

*The Relation of Screen Time with Sleep Quality moderated by Extraversion*

Bram Brinkman

s2775395

Faculty of Behavioural, Management and Social Sciences (BMS)

University of Twente

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First Supervisor: Nienke Peeters

Second Supervisor: Selin Ayas

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## **Abstract**

### ***Background***

Screen Time is higher than it has ever been. Because of this it is very important to investigate what effects this could have. This study will investigate the relationship between Screen Time, Extraversion, and Sleep Quality. This is specifically done in students aged 18-25, as they are some of the most intensive users of screens.

### ***Methods***

This study utilizes the Mini-IPIP for Extraversion, shortPSQI for Sleep Quality, as well as a self-report questionnaire related to Screen Time. These total scores are then calculated, and analysed in a linear regression analysis. An interaction coefficient is added to investigate the moderation effect of Extraversion on the relationship between Screen Time and Sleep Quality.

### ***Results***

A significant positive relationship was found between Extraversion and Sleep Quality. Screen Time unexpectedly yielded a positive relationship with Sleep Quality, though this was not significant. No significant proof was found for an moderation effect of Extraversion on the relationship between Screen Time and Sleep Quality.

### ***Conclusion***

This study found no significant relationship between Screen Time and Sleep Quality, possibly due to post-COVID-19 effects or cultural differences. Strengths include using shortened questionnaires and possible new insights; limitations include self-reported screen time, lack of screen use guidelines, and an unbalanced sample.

## **Introduction**

The usage of screens is almost unavoidable in the modern age (LeBlanc et al., 2017). This provides a lot of positive opportunities, ranging from working remotely to being able to videocall your grandmother from the other side of the globe. Screen use can even have positive mental effects. Most videogames have a positive association with problem-solving and creativity, and social media has the possibility to increase social support as well as being used for health communication related to specific diseases (LeBlanc et al., 2017). Reading this, it might seem that the use of screens only has positive effects, however, this is not the case. There have been multiple studies showing that a high Screen Time has detrimental effects for one's mental and physical health. The first example of this is a study by Rosenthal

et al. (2021), who found that a Screen Time of over 5.72 hours a day are also significantly more likely to have depressive symptoms in college age undergraduate students. It is however worth noting that studies differ a lot in what is considered 'high screen time'. Ma et al. (2020) considered a Screen Time above 2 hours as high Screen Time, whereas in the Rosenthal et al. (2021) study in the United States the lowest 25% of users already had a mean Screen Time of 2 hours. This indicates that for them, 2 hours a day is far below average. This shows that there is a wide range of interpretation as to what is too much screen time. This problem is related to the fact that there are no clear guidelines for Screen Time in adults (LeBlanc et al., 2017). In another study, with a mean Screen Time of around 6 hours a day, higher Screen Time was shown to be able to lessen loneliness if the screen was used socially, but when the screen was used to compensate for social skills, it was shown to increase loneliness in people from the age 18-25 (MacDonald & Schermer, 2021). It has also been shown that a Screen Time of 27 hours a week, around 3.8 hours a day, has an association with increased headaches (Montagni et al., 2016). As well as the fact that when high Screen Time is combined with low physical activity, health related quality of life is even comparable to the level of chronically ill patients (Lacy et al., 2012). All of these detriments indicate that a lot of Screen Time is not good for anyone. However, there is another possible risk that comes with high Screen Time: a decrease in Sleep Quality.

### ***Sleep Quality***

Sleep Quality is one of the best predictors of health, even more indicative than sleep quantity. This means that a qualitatively good sleep of 4 hours can be more healthy than an 8 hour sleep of worse quality (Kohyama, 2021). It is therefore important to keep Sleep Quality high. A longitudinal study over a period of 7 years recorded an increase of several health hazards that were related to low Sleep Quality. These hazards include an elevated risk for hypertension and diabetes as well as an increased likelihood of developing mental disorders (Bin, 2016). Mobile phone dependency has also been shown to be related to poorer sleep, which was related to sleep displacement, blue light emission, or mental arousal from using a screen before going to sleep (Cabr -Riera et al., 2019). Phone based-behaviours, which count as Screen Time, are specifically worth looking into, as they seem to make up an increasing part of our total Screen Time (Harvey et al., 2022). However, other kinds of screen use behaviours, like watching television and playing games, also have a negative association with Sleep Quality (Ma et al., 2020). It is for that reason that the focus of this study lies on general

Screen Time, rather than one specific kind. From this evidence there seems to be a negative relationship between Screen Time and Sleep Quality.

### ***Target Group***

To be able to adequately use this information for an improvement of wellbeing it is important to identify the biggest at-risk group for high Screen Time and low Sleep Quality. One of the groups that this relationship impacts most is students aged 18-25. This is because of multiple reasons. The first reason for this is that high Screen Time is prevalent within this group. In a study by Rosenthal et al. (2021) that was focused on students over the age of 18, the 25% most intensive screen users within their sample had a Screen Time between 5.72-12.03 hours a day. This would mean that some students could spend approximately half of their life in front of a screen. This can be combined with the fact that Sleep Quality is already on the decline within students due to increased stimulant intake, such as caffeine, and an increase in sedentary behaviour, as these behaviours decrease Sleep Quality (Wang & Bíró, 2021).

