The Relationship Between Nighttime Social Media Use and Sleep Quality in Young Adults: The Mediating Role of Social Comparison and the Moderating Gender Roles

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Abstract

Background. Nighttime social media use in young adults has increased significantly in the past years. Due to the shift towards online social interactions, young adults continue to use social media – even after lights out. Using social media after planning to go to bed has been positively associated with physical and mental problems. Especially young adults tend to engage in social comparison behaviour, which is why this variable has been proposed to mediate the relationship between nighttime social media use and sleep quality. Additionally, gender differences have been suggested to moderate this mediation. Previous research has focused mostly on the time spent on social media. However, not all young adults engage with social media in the same way, which calls for a nuanced understanding of social media engagement styles at nighttime. The impact of social media depends significantly on a range of protective and risk factors around *how* users engaged online. Therefore, this study focused on active and passive use of social media instead of time spent on social media at nighttime.

Method. Through convenience and snowball sampling, a total of $N = 80$ participants between the age of 18 and 29 were recruited. The participants filled out an online survey, which included questionnaires measuring the variables of sleep quality, social comparison, and nighttime social media use.

Results. The mediation analysis revealed no significant difference in people who do and do not use social media at nighttime regarding their sleep quality and social comparison behaviour. Furthermore, social comparison behaviour did neither predict sleep quality nor did it mediate the relation between nighttime social media use and sleep quality. Besides that, no gender differences were found.

Conclusions. Overall, this study did not confirm the hypothesized outcomes. Nonetheless, valuable insights for future research are generated and possible ideas for further study designs are suggested.

Keywords: social media, nighttime social media use, well-being, social comparison, sleep quality, gender, active and passive social media use

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Introduction

Social media has become a prominent component in the lives of many individuals. In 2021, social media users passed the 4.5 billion mark – more than half the global population (We are Social 2021). Social media broadly refers to online platforms which allow individuals to connect with others within a virtual network. Services such as Instagram, Snapchat, Twitter, or Facebook allow users to share or exchange a wide range of digital content, including pictures, messages, or videos (Ahmed et al., 2019). Since social media is a communication platform, it enables users to communicate with virtually anybody all over the world at any time (Williams et al., 2012). Over 90% of social media users are engaged both day and night (Duggan & Smith, 2013).

Social media platforms promote uninterrupted online social interactions in bed, even after lights out. A reason for this is that platforms are easily accessible via smartphone apps and specifically designed, using artificial intelligence algorithms, to cause the release of dopamine into our brain's reward pathway (Burhan & Moradzadeh, 2020; Macït, et al., 2018). Dopamine, also known as the "pleasure chemical", is being released when getting likes, texts, or messages via social media, thereby evoking an intrinsically rewarding feeling (Burhan & Moradzadeh, 2020). Using artificial intelligence algorithms, social media creates an immense comfort factor, seemingly always knowing how to catch the user's attention. Since these feelings of excitement are temporary, individuals are looking for more when an initial short-lived moment wears off – and this urge persists, at any time of the day or even at night (Shang et al., 2011).

Evidence is increasingly supporting a link between nighttime social media use and various facets of wellbeing, including sleep quality. Sleep quality can be defined as how well a person is sleeping – in other words, whether one's sleep is restorative and restful (Woods & Scott, 2016). The concept of sleep quality is more complicated to measure than sleep quantity, but factors like how long it takes one to fall asleep (sleep latency), how often (sleep-waking), and for how much time (wakefulness) one wakes up during the night, form part of the assessment (Krystal & Edinger, 2008). Up to 25% of the US population does not get enough sleep of high quality (Ram et al., 2010). A lack of high-quality sleep slows down reaction time and decreases alertness, possibly causing for instance a serious motor vehicle accident. Moreover, sleep deficiency weakens the immune system, impairs emotional control, and ultimately may even facilitate the appearance of depressive symptoms (Cain & Gradisar, 2010). These numbers highlight how important the issue of high-quality sleep is. Getting enough sleep of high quality is one of the most basic things one can do to ensure good health, safety, as well as emotional and physical well-being.

Despite the numbers emphasizing the seriousness of sleep quality, young adults tend to sacrifice their sleep quality in favor of nighttime social media use. Several studies revealed that social media use around bedtime has a greater impact on sleep quality than overall use (Bartel & Gradisar, 2017; Cain & Gradisar, 2010; Exelmans & Van den Bulck, 2017). Social media use at nighttime increases cognitive arousal more than overall use during daytime (Woods & Scott, 2016). Together with the screen light and the electromagnetic radiation of the electronic device, cognitive arousal has been shown to change sleep architecture (Hamblin & Wood, 2002; Loughran, et al., 2005), the basic structure of the sleeping patterns (Higuchi et al., 2005), due to the suppression of melatonin production, consequently delaying the circadian rhythm (Cain & Gradisar, 2010; Higuchi et al., 2005). Using social media after planning to go to bed has also been positively associated with physical and mental problems. Belated sleep onset latency, as well as reduced sleep quality due to nighttime social media use (Woods & Scott, 2016), are responsible for symptoms like for instance headaches, tinnitus, stomachache, or high body mass index (BMI) (Hutter et al., 2010; Lajunen et al., 2007). Further, Oshima et al. (2012) revealed that screen-based media device use after lights out was linked to anxiety and depression and might even lead to an increased risk of suicidal thoughts and self-harm.

Previous research pointed out the difficulty of measuring the threat of nighttime social media use. Examining only the frequency and duration of nighttime social media use has been proven to be overly simplistic. Seabrook, et al. (2016) reported inconclusive correlations between measurement of *how often* and *how much* individuals use social media and mental health problems. Furthermore, Orben and Przyblylski (2019) investigated large-scale social datasets and revealed that screen time accounts for only 0.4% of the variance in well-being. Understanding the complex links between individuals' nighttime social media practice and mental health is much more complex. In their 2016 systematic review of the available evidence, Seabrook and colleagues accentuated that the impact of social media depends significantly on a range of protective and risk factors around *how* users engaged online. The wider context of the use of social media around bedtime is thus crucial to scrutinize. Giving an example, individuals who engage the same amount of time using social media each night can have very different evaluations depending on the importance of and emotional connection to this use (Jenkins-Guarnieri, et al., 2013). This differentiation stems from the way people use social media.

