is beneficial to know whether respondents display symptoms of or are diagnosed with a substance use disorder and if so, for how long this has been present.

Furthermore, to gain an extensive scope of the individual circumstances of use, necessary information would include whether participants have been prescribed with medications for a certain clinical diagnosis, and for how long they have been taking these. Long-term use of a substance will cause the CNS to build up a tolerance, sometimes even cross-tolerance, which requires the user to ingest more of a substance to achieve the same strength of effects. Upon consumption, prescribed medication can additionally display different symptoms in people with associated diagnoses than in those without an associated disorder. To illustrate, stimulants like methylphenidate or amphetamines are often prescribed for individuals suffering from ADHD to induce a calm and focused state, whereas they can produce a rather contrasting state of euphoria or paranoia in people without ADHD. In short, the development of tolerance and whether the drug is taken to treat an underlying disorder or not might have affected the relationship as well.

Generally speaking, drug interactions and neurotransmitter mechanisms within different individuals are complex topics and still extensively discussed subjects in pharmacology and neuroscience. There are far too many possibly involved variables to consider for an analysis, such as for instance undiagnosed cases of physical and psychological disorders. However, the sample size was large enough and included an adequate range of ages, genders, and employment types among young adults. Furthermore, the computation of general severity of psychoactive drug used based on quantity and harm to the user was effectively implemented. Hence, although the two variables are certainly related, it can be assessed that there is generally no positive effect of severity of substance use on EDS or vice versa in young adults.

Interestingly, since no significant correlation was shown for employment hours and SPSU but between type of employment and SPSU, a weak but significant positive relationship could be assessed. It can therefore be inferred that substance use is positively affected by the variety of employments or studies a person is pursuing in their daily life, rather than the quantity of workload of a person on a regular basis. It would be false, however, to assume a causality here since higher substance use severity is naturally associated with substance dependency or addiction. For instance, if these high scores of SPSU were partially due to a substance use disorder, it might have led individuals to seek a job (in addition to the study) as a financial means to afford the dependence.

**Implications for future research**

Despite the lack of correlation found in this study, the review of past literature in several domains of science has shown that interactions between substance use and wakefulness levels are a widely accepted observation. Subsequently, it would be of high interest for future research to explore this relationship by conducting an interdisciplinary study including a variable for psychoactive substance use with more dimensions. Preferably, this would involve regularity and frequency of use, different subclasses of drugs, and drug-interactions such as additive mechanisms. Further areas of interest could include whether the drugs are prescribed as treatment for certain disorders, as well as quantity and harm to the user.

## References


Alhola, P., & Polo-Kantola, P. (2007). Sleep deprivation: Impact on cognitive performance. *Neuropsychiatric Disease and Treatment, 3*(5), 553.

American Academy of Sleep Medicine. (2014). *International Classification of Sleep Disorders* (3rd ed.; ICSD-3). American Academy of Sleep Medicine.

*Ativan (Lorazepam): Uses, Dosage, Side Effects, Interactions, Warning*. (2021, March 1). RxList.Com. Retrieved 18 January 2022, from https://www.rxlist.com/ativan-drug.htm#indications approved by the U.S. Food and Drug Administration.

Auger, R. R., & Morgenthaler, T. I. (2005). Sleep: A Comprehensive Handbook. *Wiley Online Library*, 175–182. https://doi.org/10.1002/0471751723

Bernstein, J. M. (2019, July 19). *Like LaCroix, but With a Buzz*. The New York Times. Retrieved 17 January 2022, from https://www.nytimes.com/2019/06/21/dining/drinks/hard-seltzer-alcohol.html

Bixler, E. (2009). Sleep and society: An epidemiological perspective. *Sleep Med*, 10(Suppl. 1), S3–S6.

Bonnet, U., Specka, M., Soyka, M., Alberti, T., Bender, S., Grigoleit, T., Hermle, L., Hilger, J., Hillemacher, T., Kuhlmann, T., Kuhn, J., Luckhaus, C., Lüdecke, C., Reimer, J., Schneider, U., Schroeder, W., Stuppe, M., Wiesbeck, G. A., Wodarz, N., . . . Scherbaum, N. (2020). Ranking the Harm of Psychoactive Drugs Including Prescription Analgesics to Users and Others–A Perspective of German Addiction Medicine Experts. *Frontiers in Psychiatry*, *11*. https://doi.org/10.3389/fpsyt.2020.592199

Borsari, B., & Carey, K. B. (2006). How the quality of peer relationships influences college alcohol use. *Drug and Alcohol Review, 25*(4), 361–370. https://doi.org/10.1080/09595230600741339

Boys, A., Marsden, J., & Strang, J. (2001). Understanding reasons for drug use amongst young people: a functional perspective. *Health Education Research, 16*(4), 457–469. https://doi.org/10.1093/her/16.4.457

Bristol Drugs Project. (2021a, April 19). *GHB/GBL*. Bpd.Uk.Org. Retrieved 22 January 2022, from https://www.bdp.org.uk/get-information/drugs-information/ghb-gbl/

Bristol Drugs Project. (2021b, April 19). *Magic Mushrooms*. Bpd.Uk.Org. Retrieved 22 January 2022, from https://www.bdp.org.uk/get-information/drugs-information/magic-mushrooms/

Bronfenbrenner, U. (1979). *The Ecology of Human Development*. Amsterdam University Press.