### ***Extraversion***

There are other factors that influence both Sleep Quality and Screen Time in students. One such factor, is personality. Personality determines a multitude of the things in our daily life, such as parts of our mental and physical health or even parts of our grade point average in education (Komarraju et al., 2011; Sharpe et al., 2011). In the case of Screen Time and Sleep Quality, there is one facet that influences both. This facet is Extraversion. Extraversion is one of the personality traits that is assessed in the Big 5 Personality test. This trait is comprised of several parts: gregariousness; assertiveness; activity; excitement-seeking; positive emotions, and warmth (John & Srivastava, 1999). Extraversion is most often associated with sociability. This led Beierle et al. (2020) to speculate that the average Screen Time, specifically on smartphones, would increase because of more frequent social uses, because they are more socially activated. However, it was found that Extraversion also includes an increased level of reward sensitivity (Lucas et al., 2000). Reward sensitivity indicates the tendency of individuals to prefer quick, small rewards over delayed, big rewards (Martin & Potts, 2004). This part of extraversion has been shown to be a predictor of disordered use of social media. This kind of use of social media often includes spending a notable amount of time on said social media, and thus on a screen. The explanation given for

this by Sindermann et al. (2020) is that extraverted people are very socially activated, and thus will use social media more often, increasing their Screen Time.

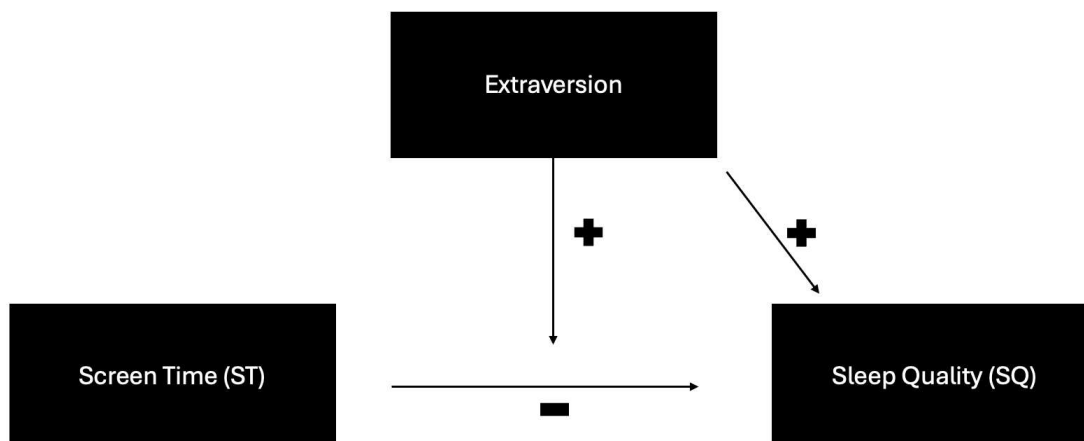
With Extraversion increasing Screen Time, one would expect it to decrease Sleep Quality, however, this does not seem to be the case. Randler et al. (2017) found a positive relationship between Extraversion and Sleep Quality in a study investigating the effects of personality on sleep in a sample of 2,492 participants. Fardin et al. (2017) also found a positive relationship between Extraversion and Sleep Quality in University Students. This means that higher Extraversion indicates higher Sleep Quality. Stephan et al. (2018) even found that Extraversion has a bigger influence on Sleep Quality than some demographical factors. Because Extraversion has also been shown to increase Screen Time, it seems to increase Sleep Quality as well as Screen Time. With this in mind, it is interesting to test whether there is an effect of Extraversion on the relationship between Screen Time and Sleep Quality. However, to be able to answer this question, further research is required.

### ***Hypotheses and Research Question***

Now that all relevant variables have been formulated the research question and hypotheses can be introduced. The main research question of this study will therefore be: “How is Extraversion moderating the relationship between Screen Time and Sleep Quality?”

To answer this three-part research question, three hypotheses were created, that were visualized in Figure 1. The first hypothesis is, that “Screen Time negatively predicts Sleep Quality in Students”. This needs to be tested first, since if there is no relationship between the two, it becomes harder for Extraversion affect this relationship. The second hypothesis “Extraversion positively predicts Sleep Quality”, is created to verify whether there is indeed an effect of Extraversion on Sleep Quality within our sample. The final hypothesis, “Extraversion positively moderates the relationship between Screen Time and Sleep Quality”, is used to answer the final part of the research question.

### **Figure 1. Visualisation of the Hypotheses**



## Methods

### *Study Design*

This study followed a cross-sectional design, meaning it used measurements at one moment in time to investigate the possible relationship between variables. It was part of a bigger study that investigated the relationship between Screen Time, Personality and several aspects of Student Life, such as procrastination and life satisfaction. The goal of this study is to get a better view of the interplay between these variables. For this specific study, the focus was on Screen Time, Extraversion, and Sleep Quality. Quantitative data was analysed to answer the research question and the hypotheses. The data was collected through an online questionnaire in the English language. Because this study was a part of a bigger study, the questionnaire includes multiple scales. The full questionnaire has been added to Appendix B. The analysis that was done to test the hypotheses was a linear regression analysis.

### *Participants/Demographics*

This study only included people that are currently following an education at a college or university. The specific demographic was for students ages 18-25. Another requirement for the participants was to be proficient in English, as to ensure they were able to fully comprehend the question they had to answer. People who did not fit one of these requirements were excluded.