The type of social media use can be distinguished between active and passive use. Active use refers to the use, which is more interactive such as producing own content, chatting with others, and commenting on other peoples' content. On the contrary, passive use is

characterized by less interaction with others, such as browsing content, viewing others' posts, and reading comments (Thorisdottir et al., 2019). Although having good intentions for using social media at nighttime, users are sometimes faced with a different reality. Existing research showed that different user patterns are associated with divergent outcomes related to individuals' well-being. As reported by Thorisdottir et al. (2019) in their large-scale study of Icelandic adolescents, passive use is related to greater depressive symptoms. Quitting passive use of social media has been shown to increase life satisfaction in Facebook users (Tromholt, 2016). Active social media use was related to a decrease in symptoms of depression and anxiety while the contrary was discovered for passive use (Escobar-Viera et al., 2018; Thorisdottir et al., 2019). Next to the effects of active and passive social media use at nighttime, Thorisdottir et al. (2019) suggested social comparison as an important risk factor for emotional distress.

Social comparison theory argues that individuals have a constant urge to compare themselves to their peers (Festinger, 1954). There are two major types of social comparison: upward comparison, when individuals compare themselves to others who are "better", and downward comparison, when individuals compare themselves to others who are "less proficient" (Gibbons & Gerrard, 2011). While upward comparisons are typically associated with negative feelings for the self (feeling inferior), downward comparisons are linked to positive effects (feeling superior). Lee (2014) studied the impact of social comparison on wellbeing and discovered a positive correlation between social comparison frequency on Facebook and the frequency of having a negative feeling (i.e., thinking others are having a better life and doing better than the comparer). Literature dating back to the 70s and 80s already suggests that upward comparisons are connected as a major risk factor for poor mental health (Bäzner et al., 2006; Jang et al., 2016; Marsh & Parker, 1984; Morse & Gergen, 1970).

Social media is replete with upward comparisons as it provides individuals with a platform to present their idealized versions of themselves. Strengthened by flawless pictures and a seemingly carefree life (Chou & Edge, 2012; Qiu et al., 2012), users have full control over their online self-presentation. For instance, the use of Instagram filters enables users to edit their content to create a highly desirable and attractive appearance. At the same time, individuals can continually compare their appearance to one of their social media friends, which normally does not happen to such a large extent in real life (Gerson et al., 2016), because modern technologies facilitate such behaviours. The quantification of peer approval through likes and comments serves as a form of peer influence or social reinforcement (Tiggemann et al., 2018), defining peer status and popularity (Dumas et al., 2017). Individuals compare themselves on many dimensions like opinions, skills, and even personality traits (Chou & Edge,

2012). Features such as Instagram's newsfeed provide users with a steady stream of updates in form of peers' achievements, beliefs, and personalities, establishing the ideal hatchery for social comparison to taking place.

Social comparison is especially relevant at nighttime. Evidence proposes that any kind of behaviour around bedtime is of greater importance in explaining poor sleep than behaviours throughout the day (Cain & Gradisar, 2010). Furthermore, social comparison indeed has been found to be linked with nighttime social media use (McNee & Woods, 2019). Shortly before falling asleep, the brain processes the events of the day. Rumination, which is best described as repetitive negative thought, initiated by social media use, is further fueled by social comparison (Bergfeld & Van den Bulck, 2021). This interferes with the mind's preparation to fall asleep since rumination increases pre-sleep cognitive arousal (Brosschot et al., 2006). People diagnosed with insomnia often report pre-sleep worries to be the most important reason for being unable to fall asleep (Harvey, 2000; Lichstein & Rosenthal, 1980).

Pre-sleep worrying is especially prominent in individuals who have low self-confidence. They are more likely to compare themselves to others on social media (Lee, 2014). Users may struggle at bedtime not only using social media but also continue thinking about it constantly when in bed. According to Gibbons and Buunk (1999), the reason for this is their urge to enhance their self-concept through social comparison. Moreover, they found that a person who is more self-conscious in the presence of others tends to immerse more frequently in social comparison behaviours on social media. The background to this is that social media, unlike other uses of the Internet, entails incoming alerts at all times of the day. First, these alerts pose a high risk to disturb sleep, since 89% of adolescents have their phones in their bedroom, either under the pillow or even in their hands while sleeping (Lenhart et al., 2010). Second, incoming alerts create a perceived pressure to be available 24/7 and contribute to a fear of missing out (Thomée et al., 2010). It is therefore plausible that young adults and especially people who feel less certain about themselves struggle to relax at bedtime and tend to become a victim of the described vicious cycle (Skierkowski & Wood, 2012; Thomée et al., 2010).

Females seem to be particularly affected by these risk factors. Research on gender differences in sleep hygiene practices and sleep quality, using the Adolescent Sleep Hygiene Scale reports a slightly lower score in girls than in boys, reflecting worse sleep hygiene (Galland et al., 2017). Sleep hygiene refers to those behaviours that are believed to promote consistent, uninterrupted sleep (Stepanski & Wyatt, 2003). Females scored significantly worse on the "behavioural arousal" domain (activating behaviours before bedtime, e.g., using the smartphone) and the "cognitive/emotional" domain (rumination behaviours and negative

emotional states at bedtime). This can be explained by the results of Haferkamp & Krämer (2011), which suggest that females are more likely to compare themselves through social comparison in terms of physical attractiveness based on pictures they encounter on social media. Regarding the emphasis on photo sharing in today's popular social media, together with the increased likelihood that females will post photos, it may be that girls are drawn to more self-relevant comparisons (Nesi & Prinstein, 2015; Stefanone et al., 2011). These social comparison behaviours have been proven to result in negative emotional states, due to the perceived threat to self-worth (Stefanone et al., 2011), and again put sleep of good quality at risk.