Broholm, K., Galluzzo, L., Gandin, C., Ghirini, S., Ghiselli, A., Jones, L., Martire, S., Mongan, D., Montonen, M., Mäkelä, P., Rossi, L., Sarrazin, D., Scaffato, E., Schumacher, J., & Steffens, R. (2016). *Good practice principles for low risk drinking guidelines*. National Institute for Health and Welfare (THL). https://www.julkari.fi/handle/10024/131322

Bühler, E., Lachenmeier, D. W., Schlegel, K., & Winkler, G. (2014). Development of a tool to assess the caffeine intake among teenagers and young adults. *Ernahrungs Umschau*, *61*(4), 58-63.

Datapharm. (n.d.). *OxyContin 5 mg, 10 mg, 15 mg, 20 mg, 30 mg, 40 mg, 60 mg, 80 mg and 120 mg prolonged release tablets - Summary of Product Characteristics*. Electronic Medicines Compendium. Retrieved 23 January 2022, from https://www.medicines.org.uk/emc/medicine/29384#gref

Datapharm. (2021, March 22). *Medikinet 5 mg tablets - Summary of Product Characteristics*. Electronic Medicines Compendium. Retrieved 20 January 2022, from https://www.medicines.org.uk/emc/product/328/smpc#gref

Dewald, J. F., Short, M. A., Gradisar, M., Oort, F. J., & Meijer, A. M. (2012). The Chronic Sleep Reduction Questionnaire (CSRQ): a cross-cultural comparison and validation in Dutch and Australian adolescents. *Journal of Sleep Research*, *21*(5), 584–594. https://doi.org/10.1111/j.1365-2869.2012.00999.x

Essenmacher, C. A. (2009, November 9). *Session 3031 Handout | November 9, 2012 Essenmacher* [Handout]. sntc.medicine.ufl.edu. https://sntc.medicine.ufl.edu/Content/Webinars/SupportingDocs/3031-Essenmacher_-_Handout_1.pdf

European Monitoring Centre for Drugs and Drug Addiction. (n.d.). *Cocaine and crack drug profile*. Emcdda.Europa.Eu. Retrieved 22 January 2022, from https://www.emcdda.europa.eu/publications/drug-profiles/cocaine_en

European Monitoring Centre for Drugs and Drug Addiction. (2021). *European Drug Report 2021*. Publications Office of the European Union, Luxembourg. https://doi.org/10.2810/18539

Expert Committee on Drug Dependence. (2018, September). *3-Methylmethcathinone (3-MMC) Critical Review Report*. WHO.Int. Retrieved 22 January 2022, from

https://www.who.int/medicines/access/controlled-substances/4.4_3-MMC_CritReview.pdf

Ford, E. S., Cunningham, T. J., & Croft, J. B. (2015). Trends in selfreported sleep duration among US adults from 1985 to 2012. *Sleep*, 38(5), 829–832

Frenda, S. J., & Fenn, K. M. (2016). Sleep Less, Think Worse: The Effect of Sleep Deprivation on Working Memory. *Journal of Applied Research in Memory and Cognition*, *5*(4), 463–469. https://doi.org/10.1016/j.jarmac.2016.10.001

Gandhi, K. D., Mansukhani, M. P., Silber, M. H., & Kolla, B. P. (2021). Excessive Daytime Sleepiness. *Mayo Clinic Proceedings*, *96*(5), 1288–1301. https://doi.org/10.1016/j.mayocp.2020.08.033

Garland, E. L., Howard, M. O., & Perron, B. E. (2009). Nitrous Oxide Inhalation Among Adolescents: Prevalence, Correlates, and Co-Occurrence with Volatile Solvent Inhalation. *Journal of Psychoactive Drugs*, *41*(4), 337–347. https://doi.org/10.1080/02791072.2009.10399771

Gibson, E. S., Powles, A. P., Thabane, L., O'Brien, S., Molnar, D. S., Trajanovic, N., Ogilvie, R., Shapiro, C., Yan, M., & Chilcott-Tanser, L. (2006). 'Sleepiness' is serious in adolescence: Two surveys of 3235 Canadian students. *BMC Public Health*, *6*(1). https://doi.org/10.1186/1471-2458-6-116

*Gold Standard Pre-Workout*. (2021, September 29). Optimum Nutrition US. Retrieved 19 January 2022, from https://www.optimumnutrition.com/en-us/Products/Energy/Pre-Workout/GOLD-STANDARD-PRE-WORKOUT/p/gold-standard-pre-workout

Grandner, M. A. (2017). Sleep, Health, and Society. *Sleep Medicine Clinics*, *12*(1), 1–22. https://doi.org/10.1016/j.jsmc.2016.10.012

Grunstein, R. R., & Banerjee, D. (2007). The case of "Judge Nodd" and other sleeping judges--media, society, and judicial sleepiness. *Sleep*, *30*(5), 625–632. https://doi.org/10.1093/sleep/30.5.625

Hagell, P., & Broman, J. E. (2007). Measurement properties and hierarchical item structure of the Epworth Sleepiness Scale in Parkinson's disease. *Journal of Sleep Research*, *16*(1), 102–109. https://doi.org/10.1111/j.1365-2869.2007.00570.x

Hindocha, C., Freeman, T. P., & Curran, H. V. (2017). Anatomy of a Joint: Comparing Self-Reported and Actual Dose of Cannabis and Tobacco in a Joint, and How These Are Influenced by Controlled Acute Administration. *Cannabis and Cannabinoid Research*, *2*(1), 217–223. https://doi.org/10.1089/can.2017.0024