### *Materials*

### *Questionnaire Screen Time*

The concept of Screen Time that was measured within this research is related to the time spent interacting with or using screen-related devices such as mobile phones or laptops. The reason for the interaction could both be professional, as well as recreational. To measure screen time a questionnaire was used created by Montagni et al. (2016). This was done because this version best fits the target demographic, as that study also focused on students between ages 18-25. It was used to give an overview of the Screen Time of participants divided over their different activities, specifically working on a tablet or computer, playing videogames on a tablet or computer, surfing the internet on a tablet or computer, watching TV or videos, and using a smartphone. One example of a question from this questionnaire would be ‘What is the average time in a day spend working on a computer/tablet?’ with the answer possibilities ranging from ‘never’ to ‘More than 7h’. There was also a separate question that asked the participants to estimate their total screen time: “What is your estimated daily screen time across all devices in hours?”.

### *Mini-International Personality Item Pool (Mini-IPIP)*

To measure personality facets a modified version of the Mini-IPIP was utilized. The Mini-IPIP was created to be able to measure personality facets more efficiently, to reduce the risk of measurement errors due to fatigue (Donnellan et al., 2006). These errors of fatigue are caused by the length of questionnaires, where the longer a questionnaire is, the harder it is for the participants to keep their focus. This was also the reason this version was chosen over the bigger IPIP, since the questionnaire was already quite long. The modifications regarded the exclusion of the personality facets Agreeableness and Openness to experience, as these were not investigated. The facets of Neuroticism and Conscientiousness were also not utilized in this study, but the items were included. This was because this data was shared across multiple studies, some of which did need the data on Neuroticism and Conscientiousness, but not on Agreeableness and Openness to experience.

The Mini-IPIP has been found to be a reliable measure of the personality facets, measuring Extraversion with a reliability of .90 (Donnellan et al., 2006). The scale is valid as well. When compared with the original IPIP, the Mini scores are extremely similar, with only a difference of .05 in negative affect and no difference in positive affect (Donnellan et al., 2006). In this questionnaire participants were asked to state how well some statements represented them as a person. The questions were measured on a 5-point Likert scale, ranging

from ‘very inaccurate’ (1) to ‘very accurate’ (5). An example of a statement question would be ‘I am the life of the party’.

### *Short - Pittsburgh Sleep Quality Index (shortPSQI)*

To collect the data on Sleep Quality, the Short – Pittsburgh Sleep Quality Index (shortPSQI) was utilized. As the name might imply, this questionnaire is a shortened version of the Pittsburgh Sleep Quality Index (Famodu et al., 2018). This was a questionnaire developed to specifically help users self-report their Sleep Quality (Shahid et al., 2011). Multiple studies have shown that this scale is a cross culturally reliable and valid questionnaire to assess Sleep Quality (Manzar et al., 2015; Mollayeva et al., 2016). The decision to use the shortened version came down to the length of the whole questionnaire. It was already quite long, and thus the decision was made to use the shortened version. The shortPSQI does still measure the same construct, correlating .94 with the original scores on the Pittsburgh Sleep Quality index (Famodu et al., 2018). The questionnaire contained 9 multiple choice questions and 4 open questions. The multiple choice questions were ranged on a 4-point Likert scale, ranging from ‘Not during this past month’ (1) to ‘Three or more times a week’ (4). An example of a question in this questionnaire is ‘During the past month, how often have you had trouble sleeping because you wake up in the middle of the night or early morning?’. An example of an open question would be ‘During the past month, how many actual hours of sleep did you get at night?’.

### ***Procedure***

Before this study started, ethical approval was provided by the BMS Ethics Committee of the University of Twente. The participants were recruited through social media (Instagram and Twitter) as well as through the SONA-system of the University of Twente. If the participants were recruited through SONA they were rewarded with 0.25 SONA-points. No other incentives were offered to the participants. When the participants opened the link to the questionnaires they first had to agree to the informed consent. This informed consent informed the participants on what would be investigated, the estimated time it would take to fill in the questionnaire, the anonymization of the data, and that there were no risks associated with participating in this study. It can be found in Appendix A. After agreeing to the informed consent the participant were first presented with questions related to their Screen Time and personality. After filling this in they would receive questions about Sleep Quality, procrastination, life satisfaction, and perceived stress in a random order as part of a bigger



study. When they finished filling this in, which should approximately take them 30 minutes, the participants were thanked for their participation.

### ***Data Analysis***

To answer the hypotheses there were several steps. The first one was extracting the relevant data for this research from the full dataset. After this the data was operationalised. Participants with an implausibly high Screen Time (>18h) were also removed, as this was also done in similar studies (Rosenthal et al., 2021). All participants who had failed to answer any of the relevant questions were removed as well. Relevant questions included all demographical questions, the Screen Time questionnaire, the Extraversion questions of the mini-IPIP, and all shortPSQI questions.