However, the direct impact of social comparison behaviour when using social media at nighttime on sleep quality has rarely been studied so far. To our knowledge, no study has yielded the differences in gender in this relationship. Previous research by McNee and Woods (2019), examined the interaction between nighttime social media use and sleep quality, moderated by social comparison behaviour, while solely focusing on young women, with a mean of 20 years of age. Moreover, the findings must be interpreted within the limitation of the study being part of a larger lab-based experiment investigating young women's endeavors with the social media trend of #fitspiration. This current work differs in its aims at contributing to earlier studies by investigating both males and females, taking into consideration also other genders, thereby trying to shed light on the larger population. The present study makes a novel contribution to the literature by examining how nighttime-specific social media use relates to sleep quality and what role gender and social comparison behaviour play. These efforts could inform safety measures and encourage social media use in ways that maximize potential benefits while minimizing the risk of harm. Recognizing how gender contributes to differences in social comparison when using social media at nighttime helps with creating successful interventions. Interventions that are specifically targeted at the most prominent at-risk group, involve methods that are scientifically proven to make a difference. Ultimately, it is highly important to ensure one of the most precious times of human life: nighttime sleep of the highest quality.

Based on the information presented in the introduction, the following research questions (RQ) and hypotheses (H) have been developed:

RQ 1: *To what extent does social comparison behaviour mediate the relationship between nighttime social media use and sleep quality?*

H1: People who use social media at nighttime have a lower sleep quality than people who do not use social media at nighttime

H2: People who use social media at nighttime have a higher social comparison behaviour than people who do not use social media at nighttime

H3: There is a relationship between social comparison behaviour and sleep quality

H4: Social comparison behaviour mediates the relation between nighttime social media use and sleep quality

RQ 2: *What influence does gender have on the mediated role of social comparison behaviour in the relation to nighttime social media use and sleep quality?*

H5: Gender is a moderator in the mediation of social comparison in the relation between nighttime social media use and sleep quality

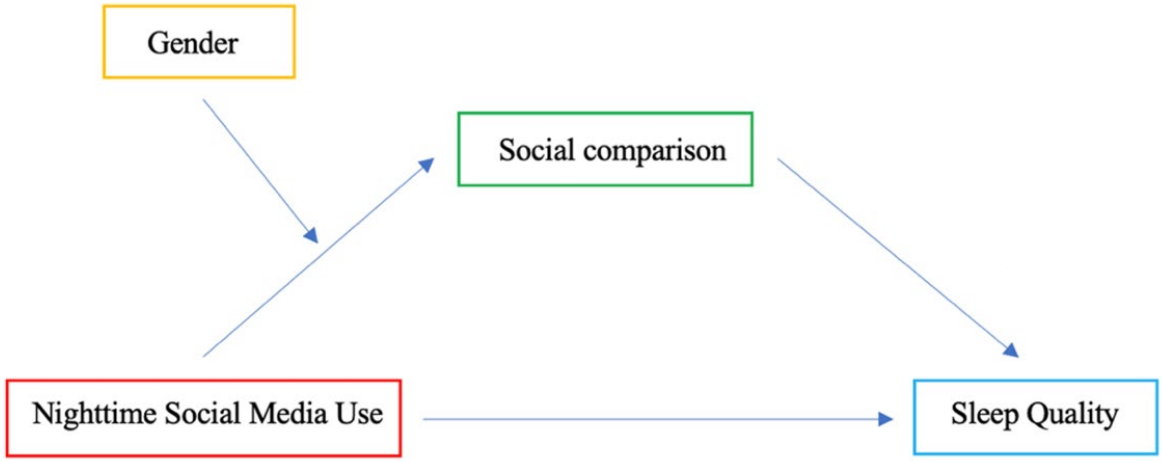
Methods

Design

A cross-sectional quantitative questionnaire survey design was used to investigate the relationship between the nighttime use of social media and sleep quality as well as to examine the mediating role of comparison behaviour and the moderating role of gender (see Figure 1). This study was conducted in the context of a larger survey of a research group, consisting of nine third-year Psychology students at the University of Twente.

Figure 1

Model of the Relationship Between Nighttime Social Media Use and Sleep Quality Mediated by Social Comparison and Moderated by Gender



Participants

To be eligible, participants needed to be between 18 and 29 years old and have a sufficient level of English language abilities. They were also required to possess a mobile device and use social media. Participants were recruited via the survey distribution application Sona Systems, run by the Behavioral, Management, and Social Science (BMS) faculty of the University of Twente, where they received 0.25 credits for their participation. The survey was also distributed using convenience sampling and snowball sampling among friends and family. The data collection took place in the period from the 12th of April until the 29th of April 2022. The minimum sample size required to achieve good statistical power was $n = 74$, as calculated using G*power. Initially, $n = 243$ responses were recorded via Qualtrics.com. However, $n = 163$ responses had to be excluded due to the following reasons: As Qualtrics.com records every start of the survey, some participants did not complete the full survey. Consequently, data was missing to consider these participants. Some participants wrongly answered the attention check – a question testing whether participants were actively paying attention, by asking them to choose "strongly disagree".

The final sample (Table 1) consisted of $N = 80$ participants, with a mean age of 22.6 years ($SD = 2.7$). The youngest participant was 18 years old and the oldest was 29 years old.

Table 1

Sociodemographic Characteristics of Participants in Final Sample

	Sample	
Baseline Characteristic	*n*	%
Gender		
Male	28	35
Female	49	61.3
Prefer not to say	3	3.7
Nationality		
German	53	66.3
Dutch	6	7.5
Other	21	26.2

Note. $N = 80$.

Materials

Qualtrics.com was used to create and distribute the online survey. For this study, the respondents' demographics, social comparison, sleep quality, and nighttime social media use were explored. In the subsequent paragraphs, the administered questionnaires are described.

Social Media Use

Social media use was measured using distinctive questions for active and passive use. Active use was defined as "producing your own content, chatting with others, and commenting on others' content". Passive use was defined as "browsing content, viewing others' posts, and reading comments". Participants were then asked to indicate how much they use social media actively and passively, by answering items on a 7-point Likert scale, ranging from one (*not actively/passively at all*) to seven (*only actively/passively*). In total there were two questions, formulated according to previous literature on that topic, with one item each.