Hoffman, R. J. (2020, November 9). *Ketamine Poisoning*. UpToDate.Com. Retrieved 22 January 2022, from https://www.uptodate.com/contents/ketamine-poisoning

Ian Chen, Robert Vorona, Ritche Chiu & J. Catesby Ware (2008) A Survey of Subjective Sleepiness and Consequences in Attending Physicians, Behavioral Sleep Medicine, 6:1, 1-15, DOI: 10.1080/15402000701796023

Izci, B., Ardic, S., Firat, H., Sahin, A., Altinors, M., & Karacan, I. (2007). Reliability and validity studies of the Turkish version of the Epworth Sleepiness Scale. *Sleep and Breathing*, *12*(2), 161–168. https://doi.org/10.1007/s11325-007-0145-7

Johns, M. W. (n.d.). *About the ESS – Epworth Sleepiness Scale*. The Epworth Sleepiness Scale. Retrieved 2 November 2021, from https://epworthsleepinessscale.com/about-the-ess/

Johns, M. W. (1991). A New Method for Measuring Daytime Sleepiness: The Epworth Sleepiness Scale. *Sleep*, *14*(6), 540–545. https://doi.org/10.1093/sleep/14.6.540

Johns, M. W. (1992). Reliability and Factor Analysis of the Epworth Sleepiness Scale. *Sleep*, *15*(4), 376–381. https://doi.org/10.1093/sleep/15.4.376

Johnson, J. (2020, March 30). *Edibles: How long do they last?* Medical News Today. Retrieved 21 January 2022, from https://www.medicalnewstoday.com/articles/how-long-do-edibles-last#dosage

Kamimori, G. H., Karyekar, C. S., Otterstetter, R., Cox, D. S., Balkin, T. J., Belenky, G. L., & Eddington, N. D. (2002). The rate of absorption and relative bioavailability of caffeine administered in chewing gum versus capsules to normal healthy volunteers. *International Journal of Pharmaceutics*, *234*(1–2), 159–167. https://doi.org/10.1016/s0378-5173(01)00958-9

Kennedy S. (2018). Raising Awareness About Prescription and Stimulant Abuse in College Students Through On-Campus Community Involvement Projects. *Journal of undergraduate neuroscience education : JUNE : a publication of FUN, Faculty for Undergraduate Neuroscience*, *17*(1), A50–A53.

López-Cruz, L., Salamone, J. D., & Correa, M. (2018). Caffeine and Selective Adenosine Receptor Antagonists as New Therapeutic Tools for the Motivational Symptoms of Depression. *Frontiers in Pharmacology*, *9*. https://doi.org/10.3389/fphar.2018.00526

Mariani, J. J., Brooks, D., Haney, M., & Levin, F. R. (2011). Quantification and comparison of marijuana smoking practices: Blunts, joints, and pipes. *Drug and Alcohol Dependence*, *113*(2–3), 249–251. https://doi.org/10.1016/j.drugalcdep.2010.08.008

Marraccini, M. E., Weyandt, L. L., Rossi, J. S., & Gudmundsdottir, B. G. (2016). Neurocognitive enhancement or impairment? A systematic meta-analysis of prescription stimulant effects on processing speed, decision-making, planning, and cognitive perseveration. *Experimental and Clinical Psychopharmacology*, *24*(4), 269–284. https://doi.org/10.1037/pha0000079

Mayo Clinic. (2020, February 29). *Caffeine content for coffee, tea, soda and more*. Retrieved 19 January 2022, from https://www.mayoclinic.org/healthy-lifestyle/nutrition-and-healthy-eating/in-depth/caffeine/art-20049372

Mayo Clinic. (2021a, September 7). *Methylphenidate (Oral Route)*. Mayoclinic.Org. Retrieved 20 January 2022, from https://www.mayoclinic.org/drugs-supplements/methylphenidate-oral-route/proper-use/drg-20068297

Mayo Clinic. (2021b, December 10). *Alprazolam (Oral Route)*. Mayoclinic.Org. Retrieved 13 January 2022, from https://www.mayoclinic.org/drugs-supplements/alprazolam-oral-route/proper-use/drg-20061040

McNeely, J., Wu, L.T., Subramaniam, G., Sharma, G., Cathers, L.A., et al. (2016). Performance of the Tobacco, Alcohol, Prescription Medication, and Other Substance Use (TAPS) Tool for Substance Use Screening in *Primary Care Patients. Annals of Internal Medicine*, in press.

Meijer, A. (2008). Chronic sleep reduction, functioning at school and school achievement in preadolescents. *Journal of Sleep Research, 17*, 395–405. doi:10.1111/j.1365-2869.2008.00677.x.

Morefield, K. M., Keane, M., Felgate, P., White, J. M., & Irvine, R. J. (2011). Pill content, dose and resulting plasma concentrations of 3,4-methylendioxymethamphetamine (MDMA) in recreational 'ecstasy' users. *Addiction*, *106*(7), 1293–1300. https://doi.org/10.1111/j.1360-0443.2011.03399.x

National Health Service. (2020, February 28). *Antihistamines*. Nhs.Uk. Retrieved 21 January 2022, from https://www.nhs.uk/conditions/antihistamines/

National Institute on Drug Abuse. (2012, November 1). *Prescription Stimulants Affect People With ADHD Differently*. NIDA Archives. Retrieved January 10, 2022, from https://archives.drugabuse.gov/blog/post/prescription-stimulants-affect-people-adhd-differently#:%7E:text=BUT%E2%80%94for%20people%20who%20do,brain%20communication%20and%20cause%20euphoria.