For the scales, some answers had to be modified for analysis. To calculate the Extraversion score for all participants, the items ‘I don’t talk a lot’ and ‘I keep in the background’ were reversely coded. The question regarding total daily screen time also had to be modified. An example of this would be that ‘4-5 hours’ would be averaged to ‘4.5’, and ‘30 minutes – 1 hour’ was modified into ‘0.75’. Examples of the modifications to answers in the shortPSQI would be to modify ‘7-8 hours’ into ‘7.5’ and modifying ‘7-10’ into ‘8.5’ for the question ‘During the past month, how many actual hours of sleep did you get at night?’. The question ‘During the past month, how long (in minutes) has it taken you to fall asleep each night?’, also contained some modifications, changing out ‘1 hour’ into ‘60’ and ‘30-60’ into ‘45’. This had to be manually changed due to technical limitations. After preparing the data for analysis, the analysis was started.

First, the demographical data of the participants was analysed, which included their age, gender and nationality. After this their Extraversion score was calculated. This was done by averaging the scores on all four statements into one total score. For Screen Time, the self-reported total Screen Time was used. For the shortPSQI five components were calculated in line with the paper that created the questionnaire (Famodu et al., 2018). An example of such a component was Component 1: Sleep Latency. It was calculated by taking the answer to the question ‘During the past month, how long (in minutes) has it taken you to fall asleep each night?’, and scoring a 0 for anything under 15 minutes, a 1 for anything between 15 and 30 minutes, a 2 for 31-60, and a 3 for anything over 60. Added to this was the score for question 5a, ‘During the past month, how often have you had trouble sleeping because you cannot get to sleep within 30 minutes?’. If these scores together were equal to 0, that would be the score for Component 1. If the score was 1-2, it would be 1, for 3-4 it would be 2, and for 5 and over

it would be 3. Because the scoring was very different for each component the scoring sheet has been provided in Appendix C. After this the scores of the components were added up together to create the Sleep Quality score. These final scores for all 3 variables were put together in one dataset. This dataset was used to perform a linear regression analysis. This analysis included an interaction term to measure the moderation effect of Extraversion on the relationship of Screen Time and Sleep Quality.

## Results

This section of the study gives an overview of the results. It starts by summarizing the demographical data of all participants. This includes the total amount of participants, total amount of participants with complete data, as well as their gender, nationality and age. Then the descriptive statistics are given, including the mean, standard deviation and range of the different variables. In the final part of this section the results of a linear regression analysis are shown.

### *Participants*

The sample for this study consisted of a total of 150 participants, of which 69 had to be omitted due to incomplete data. Additionally, one person had to be omitted due to implausibly high Screen Time. This means that the effective sample consisted of 80 participants. 18 (22,5%) of these participants identified as male, 58 (72,5%) identified as female, and 4 (5%) participants identified as non-binary/other. The ages of the participants ranged from 18-25 with a mean age of 21.2 years old. From the responses it was gathered that the pool of participants consisted of 35 (43,75 %) Dutch participants, 26 (32,5%) German participants, and 19 (23,75%) participants with a different nationality. All participants were students from either HBO, Bachelor, Master, or PHD study, that are proficient in English.

### *Descriptive Statistics*

The scores for Extraversion, Screen Time and Sleep Quality were calculated. The scores for Extraversion ranged from 1.00 until 4.75, with a mean score of 2.84 ( $SD = 1.00$ ). In context, the original study by Donnellan et al. (2006) contained two studies testing the questionnaire, these contained a mean score of 3.28 and 3.45. This indicates that this group has scored below average on Extraversion, even though the score itself seems to be a medium score. The scores for the total screen time ranged from 3,00 hours to 14,00 hours a day. The

mean score for this variable was 7,87 hours ( $SD = 2.37$ ). This seems to be higher than average, as similar studies indicate the average to be around 5-7 hours (Bani-Issa et al., 2022; (Lavados-Romo et al., 2021) The scores for Sleep Quality were also calculated. The total scores ranged from 3.00 until 11.00, with a mean score of 4,96( $SD = 2,52$ ). Famodu et al. (2018) indicated that a score of four or higher, until the maximum score of 15, indicates poor sleep quality. This means that most of the sample seems to have a poor sleep quality.

### ***Regression Analysis***

For the first hypothesis, “Screen Time negatively predicts Sleep Quality in Students”, a small negative relationship was found, but this was not statistically significant ( $B = -.04$ ,  $SE = .38$ ,  $t = -.81$ ,  $p = .76$ ). Since this result is not significant, there seems to be no relationship between Screen Time and Sleep Quality. This means that the hypothesis has to be rejected.

For the second hypothesis, “Extraversion positively predicts Sleep Quality in Students.”, the relationship between Extraversion and Sleep Quality was found to be negative and significant ( $B = -.75$ ,  $SE = .98$ ,  $t = -1.48$ ,  $p < .01$ ). A higher score on Sleep Quality indicates less Sleep Quality. Since Extraversion negatively affects the Sleep Quality score, it in reality seems to positively predict Sleep Quality.

For the final hypothesis, “Extraversion will moderate the relationship between Sleep Quality and Screen Time”, a small positive effect was found, but it was not significant, ( $B = .09$ ,  $SE = .12$ ,  $t = .75$ ,  $p = .46$ ). Meaning that we did not find a moderation effect of Extraversion on the relationship between Screen Time and Sleep Quality. This means that the hypothesis has to be rejected.

## **Discussion**

The main goal of this discussion will be to provide a better insight in the results of this study and how they compare to the preexisting literature. Then it will provide additional information on what this implies for both future studies and research as well as for day to day life. After this the study will be evaluated by listing the strengths and limitations. The study ends with a conclusion, summarizing all findings.