Nighttime Social Media Use

To measure the participants' nighttime social media use, they were asked to think about the time they usually go to bed before falling asleep. Then, they had to estimate the time they spend on social media while lying in bed before falling asleep. An example of how to indicate that time was given: "If you go to bed at 11:00 p.m. and lay in bed using social media until 12:30 p.m. every night, your average screen time before falling asleep would be 1 hour and 30 minutes. Thus, you would enter 1.30 below." Following that, participants answered the two abovementioned items on active and passive use again, this time specifically highlighting their active or passive use of social media when lying in bed before falling asleep. Again, answers were given on a 7-point Likert scale ranging from one (*not actively/passively at all*) to seven (*only actively/passively*).

Furthermore, the estimation of time they spend actively on social media was asked and the time they spend passively on social media. Again, the participants were provided with an example: "If you usually spend 1 hour and 30 minutes using social media while lying in bed before falling asleep, but of that time only 30 minutes are spent actively (producing your own content, chatting with others, commenting) you would enter 0.30 below, which corresponds to 0 hours, 30 minutes." And the same example was given in the question concerning passive use, with the word "actively" changed to "passively".

Social Comparison Behaviour

To measure the variable social comparison behaviour, the Iowa-Netherlands Comparison Orientation Scale (INCOM scale) by Gibbons and Buunk (1999) was used. First, participants were given the following introducing text: "Most people compare themselves from

time to time with others. For example, they may compare the way they feel, their opinions, their abilities, and/or their situation with those of other people. There is nothing particularly 'good' or 'bad' about this type of comparison, and some people do it more than others. We would like to find out how often you compare yourself with other people. To do that we would like to ask you to indicate how much you agree with each statement below." The core instrument of the INCOM scale contains 11 items. In these items, participants are given statements about their self-comparisons with others, to which they can respond on a five-point scale ranging from one (*strongly disagree*) to five (*strongly agree*). For instance, one of the items looked like this: "I often compare myself with others concerning what I have accomplished in life". The validity of the instrument has been tested in 22 questionnaires in the United States and the Netherlands. It has proven to be valid and reliable based on a wide range of empirical tests (Gibbons & Buunk, 1999). Cronbach's alpha in this sample turned out to be .79, suggesting that the reliability of the scale is very high also in the current sample.

Sleep Quality

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) by Buysse et al. (1989). This measure consists of nine self-rated questions, with a total of 17 items, assessing sleep quality over the time of a month. These 17 items are combined to form seven "component" scores (sleep duration, subjective sleep quality, sleep efficiency, sleep latency, sleep disturbances, daytime dysfunction, and use of sleep medication), each of which has a range of zero to three points. In all cases, a score of zero indicates no difficulty, while a score of three indicates severe difficulty. The seven component scores are then added to yield one global score, with a range of 0-21 points, zero meaning no difficulty and 21 meaning severe difficulties in all areas, thereby respondents that had a score higher than five were categorized as poor sleepers. The specific items concern for example the time, participants usually have gone to bed during the past month, or how long it has taken them to fall asleep. But there are also other items, asking participants about their trouble sleeping because for instance they felt too hot/too cold, they had to use the bathroom, or they had pain. These items could then be answered on a 4-point scale from "not during the past month" to "three or more times a week". The scale is commonly used with adolescents, as well as adults, and has a Cronbach's alpha of .72 in adolescents and young adults (De la Vega et al., 2015). In the current study, a satisfying Cronbach's alpha of .76 has been found.

Procedure

The first step after creating the survey on Qualtrics.com was to obtain ethical approval from the ethics committee of the University of Twente (Nr. 220244, see Appendix A). After

the successful approval, the survey's link was distributed via Instagram and WhatsApp, leading directly to Qualtrics.com, and the Sona Systems website, including a short recruitment text.

The survey started with a sheet of general information (see Appendix B), including the purpose of the study, the study content, the data acquisition, and the contact details of the researchers. Participants were asked to carefully go through this information and could then indicate whether they read and understood the study information, whether they consent voluntarily to be a participant in this study, and understand that they can refuse to answer questions and withdraw from the study at any time, without having to give a reason, whether they understood the purpose of the study and what it entails and whether they are at least 18 years old, and give permission for the anonymized answers to be archived in the University of Twente Research repository so it can be used for future research and learning.

Then, participants filled in their demographics (age, nationality, and with which gender they identify most) and indicated whether they are using an iOS or Android device. This information then helped to lead them to the correct instructions on how to access the necessary information on their smartphone, regarding total weekly and daily screen time. Instructions were given using explanatory texts as well as screenshots of smartphone screens, where certain keywords were circled in red. This was followed by the questionnaires in a random order, and in the end, participants were thanked for their time spent completing the survey and got informed that their responses had been recorded. On average participants spent 43 minutes filling in the survey.

Data analysis

The collected data was analyzed using the database Statistical Packages for the Social Sciences (SPSS), version 23. Firstly, the data were screened, and a final data set got determined. Participants who did not properly answer the questionnaire were removed. This was done by looking at the progress of the participants and seeing if they answered the consent questions with “yes”, and if they chose the correctly answered the attention check. Secondly, the descriptives of the demographic data of the participants were assessed to get an overview of the sample’s characteristics. Then, the scales were inspected for reverse items. For the INCOM scale, item 6 (“I am not the type of person who compares often with others”) and item 10 (“I never consider my situation in life relative to that of other people”) were reverse items and consequently coded into the opposite. To obtain the global score of the PSQI, the calculation following the instructions of the authors (Gibbons & Buunk, 1999) were made by hand and afterward added as a new variable in SPSS. For the INCOM scale, the average of the items’ values was calculated.