National Institute on Drug Abuse. (2014, January). *Stimulant ADHD Medications*. Drugabuse.Gov. Retrieved 20 January 2022, from https://www.drugabuse.gov/sites/default/files/drugfacts_stimulantadhd_1.pdf

National Institute on Drug Abuse. (2021, June 7). *Prescription CNS Depressants*. Drugabuse.Gov. Retrieved 18 January 2022, from https://www.drugabuse.gov/publications/drugfacts/prescription-cns-depressants#:%7E:text=Most%20CNS%20depressants%20act%20on,for%20anxiety%20and%20sleep%20disorders.

National Sleep Foundation. (2008). *2008 State of the States Report on Drowsy Driving*. Drowsydriving.org. https://drowsydriving.org/resources/2008-state-of-the-states-report-on-drowsy-driving/

NHS. (2021, November 18). *Excessive daytime sleepiness (hypersomnia)*. Nhs.Uk. https://www.nhs.uk/conditions/excessive-daytime-sleepiness-hypersomnia/#:%7E:text=Excessive%20daytime%20sleepiness%20(hypersomnia)%20is,meal%20or%20during%20a%20conversation.

NTSB. (1995). *Factors That Affect Fatigue In Heavy Truck Accidents Volume 2: Case Summaries*. National Transportation Safety Board. https://www.ntsb.gov/safety/safety-studies/Pages/SS9502.aspx

Pagel J. F. (2009). Excessive daytime sleepiness. *American family physician, 79*(5), 391–396.

Pagel, J. F., Forister, N., & Kwiatkowki, C. (2007). Adolescent sleep disturbance and school performance: the confounding variable of socioeconomics. *Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine, 3*(1), 19–23.

Pfizer Laboratories. (2019, March 29). *Valoron Drops*. Labeling.Pfizer.Com. Retrieved 22 January 2022, from https://labeling.pfizer.com/ShowLabeling.aspx?id=1170
Pharmasave. (2017, August 11). *Bromazepam*. Retrieved January 16, 2022, from https://pharmasave.com/health/medications/bromazepam/

Phillips-Waller, A., Przulj, D., Pesola, F., Smith, K. M., & Hajek, P. (2021). Nicotine Delivery and User Ratings of IQOS Heated Tobacco System Compared With Cigarettes, Juul, and Refillable E-Cigarettes. *Nicotine & Tobacco Research, 23*(11), 1889–1894. https://doi.org/10.1093/ntr/ntab094

Robert Wood Johnson Foundation. (2021, October 1). *Comments on Maximum Nicotine Level for Tobacco Products*. RWJF.Org. Retrieved 19 January 2022, from

https://www.rwjf.org/en/library/articles-and-news/2018/07/comments-from-richard-besser-on-advanced-notice-of-proposed-rulemaking-regarding-maximum-nicotine-level-for-tobacco-products.html

Scottish Drugs Forum. (2017, June 19). *Etizolam Information Sheet*. NHSAAA.Net. Retrieved 20 January 2022, from https://www.nhsaaa.net/media/4654/etizolam_infosheet_sdf_drugwatch1_1-2.pdf

Sforza, E., de Saint Hilaire, Z., Pelissolo, A., Rochat, T., & Ibanez, V. (2002). Personality, anxiety and mood traits in patients with sleep-related breathing disorders: effect of reduced daytime alertness. *Sleep medicine*, *3*(2), 139–145. https://doi.org/10.1016/s1389-9457(01)00128-9

Skidmore, C. R., Kaufman, E. A., & Crowell, S. E. (2016). Substance Use Among College Students. *Child and Adolescent Psychiatric Clinics of North America*, *25*(4), 735–753. https://doi.org/10.1016/j.chc.2016.06.004

Slater, G., & Steier, J. (2012). Excessive daytime sleepiness in sleep disorders. *Journal Of Thoracic Disease, 4*(6), 608-616. doi:10.3978/j.issn.2072-1439.2012.10.07

Stein, M. A., Weiss, M., & Hlavaty, L. (2012). ADHD Treatments, Sleep, and Sleep Problems: Complex Associations. *Neurotherapeutics*, *9*(3), 509–517. https://doi.org/10.1007/s13311-012-0130-0

United Nations Office of Drugs and Crime. (2018). *World Drug Report 2018* [E-book]. United Nations Publications.

U.S. Department of Agriculture. (2019, April 1). *Beverages, coffee, brewed, prepared with tap water*. FoodData Central. Retrieved 19 January 2022, from https://fdc.nal.usda.gov/fdc-app.html#/food-details/171890/nutrients

van der Heide, A., van Schie, M. K., Lammers, G. J., Dauvilliers, Y., Arnulf, I., Mayer, G., Bassetti, C. L., Ding, C. L., Lehert, P., & van Dijk, J. G. (2015). Comparing Treatment Effect Measurements in Narcolepsy: The Sustained Attention to Response Task, Epworth Sleepiness Scale and Maintenance of Wakefulness Test. *Sleep*, *38*(7), 1051–1058. https://doi.org/10.5665/sleep.4810

Watson, N. F., Badr, M. S., Belenky, G., Bliwise, D. L., Buxton, O. M., Buysse, D., et al. (2015). Recommended amount of sleep for a healthy adult: A Joint Consensus Statement of the American Academy of Sleep Medicine and Sleep Research Society. *Sleep*, 38(6), 843–844.