### ***Interpretation of the results***

The first hypothesis: “Screen Time negatively predicts Sleep Quality in Students.”, yielded a non-significant. The fact that no relationship was found contradicts previous

literature, as multiple studies indicate a negative, significant relationship between Screen Time and Sleep Quality (Ma et al., 2020; Cabré-Riera et al., 2019). However, another study by Liebig et al. (2023) also failed to find a significant relationship between Screen Time and Sleep Quality. In this same study, other factors were found that could decrease Sleep Quality, such as a later bedtime being related to Screen Time for leisure, or Screen Time for work affecting sleep duration negatively. These different factors were not specifically taken into account in the current study, even though they might provide better explanations than general Screen Time. Another possible reason for the Liebig et al. (2023) and current study contradicting the other studies might be that this study is more recent than the previous two. The studies with significant results took place before the COVID-19 pandemic, whereas this study and the Liebig et al. (2023) study took place after. This could indicate that the pandemic changed our relationship with Screen Time regarding Sleep Quality. There has been an increase in most media based activities when comparing Screen Time before and after the pandemic in adolescents (Marciano et al., 2022). To know whether this affected our target group in a similar way, more research would need to be done. Alternatively, the reason for the different outcomes could be cultural. The sample of Liebig et al. (2023) consists of German medical students. This seems to be closer to our sample of mostly Dutch and German students than both the Spanish sample of Cabré-Riera et al. (2019) as well as the sample of Ma et al. (2020), which was recruited at a Chinese University. However, before being able to make these claims, additional research on this topic is required.

The second hypothesis, “Extraversion positively predicts Sleep Quality in Students.”, was confirmed within our sample. This is consistent with prior research as multiple studies obtained similar findings. Stephan et al. (2018) confirmed these findings, and even stated that tracking changes in personality over time could provide information about sleeping difficulties. Fardin et al. (2017) attributed the positive relationship between Extraversion and Sleep Quality to the fact that most health related behaviours are rooted in personality. Implying that Extraversion can be linked to behaviour that improves Sleep Quality. Another possibility for the positive relationship could be the fact that higher Extraversion is related to lower stress sensitivity (Lai, 2018). This too, positively affects Sleep Quality, as this means there is less stress (Huang et al., 2016). For further theoretical implications, it could be interesting to find out what the exact reasons are for the positive relationship between Extraversion and Sleep Quality. If this is investigated it would have practical implications as well, possibly providing insights into how Sleep Quality could be improved.

The last hypothesis, “Extraversion will moderate the relationship between Sleep Quality and Screen Time”, yielded a non-significant result. This is a strong indication that there is no moderation effect from Extraversion on the relationship between Sleep Quality and Screen Time. One of the reasons this might have been the case is that no relationship was found between Sleep Quality and Screen Time within this sample. This would mean it is harder, if not impossible, for Extraversion to affect this relationship. Even if the effect seems to be very weak, there are still possible explanations. The fact that Extraversion seems to moderate the positive relationship between Screen Time and Sleep Quality could likely be explained by the fact that Extraversion increases both variables (Sindermann et al., 2020; Randler et al., 2017). Practical situations for this result are difficult to find, as there is no clear relationship. For theoretical implications, it is advised to retest this hypothesis in situations where an established negative relationship between Screen Time and Sleep Quality was found.

## ***Evaluation***

### ***Strengths***

The first strength of the study is that most of the measurements that were used have been proven to be short, but effective questionnaires. Starting with the Mini-IPIP, this questionnaire is highly reliable, with a .90 score in Extraversion specifically, as well as valid, having barely any differences to the original IPIP (Donnellan et al., 2006). Next, the shortPSQI. The original PSQI has been shown to be reliable and valid even across cultures (Manzar et al., 2015; Mollayeva et al., 2016). The shortPSQI having a correlation of .94 with the original, shows us that it is a very effective measure on Sleep Quality. Utilising the shortened versions might improve the data that was collected even further, as the risk of errors due to fatigue decreases (Donnellan et al., 2006) It can therefore be advised to utilize shortened questionnaires more often, especially when collecting data on multiple variables.

The second main strength of the study is that it provides a new insight. Specifically the fact that no relationship was found between Screen Time and Sleep Quality. This related very nicely to the study by Liebig et al. (2023), which also found no relationship. This would not necessarily be a new finding, however due to the timeframe of this study and the Liebig et al. (2023) study, contrary to earlier studies finding the relationship could suggest a change in our relationship with Screen Time or Sleep Quality. This does however warrant further investigation.

### *Limitations*

There were also parts of this study that would be wise to avoid in the future. The first one is the data collection regarding Screen Time. When starting out in this study, it was decided to use self-reported screen time. This was done because not everyone has the applications necessary to objectively measure their Screen Time, and the sample size was preferred to be as big as possible. This decision ended up harming the study's effectiveness on several fronts. The first front regards the reliability of self-reports against objective measurements. A study by Ohme et al. (2020) found that the difference between self reported Screen Time, in their case 146 minutes, and actual Screen Time, 256 minutes, could be up to almost two hours. It is therefore advisable to prefer a smaller, more reliable sample, over a bigger, less reliable one. The less reliable sample could also be an explanation for the non-significant findings. One way the sample could be made more reliable is to use apps that monitor Screen Time. Another problem was with the scale. The specific scale that was used in this study does not account for using multiple screens at the same time. It is for example possible for people to watch television while also being on their phone. If this would be done for two hours, it would indicate four hours on our questionnaire, even if in reality it is only two hours of screen time. This forced the use of the previously stated subjective total Screen Time measure. To avoid this in the future, it would again be better to utilize objective measurements. Examples of these objective measurements are apps that monitor the full Screen Time accurately. That way, it is possible to see when these appliances overlap, and act accordingly.