Since nighttime social media use was measured by one item for active use and one item for passive use, a new variable was created to obtain an overall score of nighttime social media use. To do so, the score of passive nighttime social media use was subtracted from the score of active nighttime social media use. Consequently, a positive overall score represented a more active use of social media at nighttime. A negative score indicated a more passive use of social media at nighttime. The variable "With which gender do you identify most?" was turned into a variable with the values "0 = female" and "1 = male". Next, Cronbach's alpha was computed to check the internal consistency reliability of the INCOM scale and the. Besides that, descriptive statistics (frequency, percentage, minimum, maximum, mean, *SD*) were calculated for the variables of sleep quality, social comparison, active and passive nighttime social media use, the overall score of nighttime social media use, and the participants' time spent on social media at nighttime.

Prior to testing the hypotheses, the corresponding statistical assumptions were checked. A Shapiro-Wilk's test ($p > .05$) (Shapiro & Wilk, 1965) and a visual inspection of the histograms showed that the data were approximately normally distributed, except for the Pittsburgh Sleep Quality Index scores, which were skewed to the right. This was corrected using the square root transformation method (Atkinson, 1973). There were no signs of heteroscedasticity or multicollinearity, and no outliers were identified.

To answer the first two hypotheses, a t-test was performed. For hypothesis three, a regression analysis was run to understand the effect of social comparison on sleep quality. For testing hypothesis four, a mediation analysis was realized, using the additional program PROCESS macro for SPSS, version 4.1 by Hayes (2017). In the program, model number four was chosen, nighttime social media use thereby being the independent variable and sleep quality as the dependent variable. Social comparison was the mediator in this case. A confidence interval of 95% and a bootstrapping of 5000 was used to test the statistical significance of total, direct, and indirect effects. Hypothesis five examined a moderated mediation, where gender as a moderating variable was added to the mediation model used to answer hypothesis four. However, model number seven was chosen in this case.

Results

Descriptive Statistics

In table two, the descriptives for the variables of sleep quality, social comparison, active and passive nighttime social media use, and the overall score for nighttime social media use are presented.

Table 2

Descriptives of Sleep quality, Social comparison, Motivations to use Social Media at nighttime, and overall nighttime Social Media Use (N=80)

Variable	Minimum	Maximum	Mean	Std. Deviation (*SD*)
Sleep quality	1	16	5.45	2.88
Social comparison	2.27	4.82	3.61	.56
Active nighttime social media use	1.00	5.00	2.13	1.01
Passive nighttime social media use	1.00	7.00	5.16	1.66
(overall) nighttime social media use[a]	-6.00	1.00	-3.04	1.93

Note. [a]Negative values demonstrate more passive nighttime social media use, while positive values represent more active nighttime social media use.

Forty-five percent of male and female participants had scores higher than five on the PSQI and were therefore categorized as poor sleepers. The average bedtime was 11:43 pm (*SD* = 1.23) and 7:20 am was the average wake-up time (*SD* = 0.57). The mean sleep duration was seven hours and 17 minutes (*SD* = 1.42).

Looking at the distribution of answers in the variable on time spent on social media at nighttime, most people (35.3%) use social media for 15 to 30 minutes at nighttime. This was closely followed by 26.5% of participants, who indicated using social media for 31 to 59 minutes at nighttime (see Table 3).

Table 3

Time spent on social media at nighttime (N=80)

Variable	Frequency	Percentage (%)
Time spent on social media at nighttime (per day)		
Less than 15 minutes	17	21.7
15 to 30 minutes	28	35.3
31 to 59 minutes	22	26.5
1 to 2 hours	10	12.6
More than 2 hours	3	3.9

H1: Difference in Sleep Quality Between People who do and do not use Social Media at Nighttime

When running a t-test with nighttime social media use as the independent variable and

sleep quality as the dependent variable. The participants were divided into two groups: participants who use social media at nighttime and participants who do not use social media at nighttime. Those participants who use social media at nighttime had a mean score on sleep quality of $M = 2.297$ ($SD = 0.598$), and those who do not use social media at nighttime had a mean score on sleep quality of $M = 1.944$ ($SD = 0.683$). A higher score represents sleep quality is worse. However, the difference was non-significant (F (2,78) = 0.191, $t = 1.715$, $p = .090$), leading to the rejection of hypothesis one.

H2: Difference in Social Comparison Between People who do and do not use Social Media at Nighttime

Again, participants were divided in two groups: participants who use social media at nighttime and participants who do not use social media at nighttime. A t-test revealed a non-significant (F (2,78) = 0.201, t = -0.549, p = .656) difference in mean scores of social comparison behaviour between people who do ($M = 3.596$, $SD = 0.559$) and do not ($M = 3.700$, $SD = 0.552$) use social media at nighttime. Hypothesis two has been rejected.

H3: Relation Between Social Comparison and Sleep Quality

To test hypothesis three, a regression analysis was performed. Social comparison was the independent variable and sleep quality was the dependent variable. The regression analysis revealed a non-significant regression equation ($b = 0.906$, $SE = 0.588$, $t(1,76) = 1.531$, $p = .124$, 95% CI [-0.271, 2.070]). Only 3.1% ($R^2 = .031$) of the variability in sleep quality can be accounted for by social comparison. Based on the mentioned results, hypothesis three was rejected.