WebMD. (n.d.). *Caffeine: Overview, Uses, Side Effects, Precautions, Interactions, Dosing and Reviews*. Retrieved January 10, 2022, from https://www.webmd.com/vitamins/ai/ingredientmono-979/caffeine#:%7E:text=Caffeine%20can%20cause%20insomnia%2C%20nervousness,irregular%20heartbeat%20and%20even%20death.

World Health Organization. (2016). *How much is a standard drink?* European Code Against Cancer. Retrieved 18 January 2022, from https://cancer-code-europe.iarc.fr/index.php/en/ecac-12-ways/alcohol-recommendation/27-standard-drink#:%7E:text=Figure%201%3A%20A%20standard%20drink,12%20grams%20of%20pure%20alcohol.

World Health Organization. (2019, July 10). *Drugs*. WHO. Retrieved 21 January 2022, from https://www.who.int/health-topics/drugs-psychoactive

Young, T., Evans, L., Finn, L., & Palta, M. (1997). Estimation of the Clinically Diagnosed Proportion of Sleep Apnea Syndrome in Middle-aged Men and Women. *Sleep*, *20*(9), 705–706. https://doi.org/10.1093/sleep/20.9.705

## Appendix A. Employment, Wakefulness, and Substance Use Questionnaire

**Figure A1.**

**Employment, Wakefulness, and Substance Use Questionnaire**

**Nationality:**

**Gender:**

- ○ Female
- ○ Male
- ○ Other
- ○ Prefer not to say

**Age:**

**Current Employment Status:**

- ○ unemployed
- ○ part-time student (enrolled in a part-time study program; up to ca. 20 hours per week)
- ○ full-time student (enrolled in a full-time study program; up to ca. 40 hours per week)
- ○ part student, part working (e.g. in training) please specify how many study- and working hours per week approximately:
- ○ part-time job (up to ca. 20 hours per week)
- ○ full-time job (approximately 40 hours per week)
- ○ other (please specify):

**Epworth Sleepiness Scale**

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired?

This refers to your usual way of life in the **past two weeks**.

Even if you have not done some of these things recently try to work out how they would have affected you.

Use the following scale to choose the most appropriate number for each situation:

0 = would **never doze**

1 = **slight chance** of dozing

2 = **moderate chance** of dozing

3 = **high chance** of dozing

***It is important that you answer each question as best as you can.***

| | Chance of Dozing (0-3) | | | |
|---|---|---|---|---|
| | 0 = would never doze | 1 = slight chance of dozing | 2 = moderate chance of dozing | 3 = high chance of dozing |
| 1. Sitting and reading | ○ | ○ | ○ | ○ |
| 2. Watching TV/Netflix etc. | ○ | ○ | ○ | ○ |
| 3. Sitting, inactive in a public place (e. g. a theatre or a meeting) | ○ | ○ | ○ | ○ |
| 4. As a passenger in a car for an hour without a break | ○ | ○ | ○ | ○ |
| 5. Lying down to rest in the afternoon when circumstances permit | ○ | ○ | ○ | ○ |
| 6. Sitting and talking to someone | ○ | ○ | ○ | ○ |
| 7. Sitting quietly after a lunch without alcohol | ○ | ○ | ○ | ○ |
| 8. In a car, while stopped for a few minutes in the traffic | ○ | ○ | ○ | ○ |

**Substance Use Questionnaire based on NIDA Clinical Trials Network The Tobacco, Alcohol, Prescription medications, and other Substance (TAPS) Tool – Part 2**

**General Instructions:**
The TAPS Tool Part 2 is a brief assessment for tobacco, alcohol, and illicit substance use and prescription medication misuse in the **PAST 2 WEEKS ONLY**. Each of the following questions and sub questions will ask you to give an estimation of your respective substance intake over the past 2 weeks on average per day. If there have only been a few instances of substance intake over the past 2 weeks, you may write it instead (e.g., *150ml of wine during the past two weeks*). You are not expected to do complicated calculations to achieve your approximate recent average intake.

---

1. In the PAST 2 WEEKS, did you have a drink containing caffeine?

- ○ yes
- ○ no

1a. In the **past 2 weeks**, how many millilitres of the following drinks did you consume *on average per day* (small cup/glass: ca. 150ml; large cup/glass: ca. 250ml)?

- ☐ Coffee
- ☐ Energy drink
- ☐ Tea (black, green, white, mate)
- ☐ Cocoa drink
- ☐ Iced tea/drinks with tea extract
- ☐ Cola
- ☐ Other food (g) or drink (ml) containing caffeine (please specify)

2. In the **past 2 weeks**, did you smoke a cigarette (or any other product) containing tobacco?

- ○ yes
- ○ no

2a. In the **past 2 weeks**, how many tobacco containing cigarettes (or other tobacco containing products – please specify) did you smoke *on average in a day*?

- ☐ Cigarette
- ☐ Other (please specify)

3. In the **past 2 weeks**, did you have a drink containing alcohol?

- ○ yes
- ○ no

3a. In the **past 2 weeks**, how many millilitres of the following have you had *on average per day* (one standard drink is about 1 small glass of wine (175ml), 1 large beer (500ml), or 1 single shot of liquor (44ml))?

- ☐ Wine
- ☐ Beer
- ☐ Liqour
- ☐ Other foods (g) or drinks (ml) containing alcohol (please specify)

4. In **the past 2 weeks**, did you use marijuana (hash, weed)?

- ○ yes
- ○ no

a. In the **past 2 weeks**, how many of the following THC containing products have you had *on average per day*?

