Investigating the Association Between Sedentary Time and State Social Anxiety in Young Adults Through Experience Sampling Methodology

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Abstract

Background: Sedentary time is an extensive part of young adults' daily routines, through, for example, studying or watching TV. This is critical considering the adverse health consequences associated with high levels of sedentary time. Simultaneously, social anxiety is a widespread phenomenon in 18-35-year-olds. Since sedentary time is linked to different mental health conditions, this study investigated the association between sedentary time and state social anxiety in young adults. Additionally, trait Fear of Missing Out was assessed as a moderator in this relationship.

Methods: An Experience Sampling study with a sample of 49 participants (M_{age} = 24.5, SD_{age} = 3.4, 55.1% female) was conducted over eight days. The application Ethica was used to collect daily input on sedentary time in minutes and state social anxiety, each for the past 24 hours. Trait Fear of Missing Out was measured once at the beginning of the study. Linear Mixed Models and visualised Estimated Marginal Means were used to analyse the association between the constructs.

Results: The association between sedentary time and state social anxiety was insignificant in this sample. There was also no significant moderating effect of trait Fear of Missing Out. Still, a significant association between Fear of Missing Out and state social anxiety was detected.

Conclusion: Against expectations, neither a significant association between sedentary time and state social anxiety nor an interaction effect was found. The association between trait Fear of Missing Out and state social anxiety contributes to the understanding of both phenomena. The lack of association between sedentary time and state social anxiety can be regarded positively, given the high levels of sedentary time in young adults. Subsequent studies should investigate associations of sedentary time with other mental health conditions.

Investigating the Association Between Sedentary Time and State Social Anxiety in Young Adults Through Experience Sampling Methodology

Around a quarter to a third of the European population suffers from at least one mental condition (Statistica, 2020). When it comes to the aetiology of these conditions, there are factors, such as genetic predispositions and childhood experiences, that individuals cannot influence (Guintivano & Kamisnky, 2016; George, 2007). However, there are also behaviours that contribute to the development of mental disorders. When it comes to daily lifestyle habits, evidence suggests that sitting too much is associated with depression, anxiety and decreased well-being (Zhi et al., 2014; Teychenne et al., 2015). While these associations are increasingly explored, research on the effects of sitting behaviours, also known as sedentary behaviours, on specific types of anxiety is still limited. One of the mental health issues that could potentially be affected by sedentary behaviours is feelings of social anxiety. This is the most common form of anxiety in young adults and can have a detrimental influence on affected individuals. Simultaneously, research suggests that the same age group spends much time sedentarily. Thus, this study investigated the relationship between sedentary time and state social anxiety in young adults. In this age group, meaning 18-35 year-olds, sedentary time is often spent alone involving screen-based activities. Therefore, the individuals' trait Fear of Missing Out was also taken into account as a moderating variable in this relationship.

Sedentary Time

According to Tremblay et al. (2017), sedentary behaviour is defined as "any waking behavior characterised by an energy expenditure ≤1.5 metabolic equivalents (METs), while in a sitting, reclining or lying posture" (p. 9). Sedentary time, therefore, entails "time spent for any duration (e.g. minutes per day) or in any context (e.g., at school or work) in sedentary

behaviours" (Tremblay et al., 2017, p. 9). Bertrand et al. (2021) suggest that young adults spend most of their day with sedentary activities, taking up around 8.3 hours daily. These activities include, for example, watching television, leisure internet usage, playing video games or reading. Working or studying at a desk or sitting while eating or travelling is also included. Thus, sedentary time is thoroughly embedded in young adults' daily life, as it comprises many activities that make up a daily routine.

Sedentary behaviour should not be confused with physical inactivity as these are two separate constructs (Van Der Ploeg & Hillsdon, 2017). Physical inactivity entails that a person engages in insufficient amounts of physical activity. According to the World Health Organisation (WHO), this translates to less than 150 minutes of moderate-, or less than 75 minutes of vigorous-intensity activities throughout the week (Guidelines Review Committee, 2010). A person could, for example, take their car to a desk-bound office job and afterwards spend their evening watching TV on a couch. They would therefore spend the majority of their day sedentarily. However, if this person also manages to go on a 30-minute walk daily, they would still not be considered physically inactive.

Various adverse health outcomes are connected to sedentary behaviour, including physical problems and conditions such as obesity, type 2 diabetes, cardiovascular disease, and certain forms of cancer (Saunders et al., 2020). These could be a consequence of elevated blood pressure stemming from sedentary behaviour. Further, research also suggests associations with mental health conditions. High levels of sedentary time have consistently been shown to increase the risk for depression (Zhai et al., 2014; Asare et al., 2015). Associations between sedentary time and bipolar disorder have also been found (Allen et al., 2019). Both depression, as well as bipolar disorder, are commonly comorbid with another condition, namely, social anxiety

(Koyuncu et al., 2019). Given this comorbidity, exploring the association between sedentary time and social anxiety is highly valuable, considering the broader impact of sedentary time on mental health and its interplay with conditions like social anxiety.