H4: The Mediating Role of Social Comparison in the Relation Between Nighttime Social Media Use and Sleep Quality

In relation to the fourth hypothesis, stating that social comparison behaviour mediates the relationship between nighttime social media use and sleep quality, a mediation analysis was run. Concerning the relationship between the independent variable nighttime social media use and the dependent variable sleep quality, the mediation analysis revealed a non-significant total effect ($b = -0.022$, $SE = 0.180$, $p = .541$). The indirect effect of social comparison as mediating the relationship was found to be non-significant (b = 0.007, 95% CI [-0.004, 0.027]). Additionally, the paths' coefficients of the mediator were computed. Social comparison showed to have a non-significant effect on sleep quality ($b = 0.208$, $SE = 0.04$, $p = .107$) and a non-significant effect was found for the effect of nighttime social media use on social comparison ($b = 0.035$, $SE = 0.033$, $p = .293$). Also, there was a non-significant direct effect of nighttime

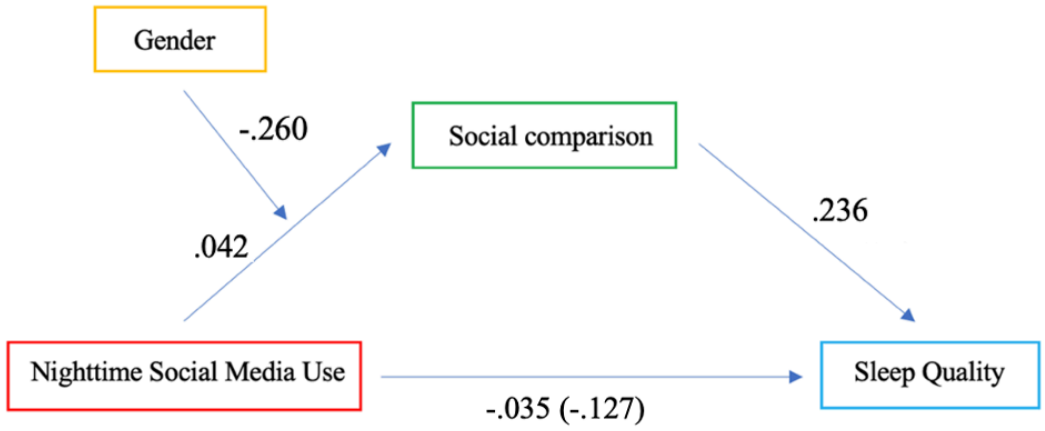
social media use on sleep quality (b = 0.063, SE = 0.170, p = .715) when taking the mediator variable social comparison into account. Due to these results, hypothesis four was rejected.

H5: Gender as a Moderator in the Mediation of Social Comparison in the Relation Between Nighttime Social Media Use and Sleep Quality

To test hypothesis five, a moderated mediation was conducted (Figure 2). Thereby, gender has been predicted to be the moderator in the mediation of social comparison in the relation between nighttime social media use and sleep quality. Again, the total, as well as the indirect and direct effects, were calculated. The total effect of the independent variable nighttime social media use on the dependent variable sleep quality turned out to be non-significant (b = -0.035, SE = 0.039, p = .344). Furthermore, the direct effect of gender as the moderator is non-significant (b = -0.260, SE = 0.132 p = .053). The non-significant indirect effects of gender are b = 0.047 (95% CI [-0.027, 0.156]) for females and b = 0.044 (95% CI [-0.081, 0.242]) for males. For the path coefficient from nighttime social media use to social comparison, a non-significant effect was found (b = 0.042, SE = 0.069, p = .196). And the effect from social comparison on sleep quality revealed to be non-significant (b = 0.236, SE = 0.174, p = .078). Also, there was a non-significant direct effect of nighttime social media use on sleep quality (b = -0.127, SE = 0.156, p = .467) when taking the mediator variable social comparison and the moderator variable gender into account. Therefore, it must be concluded that the model is not suitable for explaining the hypothesized effects and hypothesis five has been rejected.

Figure 2

Moderated Mediation Model of the Relationship Between Nighttime Social Media Use and Sleep Quality with Social Comparison as Mediator and Gender as Moderator, Including Path Coefficients



Note. The regression coefficient for the direct effect between nighttime social media use and sleep quality, controlling for social comparison and gender, is in parentheses.

Discussion

The goal of this study was to examine how nighttime-specific social media use relates to sleep quality and what role gender as a moderator and social comparison behaviour as a mediator play. The aim of including gender was to investigate gender differences.

Regarding the first hypothesis which stated that people who use social media at nighttime have a lower sleep quality, a non-significant difference in means was found. This implies that there is no significant difference in sleep quality between people who use social media at nighttime and people who do not. Thus, the first hypothesis was rejected. Compared to previous research, this result is rather surprising (e.g., Whipps et al., 2018; Levenson et al., 2017). As mentioned earlier, however, Seabrook and colleagues accentuated in their 2016 systematic review that the impact of social media depends significantly on a range of protective and risk factors around *how* users engage online. In line with this, Exelmans and Scott (2019) found out that the impact on sleep quality depends on what the use of social media at nighttime looks like. If the engagement is mindful, rather than unintentional and habitual, the engagement is less likely to be problematic. In a study by Bergfeld and Van den Bulck (2021), adverse social media use was related significantly to longer sleep latency, increased pre-sleep arousal levels, greater fatigue, and consequently poor sleep quality. Based on that, a logical implication could be that the participants' nighttime social media engagement in this study is rather mindful and intentional and therefore does not significantly impact sleep quality.

The second hypothesis stated that people who use social media at nighttime have a higher social comparison behaviour than people who do not use social media at nighttime. Again, a non-significant difference in means was found, so there was no difference in social comparison behaviour between people who do and do not use social media at nighttime. The hypothesis was rejected. One possible interpretation could be that as seen with the first hypothesis, participants in the current study seem to engage mindfully in their nighttime social media use, indicating that social comparison behaviour does not pose a significant threat. In a study conducted by Yang (2016), a third category besides active and passive social media use was introduced: interactive social media use. Interactive social media use is defined as using social media to interact and socialize with others (Yang, 2016). Although this third category has not been specifically applied to nighttime social media use, it is related to lower levels of loneliness (Brandtzæg, 2012; Burke et al., 2010). Loneliness is an emotionally unpleasant feeling, that mostly results from one's assessment of his or her social relationships. The absence of loneliness might consequently prevent people from dealing with any form of adverse social comparison behaviour. Dibb and Foster (2021) revealed that only participants who compare

themselves to their perceived superiors on the social media platform Facebook are more likely to experience loneliness. Based on the non-existing difference in social comparison behaviour between people who do and do not use social media at nighttime one could assume that the participants of this study used social media to interact and socialize with others. Including this third category of interactive social media, use could reveal clearer insights.