- ☐ Small marihuana cigarette without tobacco
- ☐ Small marihuana cigarette mixed with tobacco
- ☐ Long marihuana cigarette without tobacco
- ☐ Long marihuana cigarette mixed with tobacco
- ☐ Edible (marihuana containing food product)
- ☐ Bong hit
- ☐ Pipe hit
- ☐ Other (please specify)

5. In the **past 2 weeks**, did you use cocaine, crack, or methamphetamine (crystal meth)?

- ○ yes
- ○ no

5a. In the past 2 weeks, how many times have you consumed each of the following substances on *average per day*?

- ☐ Cocaine
- ☐ Crack
- ☐ Methamphetamine (meth)

6. In the **past 2 weeks**, did you use heroin?

- ○ yes
- ○ no

a. In the **past 2 weeks**, how many times have you consumed heroin on *average per day*?

7. In the **past 2 weeks**, did you use a prescription opiate pain reliever (for example, Percocet, Vicodin/Hydrocodone)?

- ○ yes
- ○ no

7a. In the past 2 weeks, how many milligrams of each of the following substances have you consumed *on average per day*?

- ☐ Percocet
- ☐ Vicodin
- ☐ OxyContin
- ☐ Other (please specify)

8. In the **past 2 weeks**, did you use a medication for anxiety or sleep (for example, Xanax, Ativan, or Klonopin)?

- ○ yes
- ○ no

8a. In the **past 2 weeks**, how many milligrams of each of the following substances have you consumed *on average per day*?

- ☐ Xanax
- ☐ Ativan
- ☐ Klonopin
- ☐ Other (please specify)

9. In the **past 2 weeks**, did you use a medication for ADHD (for example, Adderall, Ritalin)?

- ○ yes
- ○ no

9a. In the **past 2 weeks**, how many milligrams of each of the following substances have you consumed *on average per day*?

- ☐ Adderall
- ☐ Ritallin
- ☐ Other (please specify)

10. In the **past 2 weeks**, did you use any other medication **and/or** illegal or recreational drug (for example, ecstasy/molly, GHB, poppers, LSD, mushrooms, ketamine, bath salts, synthetic marijuana ('spice'), laughing gas/whip-its, etc.)?

- ○ yes
- ○ no

10a. In the **past 2 weeks**, what other drug(s)/medication did you use and how many milligrams have you consumed of each substance *on average per day*?

# Appendix B. Information and Consent Form

## Figure B1.

## Information and consent form

**Information Sheet and Consent**

Thank you for considering to partake in this study! The duration will take approximately 15 minutes. Please read the following information carefully before you proceed to the questionnaire. Participation in this study is voluntary and you are free to withdraw at any point throughout the study without providing reasoning and without any penalty. You can do this by contacting the researcher.

For any questions or comments, please contact:
Lola Zumdick: l.d.zumdick@student.utwente.nl

**Disclaimer**: Some items may contain sensitive topics and potential triggers for addiction and substance-related issues. If these topics induce feelings of uneasiness or cravings for you, we suggest refraining from participation.

All data you provide is anonymous, will be handled confidentially, and not passed to third parties. No information given will be judged. Neither will any personally identifiable data be collected. This will be ensured by only asking for the necessary information (you will not have to provide your name, IP address or anything that could lead to your data being traced back to you). If you choose to provide your email address, this will be stored separately from your provided data, so the two will not be associated. We therefore ask you to answer as honestly as possible.

If you have any questions about substance use or sleep-related issues, we recommend speaking to your general practitioner or psychotherapist.

**Purpose of the research**

This study's purpose is to provide insight into how the effects of substance use and daytime sleepiness are correlated in groups of people with different employment statuses. Hence, you will be asked to answer a range of items regarding your demographic information, employment status, general state of wakefulness, and substance use behaviour (including e.g., caffeine, alcohol, recreational illicit drug use, and intake of prescription medication). The results and findings will be reported in form of a bachelor's thesis under the supervision of the Universiteit Twente. If you are interested in receiving the findings of this study, please provide your email address for the researcher to contact you after the study is concluded.

I have read the aforementioned information and consent to partake in this study. I understand that I can withdraw or discontinue at any time for no reason, without any consequences.

- ○ Yes
- ○ No

## Appendix C. Substances and Associated Harm to the User

**Table C1.**

**Ranking of the harm to user by various substances and substance categories**

| Substance | Harm to user |
|---|---|
| Methamphetamine | 2.35 |
| “Crack“ Cocaine | 2.325 |
| Heroin | 2.225 |
| Cocaine | 1.95 |
| Alcohol | 1.9 |
| GHB | 1.8 |
| Amphetamine | 1.75 |
| Cathinones | 1.7 |
| Synthetic Cannabinoids | 1.65 |
| Propofol | 1.6 |
| Natural Hallucinogens | 1.55 |
| Barbiturates | 1.525 |
| Ketamine | 1.5 |
| Ecstasy | 1.5 |
| Benzodiazepines | 1.5 |
| Cannabis | 1.45 |
| LSD | 1.425 |
| Psychotropic Mushrooms | 1.4 |
| Nicotine | 1.3 |
| Opioidergic Analgesics | 1.25 |
| ZDrugs | 1.2 |
| Tilidine/tramadol | 1.15 |
| Codeine | 1.1 |
| Methadone | 1.025 |
| Gabapentinoids | 0.9 |
| Methyphenidate | 0.875 |
| Burophenorphine | 0.85 |
| Flupirtine | 0.85 |
| NSADIs | 0.8 |
| Triptans | 0.7 |

*Note*. The values were adapted from Bonnet et al., (2020).