State Social Anxiety

Social anxiety is the intense fear of social situations due to fear of actual or perceived evaluations from others (Morrison & Gross, 2013). If this fear is so severe that it impairs daily functioning, it is called social anxiety disorder (Craske et al., 2011). Social anxiety is also often accompanied by biases in attention, interpretation, memory and imagery (Givon-Benjio & Okon-Singer, 2020). These lead to negatively perceiving and interpreting social situations, further maintaining initial the fear (Kley et al., 2012).

Social anxiety is one of the most common forms of anxiety. Koyuncu et al. (2019) suggest that the overall lifetime prevalence of social anxiety lies between 8.4 and 15%. Additionally, young adults are disproportionately affected. Derived from a global study, 36% of 16-29 year-olds suffer from social anxiety (Jefferies & Unger, 2020). This is especially devastating, considering that the comorbidity rate of social anxiety is 90% (Koyuncu et al., 2019). Besides the aforementioned, common comorbid disorders include other anxiety disorders and obsessive-compulsive disorders (Koyuncu et al., 2019). The risk of developing alcohol use disorder also increases in people with social anxiety (Koyuncu et al., 2019).

However, most people who experience social anxiety do not meet the diagnostic criteria for social anxiety disorder due to their ability to avoid specific triggering social situations, thus allowing unimpaired daily functioning (Givon-Benji & Okon-Singer, 2020). As those people are still at risk for experiencing comorbid conditions, the focus on the general population is essential in investigating social anxiety. Otherwise, only considering people with social anxiety disorder

would overlook the experience of a significant number of people. Therefore, this report will examine state social anxiety, alluding to the experience of feelings of social anxiety in individuals who may or may not meet the criteria for social anxiety disorder. State social anxiety also reflects the fear of social interactions and judgement. However, it refers to the moment-to-moment experience of those feelings, thus being more fluctuant and sensitive to the circumstances (Kashdan & Steger, 2006).

State social anxiety has significant adverse effects on people's day-to-day well-being. For example, a study by Goodman et al. (2018) found that state social anxiety predicts the quality of people's social interactions, decreasing with increased state social anxiety. That same study showed that heightened state social anxiety in a social setting increases the likelihood of alcohol consumption, as well as the amount of alcohol consumed, in the subsequent social situation. Another study found that state social anxiety negatively influences the number of positive emotions experienced daily (Kashdan & Steger, 2006). Considering these detrimental consequences for affected people, possible contributing or associated factors should be investigated. Here, sedentary time was taken into regard.

Sedentary Time and State Social Anxiety

Previous research suggests a small positive association between sedentary time and anxiety (Allen et al., 2019). This could, for example, be due to increased arousal of the central nervous system stemming from screen-based activities or disrupted sleep patterns that result from sedentary behaviours (Teychenne et al., 2015). Notably, these disrupted sleep patterns are not only related to sedentary behaviours but are also closely associated with state social anxiety (Lima et al., 2020), which might hint at an association between sedentary time and state social anxiety. In fact, prior research has found a positive correlation between sedentary behaviours and

social anxiety in obese individuals (Abdollahi & Talib, 2015). Further, Teychenne et al. (2015) suggest that the social withdrawal that occurs when people often engage in sedentary behaviours, such as watching TV, might contribute to decreased interpersonal relationships, presenting a risk factor for social anxiety. Besides, other screen-based sedentary activities, such as using social media platforms, might also be associated with state social anxiety (O'Day & Gross, 2021).

While these prior studies suggest associations through specific activities or consequences of sedentary time, research on the association between total sedentary time and state social anxiety is so far limited to obese individuals. Considering the high levels of sedentary time and the prevalence of social anxiety in young adults, an exploration of this association could be valuable for the self-management of state social anxiety. To attend to the complexity of these two constructs, the Experience Sampling Methodology (ESM) was deemed most appropriate for this study.

Experience Sampling Methodology

The ESM allows the continuous collection of real-time data on daily sedentary time and state social anxiety through short daily measures. A study by Meyer et al. (2016) used the ESM to investigate work-related sedentary behaviour, and recommended the ESM as the most preferable method in measuring daily sedentary time, leading to the most accurate results. Past studies have utilised the ESM to investigate associations with mood, perceived stress or fatigue (Skupin, 2022; Zablotny, 2022; Wingbermühle, 2021).

Moreover, research on state social anxiety also employed the ESM. Associations of state social anxiety with positive emotions, quality of social interactions, and alcohol consumption have been explored through experience sampling (Goodman et al., 2018; Kashdan et al., 2014). Here, Goodman et al. (2018) concluded that the ESM helps to gather accurate information on

state social anxiety, capturing within-person fluctuations to draw precise conclusions on state social anxiety. The aforementioned study declared a clear benefit over single time point global assessment.

Hence, the ESM has been used to research both sedentary time and state social anxiety separately and has been recommended for both of these constructs. The ESM was, therefore, also selected for this study to produce informative and accurate results.