The third hypothesis contented that there is a relation between social comparison and sleep quality. A regression analysis revealed a non-significant relation, and only 3.1% of the variability in sleep quality can be accounted for by social comparison. Hypothesis three was rejected. The act of engaging in social comparison seems to be less of a risk to sleep quality than expected. Lup et al. (2015) also found that more frequent use of the social media platform Instagram was not associated with social comparison. Evidence shows that a closer look at the specific social comparison behaviour, beyond the frequency, is needed. A specification between downward and upward social comparison might add meaningful information to this research. It seems like whether one's social comparison is more upward or downward in nature; depends on how many strangers one follows. Higher levels of following people one does not know are associated with upward social comparison, where social comparison comes into play as a mediator. This behaviour has direct associations with greater depressive symptoms through social comparison as a mediator (Lup et al., 2015). Keeping in touch solely with people one personally knows can consequently be a protective factor against the negative consequences of nighttime social media use. Again, a link to hypothesis two can be drawn, as the participants of this study are likely to use social media in a very controlled way at nighttime. However, the INCOM scale, which was used to measure social comparison behaviour was not specifically designed to assess social comparison behaviour on social media. It is asking about the extent to which people generally tend to compare themselves. In addition to that, it is the only valid and reliable scale that has been developed to measure social comparison orientation, therefore it has been chosen for the current study. Festinger (1954) distinguished between two dimensions – *opinions* and *abilities*. Gibbons and Buunk (1999), who developed the INCOM scale, describe these as what one should think or feel ("opinions") versus how to behave ("abilities"). Therefore, it is unclear what behaviour – online or offline – participants were thinking about when filling in the scale. If the assumption holds true, that participants are likely to use social media interactively, thereby interacting and socializing with others, it is plausible that social comparison did not impact sleep quality.

Hypothesis four examined the mediating role of social comparison in the relation between nighttime social media use and sleep quality. However, the effects were not significant.

Including social comparison as mediating variable in the model does not resolve the relation between nighttime social media use and sleep quality. The hypothesis was consequently rejected. This result is not in line with existing studies (e.g., Skierkowski & Wood, 2012; Thomée et al., 2010) which reported that especially people who feel less certain about themselves struggle to relax at bedtime and tend to become a victim to passively browsing through their social media platforms for hours and then struggling to fall asleep. However, evidence points out that within active social media use at nighttime there are differences in the outcomes for the individual. For instance, editing one's profile on Instagram has been associated with low self-esteem whilst communicating with friends was related to high self-esteem (Lup et al., 2015). Both activities are represented in the definition of active use in this study. The differences between the findings of the present study and previous work might be explained by the inclusion of more detailed measurements in previous work. This current study was focused on gaining more insights into the overall picture including rather factual information from the side of the participants. What became clear with this approach, is that social comparison behaviour, as measured with the INCOM scale, is not important for transmitting the effect of nighttime social media use on sleep quality. Furthermore, evidence of mediation between nighttime social media use and sleep quality through social comparison might be easier to establish using a more precise measure of social comparison including psychological traits known to affect this variable. This would help to make a more profound generalization of the results since it would help rule out possible side effects. Again, the outcome of the hypothesis might be different when using the more specific variable of upward social comparison. For instance, in a study by Masciantionio (2021), upward social comparison mediated the negative association between passively using Facebook and well-being, which was consistent with the outcomes of Verduyn et al. (2017).

Hypothesis five stated that gender is a moderator in the mediation of social comparison in the relation between nighttime social media use and sleep quality. This hypothesis must be rejected, due to non-significant effects. Contrary to what has been hypothesized, there was no significant difference in social comparison between those who identified as females and those who identified as male. On the one hand, one could now assume that social comparison behaviour does not significantly differ among genders. On the other hand, research in this field is lacking, so further studies can contribute to gaining important insights. In the context of social media use, people who identify as another gender than male or female might be especially important to look at. Most content on social media platforms like Instagram is focused on a binary gender society, thus those people might struggle to perform social comparison, as they

are less likely to find users, they feel close to. However, it is arguable if social comparison is desirable behaviour. Festinger (1954) believed that it is an innate drive and helps us establish a benchmark by which we can make accurate evaluations of ourselves. In any case, literature dating back to the 70s and 80s already suggests that upward comparisons are connected as a major risk factor for poor mental health (e.g., Bäzner et al., 2006; Jang et al., 2016; Marsh & Parker, 1984; Morse & Gergen, 1970). Again, one cannot say per se that social comparison, in general, is contributing to well-being. Within social media, the emergence of gender as a category that captures more than the binary is recent and was adopted by a few social media platforms only (Bivens & Haimson, 2016). Ad agencies, among others, create "customer profiles" which also include gender to give a face to the group of people they wish to target. This information is collected through mandatory sign-up fields and equips social media algorithms with customized information. Festinger (1954) was convinced that we mostly compare ourselves to readily available people, which in the case of people who identify as another gender than male or female can lead to frustration and even subconsciously cause problems with their identity creation. This is in line with the literature, suggesting that social comparison behaviour towards others who lie within a self-imposed range of similarity to themselves plays a crucial role in individual life satisfaction (Bivens & Haimson, 2016; Guimond et al., 2007).

Strengths and Limitations

For the scope of this study, a cross-sectional quantitative questionnaire survey design was used to answer the hypotheses. However, most participants indicated using social media at nighttime mostly in a passive way. Therefore, being able to experimentally manipulate the time spent with active or passive nighttime social media use and measuring the variables repeatedly across a longer period might reveal more insightful and meaningful findings. Because when having data about both passive and active use, more precise comparisons can be done about the variables under investigation. In addition to that, when generalizing the results of this study to the larger population, one must be careful. The sample used in this study is not an accurate representation of the world population because it mostly deals with Western Educated Industrialized Rich Democratic (WEIRD) people. These individuals, who represent only around twelve percent of the world's population, do not provide a generalizable representation of human behaviour and emotions.