Another limitation in this study is the lack of clear guidelines for Screen Time in students. Most of the existing literature regarding Screen Time guidelines focusses on children and adolescents. This is the case, as rampant screen usage can cause several developmental problems. Because it mostly concerns developmental detriments, it is hard to generalize these same guidelines to adults. If there were clear guidelines, it would have been possible to see if there is a difference in relationship between Screen Time and Sleep Quality, within the groups of 'problematic' users and 'normal' users. As it is currently impossible to create clear thresholds as for what is problematic and what is not, this can be considered a limitation.

The final limitations are related to the sample. Just 53.3% of the participants offer useful data. This means that almost half of the sample had to be excluded due to incomplete data. This ties back into the advice to prefer quality over quantity when it comes to your sample. The group gender is also severely skewed, with 70.7% of the participants identifying

as female, meaning there might be some-gender related deviation from the norm. An example of this is that men usually score higher on extraversion than women (Vianello et al., 2013). Another example is that women generally tend to experience lower Sleep Quality than men (Madrid-Valero et al., 2017). Screen Time does not seem to be affected by gender (Davies et al., 2012).

### ***Conclusion***

In this discussion, multiple results were discussed, along with possible explanations for these results, and the strengths and limitations of the study as a whole. No significant relationship was found for Screen Time and Sleep Quality. This can possibly be explained by after-effects of the COVID-19 pandemic or differences in culture, but both claims warrant further investigation. Extraversion proved to affect Sleep Quality positively. Multiple possible reasons were given for this, including lower stress sensitivity or Extraversion making one more prone to Sleep improving behaviour. No significant relationship was found for the moderation effect from Extraversion on the relationship between Screen Time and Sleep Quality. This is likely because in the sample of this study no existing relationship was found. It is advised to retest this hypothesis in a population where such a relationship was found.

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**AI STATEMENT**

During the preparation of this work the author used ChatGPT in order to check for spelling and grammar mistakes, as well as possible redundancies in the text. After using this tool, the author reviewed and edited the content as needed and takes full responsibility for the content of the work.

## Appendix A: Informed Consent

Thank you for participating in our study centered around screen time, personality, and aspects of student life. Participation in this study is completely voluntary, and it is possible to withdraw from this study at any point without giving an explanation. While participating in this study you will be asked several questions that are related to (Social Media) Screen Time, Personality, Sleep Quality, Procrastination, Life Satisfaction, Perceived Stress.

There are no known safety risks related to participation. The estimated time to complete this questionnaire is 15-30 minutes. If you are a student participating through the SONA-system, completing this study will reward you with 0.25 SONA-point(s).

The data that is collected will be anonymised and will only be available to the researchers. Since the data is anonymised, even the researchers will not be able to identify you from your personal information. So please answer all questions as honestly as possible. Once the research is concluded, the data will be disposed in accordance with the guidelines of the University of Twente. If there are any questions or remarks, please feel free to contact the researchers:

Bram Brinkman: [b.g.j.brinkman@student.utwente.nl](mailto:b.g.j.brinkman@student.utwente.nl)

Matea Steven: [m.s.steven@student.utwente.nl](mailto:m.s.steven@student.utwente.nl)

Fiona Köster: [f.koster@student.utwente.nl](mailto:f.koster@student.utwente.nl)

Sara Von Pruski: [s.m.vonpruski@student.utwente.nl](mailto:s.m.vonpruski@student.utwente.nl)

Leonie van Asselt: [l.m.vanasselt@student.utwente.nl](mailto:l.m.vanasselt@student.utwente.nl)

Supervisor:

Nienke Peeters: [n.j.peeters@utwente.nl](mailto:n.j.peeters@utwente.nl)

Marcel Pieterse: [m.e.pieterse@utwente.nl](mailto:m.e.pieterse@utwente.nl)

## Appendix B: Full Questionnaire

# Screen-Time among university students

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### Start of Block: Informed Consent

Informed consent Thank you for participating in our study centered around screen time, personality, and aspects of student life. Participation in this study is completely voluntary, and it is possible to withdraw from this study at any point without giving an explanation. While participating in this study you will be asked several questions that are related to (Social Media) Screen Time, Personality, Sleep Quality, Procrastination, Life Satisfaction, Perceived Stress.

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Fiona Köster: [f.koster@student.utwente.nl](mailto:f.koster@student.utwente.nl)

Sara Von Pruski: [s.m.vonpruski@student.utwente.nl](mailto:s.m.vonpruski@student.utwente.nl)

Leonie van Asselt: [l.m.vanasselt@student.utwente.nl](mailto:l.m.vanasselt@student.utwente.nl)



Supervisor:

Nienke Peeters: n.j.peeters@utwente.nl

Marcel Pieterse: m.e.pieterse@utwente.nl

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Q21 I read the informed consent, and agree to participate in this study.