## Appendix D. Development of the SPSU Scale

### Psychoactive substance use

As mentioned in the materials section, the categories of substances were based on the TAPS. To assess the individual severity of each participant's psychoactive substance use over the past two weeks, the harmfulness of the substance or substance group to the user had to be determined. Furthermore, the consumed amount of a specific substance on average per day had to be measured.

A comprehensive European study was conducted by researchers and addiction medicine experts in 2020, ranking most psychoactive substances and prescription analgesics by their harm (Bonnet et al., 2020). This resulted in a final scale from 0 ('not harmful') to 4 ('extremely harmful') on which 30 substances or substance groups scored. The dimension "overall harm" was furthermore composed of "harm to users" and "harm to others". Since this study is concerned with the psychological, physical, and social effect of psychoactive substances on the user only, the "harm to others" dimension was excluded as a measure. The calculation of the "harm to users" dimension consisted of a physical, psychological, and social measure. The physical category includes drug-related and drug-specific mortality and morbidity respectively. The psychological measure consists of dependence, as well as drug-specific and drug-related impairment of mental functioning. Finally, the social dimension includes the user's loss of tangibles and relationships (see Bonnet et al., 2020). An overview of the exact values of each substance and its associated harm to the user is listed in Appendix C.

As can be seen in Table C1, for example benzodiazepines score similarly harmful to the user as cannabis does, with values of 1.5 and 1.4, respectively. However, the amount of active substance consumed per use differs significantly. Whereas the maximum dosage of lorazepam (benzodiazepine) administered is 10 mg per day (*Ativan (Lorazepam): Uses, Dosage, Side Effects, Interactions, Warning*, 2021), a cannabis cigarette has a wide range of possible THC dosage, which can easily reach 48 mg if it contains approximately half a gram of cannabis.

If the harm value would simply be multiplied by the amount of active substance consumed, the maximum dosage of a benzodiazepine would score 15 in usage severity and an average joint without tobacco would score 69.9. To correct for this imbalance, the "average one-instance use" for every substance will be assessed by literature research. For example, for nicotine this would be one cigarette, for prescription medicine the European starting dosage, and for alcoholic and caffeinated drinks the European standard drink.

These measurements are synonymous with average one-instance-use in the equation – see (1).

$$SPSU = \sum_{i=1}^{n} (A_i \times H_i) \quad (1)$$

Equation (1) shows the computation of the value *severity of physical and/or psychotropic effects subjected to in two weeks* (*SPSU*) by respondent. *A* refers to the average number of one-instance uses of a substance per day and *H* refers to the harm to user value of the substance. Multiplying these values results in the value *severity of physical and/or psychotropic effects subjected to in two weeks per respondent per substance*. To achieve the total score of substance severity per respondent, *A* and *H* are multiplied for every substance (i=1 to n) and then summed.

**Average one-instance uses of psychoactive substances**

Most dosages and serving sizes in research are either North American or European. This section will be orienting toward European units of one-instance use when possible as the large majority of respondents have nationalities from European countries. The metric system is furthermore widely spread, and the substance measurements developed in this paper are based on a European study (Bonnet et al., 2020).

**Caffeine**

Coffee is by far the most consumed source of caffeine (Bühler et al., 2014). Serving sizes usually range between 150 and 250 ml, therefore the standard EU drink of coffee will be set as 200 ml, containing a universal average of about 80 mg of caffeine in Europe (U.S. Department of Agriculture, 2019), which will act as the unit of one-instance use for this study. Participants indicated the consumption of coffee, energy drinks (estimated 29 mg caffeine per 100 ml; Bühler et al., 2014), cocoa drinks (estimated 18 mg caffeine per 100 ml; U.S. Department of Agriculture, 2019), tea (estimated 37.5 mg caffeine per 100 ml, drinks with tea extract (estimated 8.02 mg per 100 ml), cola (estimated 9.28 mg caffeine per 100 ml; Mayo Clinic, 2020), pre-workout (estimated 5.83 mg per serving size (11 g); *Gold Standard Pre-Workout*, 2021), and caffeine gum (estimated 52.65 mg caffeine per gum; Kamimori et al., 2002).

**Nicotine**

Smoking cigarettes is generally the most popular way of consuming nicotine. With one cigarette, an estimated *1.45 mg* of nicotine are consumed, hence this will be the standard

one-instance nicotine use (Essenmacher, 2009). Other sources of nicotine indicated by the respondents were cigars (estimated *13.3 mg* of nicotine per cigar; Essenmacher, 2009), IQOS – a heat-not-burn electric cigarette (estimated *0.5 mg* of nicotine per HEET; Phillips-Waller et al., 2021), and cannabis cigarettes mixed with tobacco, which for convenience will be referred to as "joints". A joint rolled with a short paper on average contains about 175 mg of tobacco and 70g of cannabis, whereas when rolled with a long paper on average contains about 350 mg of tobacco and 140 mg of cannabis (Hindocha et al., 2017). With an estimated average of 1.25mg of nicotine per gram of tobacco as stated by the Robert Wood Johnson Foundation (2021), a short joint contains an estimated *2.19 mg* nicotine and a long joint approximately *4.38 mg*.