Aside from the limitations, the study showed eminent strengths. A major strength is its focus on the ever-growing role of social media use in the lives of young adults. Investigating nighttime-specific social media use is especially important in understanding factors impacting

one's sleep quality. The use of validated scales for measuring sleep quality and social comparison increases the reliability of data and is reflected in a very satisfactory Cronbach's alpha for both scales in previous as well as the current research. It can also be seen as a strength of this study to not only consider generalized variables such as "time spent on the internet" or "hours on social media". These are less informative than figuring out what people do on the Internet, or with social media. The distinction between active and passive use thus provided insightful results. However, active, and passive use were each measured with one item only. A different scale measuring more aspects that differentiate active from passive use might be considered.

Recommendations for future research

The sampling procedure could be improved to be able to reach out to a more diverse representation of the general population. Since participants were recruited via convenience and snowball sampling, the sample is quite biased towards academic people, as well as women, as there is a majority of women in the study of Psychology. Since people start using social media platforms at an increasingly younger age, research on the risk factors of their using experiences is needed. Social comparison behaviour is especially prominent in teenagers, as it forms part of identity creation. On top of that, young people tend to focus on qualities like perceived attractiveness as well as popularity, both of which can be highly manipulated in the use of social media platforms. Furthermore, a recommendation for future research is to recruit specifically participants beyond the binary gender, to shed light on a larger population.

In any case, nighttime social media use is connected to many risk factors. As opposed to the suggestion of a total reduction of social media use, time-specific advice might be more realizable for young adults. Future work could thus investigate the period before lights out (e.g., 30 minutes) in which a reduced use of social media would make the biggest difference in impacting sleep quality. On top of that users could be educated to become more conscious consumers of social media content. Future work should also focus on identifying and testing feasible prevention and intervention strategies aimed at reducing nighttime social media use. Furthermore, as Shaw et al. (2020) discovered, it may be advisable to investigate individual nighttime social media use patterns. A pool of gratification items could be assembled from a focus group to find out why they use different social media platforms. Consequently, an explanatory factor analysis can be used to interpret the motives and to extract those with eigenvalues greater than 1.0 which can then be included in a questionnaire.

It must be pointed out that 45% of the participants had scores higher than five on the PSQI and were therefore categorized as poor sleepers. This number is alarming. In a study by

Gilbert and Weaver (2010) 70% of the non-depressed US university students in the sample had sleep quality scores that were poorer than the normal control sample in the original Buysse and colleagues (1989) study. Turning to prevention, these results demand that counseling centers should provide psychoeducational information aimed at young adults. The importance of good sleep quality should be stressed, and advice should be provided on how to achieve it. In earlier paragraphs, it has been mentioned that because of the non-significant results, the participants in this study seem to engage mindfully in nighttime social media use. However, almost every second participant was categorized as a poor sleeper. If this is not due to their nighttime social media use, there must be other factors explaining this issue, which need to be investigated.

Despite reasonable theoretical and empirical rationale for assessing upward – and downward-specific social comparison behaviour of physical appearance, no measure for these constructs exists (O'Brien et al., 2008). Instagram, one of the most popular social media platforms is characterized by its photo-sharing and video-editing features – allowing users to use filters and other idealizing features. Correlational literature is indicating that exposure to Instagram is significantly associated with greater body dissatisfaction (Woodley, 2018). Upward social comparison of physical appearance, when using social media at nighttime is very likely to have an impact on sleep quality, even in the sample of the current study, when using a more specific and detailed scale. Hence, future research is encouraged to develop such a scale and apply it in studies.

Conclusion

The study at hand identified nighttime social media use as playing an ever-growing role in the lives of young adults and is especially concerning because of the potential negative impact on sleep quality. In contrast to the expectations, all hypotheses were rejected. There were no differences in sleep quality or social comparison between people who do and do not use social media at nighttime. In addition, social comparison did not mediate the relationship between nighttime social media use and sleep quality and gender did not moderate this mediation. Since the mediating and moderating variables in the model used for this study have been shown to lead to non-significant differences, future research should focus on identifying and testing others. Most importantly, young adults, as repeatedly stressed throughout the report, need to understand the undisputed value of nighttime sleep of the highest quality.

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Appendix A

APPROVED BMS EC RESEARCH PROJECT REQUEST

Dear researcher,
This is a notification from the BMS Ethics Committee concerning the web application form for the ethical review of research projects.

Requestnr. :	220244
Title :	Social media use and its relationship with mental health and/or well-being
Date of application :	2022-03-22
Researcher :	Sauter, R.J.
Supervisor :	Duarte, K.D.
Commission :	Klooster, P.M. ten
Usage of SONA :	Y

Your research has been approved by the Ethics Committee.

Appendix B

Dear participant,

Thank you for taking part in this study. Please read the following information carefully.

Purpose of this study

The purpose of this study is to examine the relationship between social media platforms and user's mental health and/or well-being. This survey will take approximately 15-25 minutes to complete. To take part in this study, you have to be above the age of 18.

Study content

This study is part of the bachelor's theses of a group of psychology students from the University of Twente. As the focus of each thesis differs slightly, the questions will be divided into several sections. First, you will be asked to answer some demographic questions. This will be followed by questions that concern your daily social media consumption, including topics such as your average screen time and your intention of social media use. Lastly, you will be asked to answer some sets of questions concerning your personality and other psychological factors. Please note, that there are no right or wrong answers as this survey intends to measure your own experiences. Please read the questions carefully and answer them honestly.

Data acquisition

Your participation in this study is voluntary. You have the right to withdraw at any time without giving any reason. Your response will be anonymous and cannot be traced back to you. Your data will be treated as confidential and only used for academic purposes. There are no known risks expected from the participation in this study.

Contact

If you have any questions or concerns, please contact one of the following:
Louisa Albermann, l.albermann@student.utwente.nl (researcher)
Cara Strieckmann, c.strieckmann@student.utwente.nl (researcher)
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Karla Duarte, k.d.duarte@utwente.nl (supervisor)

For questions about the ethical approval and your rights as a participant, you can reach any of the researchers or the ethicscommittee-bms@utwente.nl. This study is approved by the ethical committee of the Behavioural, Management and Social Sciences (BMS) of the University of Twente.