Yes (1)

No (2)

End of Block: Informed Consent

---

Start of Block: Demographics

Age What is your age?

18 19 20 22 23 24 25 26 28 29 30

Age ()



Gender What is your gender?

- Male (1)
  - Female (2)
  - Non-binary/other (3)
- 

Nationality What is your nationality?

- Dutch (1)
  - German (2)
  - Other (3)
- 

Education What is your study level?

- Bachelor student (1)
- Master student (2)
- PhD (3)
- HBO student (4)

**End of Block: Demographics**

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**Start of Block: Adjusted Mini-IPIP**



Mini-IPIP Please indicate on a range of very inaccurate to very accurate how much the statements suit you as a person.

	Very inaccurate (1)	Moderately inaccurate (2)	Neither inaccurate nor accurate (3)	Moderately accurate (4)	Very accurate (5)
I am the life of the party (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I get chores done right away (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have frequent mood swings (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I don't talk a lot (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often put things back in their proper place (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am relaxed most of the time (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I talk to a lot of different people at parties (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like order (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I get upset easily (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I keep in the background (10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I make a mess of things (11)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I seldom feel blue (12)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

End of Block: Adjusted Mini-IPIP

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Start of Block: Screen Time

Screen Time For the next questions, please indicate the average time you spend in a day in front of these different screens. If you can, indicate the accurate measure by using the "screen time" option in the settings of the device. If not, try to estimate the time as good as

possible. What is the average time in a day spend...

	Never (1)	30 min or less (2)	0.5 - 1 h (3)	1 - 2 h (4)	2 - 3 h (5)	3 - 4 h (6)	4 - 5 h (7)	5 - 6 h (8)	6 - 7 h (9)	More than 7h (10)
...working on a computer/tablet. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...playing video games on a computer/tablet. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...surfing the internet on a computer/tablet. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...watching TV or videos (movies, series, TV programs) on a computer/tablet. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...using a smartphone. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



Q58 What is your estimated daily screen time across all devices in hours?

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End of Block: Screen Time

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Start of Block: Social Media Screen Time

social media Please indicate for each social media platform how much time you spend on a daily average. For this please follow these steps on your phone:

Apple: Settings -> Screen Time -> See All App & Website Activity -> Week (on top of the screen) -> click on each social media platform you used -> Daily Average

Android: Settings -> Digital Wellness and Parental Control -> click on each social media platform you used

-> Weekly (on top of the screen) -> Daily Average (...h ...min/day)

If this does not work or if you cannot find this information, take a guess at how much time on an average day in the past week you spent on each of the social media platforms you use (or look in the apps directly).

(Remember that if you fill this out at the beginning of a new week, the analysis only shows data from one or two days. In that case please look in your settings at the last week. If you do not find this, then just take a guess at how much you used the social media platform in the last week on average.)

With that information, please fill out the next items. Please also keep in mind the time on







Q49 For each statement please indicate how often you engage in said activity online when using social media on an average day, during the last 7 days.

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Very Often (5)
1. I look at the photo albums of other users. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I look at the profiles/pages of other users or read through them. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I look at the stories of my friends/ my subscriptions. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I read private messages that other users send me. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. I read entries on the chronicles and personal pages of other users. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. I read through the comments on other users' pictures. (6)

7. I read the comments on my own pictures. (7)

8. I look at links or video clips posted on other people's profile pages (e.g., YouTube). (8)

9. I look at the profile pages of my relatives. (9)

10. I look at the "newsfeed" to see the latest activities of other users (e.g., if they have new friends). (10)





Q51 For each statement please indicate whether you agree or disagree that you use social media to...





8. ... maintain  
social  
contact. (8)

End of Block: Social Media Screen Time

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Start of Block: Short - Pittsburgh Sleep Quality Inventory

Q60 During the past month, when have you usually gone to bed?

- Before 21:00 (1)
- 21:00-23:00 (2)
- 23:00-01:00 (3)
- Later than 01:00 (4)

Q11 During the past month, how long (in minutes) has it taken you to fall asleep each night?

---

---

Q61 During the past month, when have you usually gotten up in the morning?

- Before 06:00 (1)
  - 06:00-08:00 (2)
  - 08:00-10:00 (3)
  - 10:00-12:00 (4)
  - Later than 12:00 (5)
- 

Q13 During the past month, how many actual hours of sleep did you get at night? (This may be different than the number of hours you spend in bed.)

---

---

Q17 During the past month, how often have you had trouble sleeping because you...

	Not during the last month (1)	Less than once a week (2)	Once or twice a week (3)	Three or more times a week (4)
Cannot get to sleep within 30 minutes (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wake up in the middle of the night or early morning (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cannot breathe comfortably (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cough or snore loudly (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feel too hot (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have bad dreams (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have pain (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

Q19 During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

- Not during the last month (1)
  - Less than once a week (2)
  - Once or twice a week (3)
  - Three or more times a week (4)
- 

Q20 During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?

- Not during the last month (1)
- Less than once a week (2)
- Once or twice a week (3)
- Three or more times a week (4)

End of Block: Short - Pittsburgh Sleep Quality Inventory

---

Start of Block: Perceived Stress Scale

Q48 The questions in this scale ask you about your feelings and thoughts during the last week. In each case, you will be asked to indicate how often you felt or thought a certain way.