**Alcohol**

The standard European alcoholic drink contains between 10 and 12 g of pure alcohol (Broholm et al., 2016; World Health Organization, 2016). Hence, the standard average alcoholic drink set for this study will contain 11 g of alcohol. Participants indicated consuming wine, beer, liquor, seltzer, champagne and cocktails. Eleven grams of alcohol are contained in approximately 110 ml of wine, 305 ml of beer, 70 ml of liquor, and 165 ml of champagne (World Health Organization, 2016). 355 ml of seltzer approximately contain an ABV (alcohol by volume) of 5% (Bernstein, 2019), as does beer, therefore, 305 ml is roughly equal to a standard alcoholic drink. A 350 ml European cocktail usually contains about 13 g of alcohol, which computes to a standard drink of circa 296 ml.

**THC**

Generally, the most widespread cannabis consumption in Europe is smoking a joint rolled with a long paper. In Europe, the THC concentration in cannabis as of 2018-19 was around 8-13%, with an average 10.5% as reported by the European Monitoring Centre for Drugs and Drug Addiction (2021). Since a long joint contains approximately 140 mg of cannabis and *13.33 mg* of THC, this will be set as the standard on-instance use of THC. Other means of THC consumption mentioned included short joints (*6.67 mg* of THC), long and short joints without tobacco – from here on referred to as "blunts" for convenience, and edibles. Long blunts approximately contain 500 mg of cannabis and therefore an estimated *47.62 mg* of THC, whereas short blunts contain approximately 250 mg of cannabis and therefore circa *23.81 mg* of THC. Although Edibles come in a large range of THC concentration, they contain an average of *12.5 mg* (Johnson, 2020). Water-pipe ("bong") usage was also reported. The average amount of cannabis smoked via pipes and water-pipes

per unit of use is approximately 390 mg (Mariani et al., 2011), which translates to a THC level of *40.95 mg* per hit.

**Benzodiazepines**

Benzodiazepines consumed by respondents included lorazepam, for which the starting dose is set as *1 mg* per day (*Ativan (Lorazepam): Uses, Dosage, Side Effects, Interactions, Warning*, 2021), bromazepam, with a starting dose of 6 mg (Pharmasave, 2017) per day, alprazolam (Xanax), with a starting dosage of *0.75 mg* per day (Mayo Clinic, 2021b), and etizolam, with a starting dose of 0.5 mg per day (Scottish Drugs Forum, 2017). The starting doses refer to the treatment for adults experiencing anxiety related disorders.

**Methylphenidate**

Methylphenidate (MPH) was taken in the form of Ritalin, with a starting dosage of 10 mg, Concerta with a starting dosage of 18 mg per day (Mayo Clinic, 2021a), and Medikinet, with a starting dose of 5 mg per day (Datapharm, 2021). The starting doses refer to the usual treatment procedure for adults with Attention Deficit/Hyperactivity Disorder.

**Other substances**

Participants who indicated the consumption of other psychoactive substances over the past 2 weeks, mentioned cocaine, OxyContin, tilidine, amphetamine, ketamine, laughing gas (nitrous oxide), MDMA, Ecstasy, 3-MMC, GHB, and magic mushrooms (psilocybin).

A typical “line” of street-purity amphetamine or cocaine hydrochloride is about 150 mg (European Monitoring Centre for Drugs and Drug Addiction, n.d.), which will be set as the one-instance use (line) in this study. Oxycontin has a usual starting dose of 10 mg per 12 hours for pain treatment, which makes the standard use per day 20 mg (Datapharm, n.d.). Tilidine, as treatment for pain has an approximate starting dosage of 150 mg per day (Pfizer Laboratories, 2019). The use of ketamine when recreational is usually intranasal as well and contains 60 to 250 mg per unit of use, with an average of 155 mg which will hence be set as the standard unit of use for this study (Hoffman, 2020). The recreational use of nitrous oxide – belonging to the group of opioidergic analgesics – usually includes inhaling the content of an 8 mg capsule through a balloon (Garland et al., 2009). One capsule with be set as the one-instance use. One pill of Ecstasy can range from containing 0.3-80% of its main active substance MDMA, with an average of about 23.1% and 60.25 mg (Morefield et al., 2011). Oftentimes, Ecstasy contains additional substances such as MDA, ketamine, caffeine, and pseudoephedrine (Morefield et al., 2011), however it is impossible to assess whether and how much of these substances were present in the pills consumed by respondents of this study. Therefore, all mentions of MDMA and Ecstasy will be grouped under the category Ecstasy.

According to the Expert Committee on Drug Dependence (2018), recreational dosages of 3-MMC – a substituted cathinone – start at 50 mg, which will be set here as the standard unit of use. The party drug GHB is typically consumed in small doses for a stimulating effect. The usual starting dose is 0.5 to 1 ml (Bristol Drugs Project, 2021a), so the average, 0.75 mg, will be used as standard unit for this paper. Magic mushrooms contain the hallucinogenic active substance psilocybin. It is impossible to calculate an accurate usual one-instance use dosage due to the large variety of species and individual concentration (Bristol Drugs Project, 2021b), however, only one respondent indicated consuming magic mushrooms, which was only on one occasion, hence this response will be counted as one-instance use.

**Excluded substances**

Additional substances that were listed by participants included Ibuprofen, which is a non-steroidal anti-inflammatory drug (NSAID), omeprazole, and triptans, of which none fit the criterion of being psychoactive substances and were therefore excluded from the analysis. Furthermore, antibiotics, valerian, and escitalopram were named in single instances. Although all these substances have been shown to have psychoactive effects, the former three lack research on the extent and nature of said effects, and as escitalopram belongs to the group of SSRIs that are not included in the study by Bonnet et al. (2020), it has an inaccessible relative harm score to the user.