	Never (1)	Almost Never (2)	Sometimes (3)	Fairly Often (4)	Very Often (5)
1. In the last week, how often have you been upset because of something that happened unexpectedly? (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. In the last week, how often have you felt that you were unable to control the important things in your life? (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. In the last week, how often have you felt nervous and “stressed”? (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. In the last week, how often have you felt confident about your ability to handle your personal problems? (4)

5. In the last week, how often have you felt that things were going your way? (5)

6. In the last week, how often have you found that you could not cope with all the things that you had to do? (6)

7. In the last week, how often have you been able to control irritations in your life? (7)

8. In the last week, how often have you felt that you were on top of things? (8)

9. In the last week, how often have you been angered because of things that were outside of your control? (9)

10. In the last week, how often have you felt difficulties were piling up so high that you could not overcome them? (10)

End of Block: Perceived Stress Scale

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Start of Block: Academic Procrastination Scale

**Procrastination** These questions are about your procrastination tendencies, meaning how quickly you get things done or whether you tend to put them off. Please indicate your



answer to the questions on a scale of Disagree to Agree.

	Disagree (1)	Somewhat disagree (2)	Neither agree or disagree (3)	Somewhat agree (4)	Agree (5)
I usually allocate time to review and proofread my work. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I put off projects until the last minute. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have found myself waiting until the last day before to start a big project. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I know I should work on schoolwork, but I just don't do it. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When working on schoolwork, I usually get distracted by other things. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I waste a lot of  
time on  
unimportant  
things. (6)

I get  
distracted by  
other, more  
fun, things  
when I am  
supposed to  
work on  
schoolwork.

(7)

I concentrate  
on schoolwork  
instead of  
other  
distractions.

(8)

I can't focus  
on schoolwork  
or projects for  
more than an  
hour until I get  
distracted. (9)

My attention  
span for  
schoolwork is  
very short.

(10)

Tests are  
meant to be  
studied for  
just the night  
before. (11)

I feel prepared  
well in  
advance for  
most tests.  
(12)

"Cramming"  
and last  
minute  
studying is the  
best way that I  
study for a big  
test. (13)

I allocate time  
so I don't have  
to "cram" at  
the end of the  
semester. (14)

I only study  
the night  
before exams.  
(15)

If an assignment is due at midnight, I will work on it until 23:59.

(16)

When given an assignment, I usually put it away and forget about it until it is almost due.

(17)

Friends usually distract me from schoolwork.

(18)

I find myself talking to friends or family instead of working on schoolwork.

(19)

On the weekends, I make plans to do homework and projects, but I get distracted and hang out with friends. (20)

I tend to put off things for the next day. (21)

I don't spend much time studying school material until the end of the semester. (22)

I frequently find myself putting important deadlines off. (23)

If I don't understand something, I'll usually wait until the night before the test to figure it out. (24)

I read the textbook and look over notes before coming to class and listening to a lecture or teacher. (25)

End of Block: Academic Procrastination Scale

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Start of Block: Revised Social Connectedness Scale

Q52 On a scale of disagree very strongly to agree very strongly please indicate how much the statements apply to you as a person







I don't feel I  
participate with  
anyone (20)



End of Block: Revised Social Connectedness Scale

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Start of Block: Life satisfaction

Life satisfaction Taking everything into consideration, during the past week how satisfied have you been with your...

	Very Poor (1)	Poor (2)	Fair (3)	Good (4)	Very Good (5)
... physical health? (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... mood? (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... work? (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... household activities? (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... social relationships? (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... family relationships? (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... leisure time activities? (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... ability to function in daily life? (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... sexual drive, interest and/or performance? (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... economic status? (10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

...					
living/housing situation? (11)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... ability to get around physically without feeling dizzy or unsteady or falling? (12)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... your vision in terms of ability to do work or hobbies? (13)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... overall sense of well being? (14)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... medication? (If not taking any, leave this item blank.) (15)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... How would you rate your overall life satisfaction and contentment during the past week? (16)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

End of Block: Life satisfaction

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## Appendix C. Scoring Sheet shortPSQI

### Scoring

Component 1: sleep latency

C1 —

(#2) Score (<15 (0), 16–30 min (1), 31–60 min (2), >60 min (3)) + (#5a) Score (if sum is equal 0 = 0; 1-2 = 1; 3-4 = 2; 5-6 = 3)

Component 2: sleep duration

C2 —

(#4) Score (>7 (0), 6-7 (1), 5-6 (2), <5 (3))

Component 3: sleep efficiency

C3 —

(total # of hours asleep)/(total # of hours in bed) × 100; >85% = 0, 75–84% = 1, 65–74% = 2, <65% = 3

Component 4: sleep disturbances

C4 —

Examine questions (5b) to (5g) and assign scores for each questions as follows

Response: Score

Not during the past month: 0

Less than once a week: 1

Once or twice a week: 2

Three or more times a week: 3

# sum of scores (5b) to (5g) (0 = 0,  $\geq 1 \leq 6 = 1$ ;  $>6 \leq 12 = 2$ ;  $>12 = 3$ )

Component 5: daytime dysfunction

C5 —

(#6) + (#7) Score (0 = 0; 1-2 = 1; 3-4 = 2; 5-6 = 3)

Add the five component scores together...Global PSQI —

A total score of greater than “4” is indicative of poor sleep quality