Fear of Missing Out

While there could be a direct association between total sedentary time and state social anxiety, it is also possible that a moderating factor influences fluctuations. Here, Fear of Missing Out (FOMO) was considered. It describes "a pervasive apprehension that others might be having rewarding experiences from which one is absent" (Przybylski et al., 2013, p. 1841), leading a person to feel the need to be connected and informed about what other people are doing at all times. This phenomenon has generated increasing interest with the advancement of social media platforms that allow easy access to information about other people's lives (Roberts & David, 2020). This phenomenon is often regarded as a dispositional trait related to how connected individuals feel to others (Roberts & David, 2020). Moreover, research suggests that FOMO is negatively related to self-compassion, with individuals high in FOMO having insecure self-perceptions (Barry & Wong, 2020). This entails individuals having difficulties accepting their shortcomings, dealing with social setbacks, and feeling little self-satisfaction (Barry & Wong, 2020; Marsh et al., 2018). Here, Barry and Wong (2020) hypothesised that the preoccupation with other people's activities in FOMO might increase one's vulnerability to social anxiety, though concrete evidence is missing.

FOMO-related feelings of social inadequacy might also be increased since individuals high in FOMO tend to judge themselves on how they spend their time (Luca et al., 2020). Thus, they would most likely also be judgmental of their sedentary behaviours, especially when they know their peers behave differently. Here, screen-based sedentary activities could enhance this awareness by offering the possibility to draw comparisons to others. Hence, self-judgement and social comparisons could also enhance the fear that other people judge them, contributing to feelings of social inadequacy. Thus, this study will investigate FOMO as a possible moderating effect on the association between sedentary behaviour and state social anxiety.

Present study

This study's first aim was to examine the extent to which daily total sedentary time and state social anxiety are associated in young adults. Increased state social anxiety with an increase of daily total sedentary time was expected. Moreover, individuals' trait FOMO was examined as a moderating variable, possibly accounting for some fluctuations in state social anxiety. Hence, the second research question is: *To what extent does trait FOMO moderate the relationship between sedentary behaviour and state social anxiety?* It is anticipated that individuals high in FOMO experience higher levels of state social anxiety in association with their sedentary time.

Methods

Design

This observational study collected quantitative data through the ESM, using the data collection application Ethica. This study is part of a broader research project investigating the relationship between sedentary time and different psychological constructs. Thus, the questionnaires also included items unrelated to this study. Ethical approval was granted by the Ethics Committee of the University of Twente (Case number: 230487).

Participants

A sample of at least 19 participants was intended, corresponding to the median of ESM study samples found by van Berkel et al. (2017). However, due to the rather short data collection period, the intended number was closer to 53. This corresponds to the mean number identified in the aforementioned meta-analysis. Inclusion criteria included being 18-35 years old, proficient knowledge of the English language, and possessing a smartphone or similar device. Further, a response rate of 60% was set as the cut-off point.

A convenience sample was recruited through the Test Subject Pool BMS (Sona) system of the University of Twente, as well as through researchers' personal contacts. This led to an initial sample of 67 participants. Out of these, 18 were excluded for having low response rates, either initially or through the deletion of observations of *total sedentary time* that exceeded 24 hours. This led to a final sample of 49 participants between the ages of 19 and 33 years (M = 24.5, SD = 3.4), who were primarily female (55.1%, n = 27), German (63.3%, n = 31), and full-time students (51.0%, n = 25). A complete overview of the sample demographics can be found in Appendix A.

Materials

The data collection application Ethica was used to obtain informed consent through an informed consent form (Appendix B), baseline questionnaires (Appendix C), as well as daily measures (Appendix D). The application was downloadable on any device, and the study was accessible through a link. Ethica also allowed the timing of measurements by triggering logics, reminding participants to complete the surveys.

Measures

Fear of Missing Out. Trait FOMO was measured through a scale by Przybylski et al. (2013). It has five items, including statements such as "I fear others have more rewarding experiences than me.", with answers ranging on a 5-point Likert scale ranging from 1 = "totally disagree" to 5 = "totally agree". The level of trait FOMO is indicated by the sum of individual item scores. Low scores, meaning those closer to the minimum score of 5, indicate lower levels of trait FOMO. Scores closer to the maximum of 25 indicate higher levels of trait FOMO. The scale showed good reliability in this study, with $\alpha = .85$.

Sedentary Time. Daily sedentary time was assessed through the "Past Day Adults' Sedentary Time – University" (PAST-U). This is a measure derived from the PAST questionnaire, investigating sedentary time of the day prior in minutes. The PAST-U is modified to include behaviours typical for young adults and university students, now consisting of 9 items. It measures how long individuals were sitting for study, work and transport, watching television, using the computer, reading, eating or socialising, and other purposes. It includes statements such as "How long were you sitting at your workplace or working from home in a paid position yesterday (in minutes)?". Here, high mean scores indicate more sedentary time. According to Clark et al. (2016), this measure has shown to be acceptable and sensitive to the context in which sedentary behaviour occurs. Split-half reliability is moderate with $r = .53$, $p = .027$.

State Social Anxiety. For the daily collection of data on individuals' state social anxiety, the three items "I worried about what other people thought of me", "I was worried that I would say or do the wrong thing", and "During the interaction, I felt nervous/anxious" were used, asking about the social interactions one had during the day. Participants in this study responded on a 9-point Likert scale, from 1 = "not at all" to 9 = "extremely", and mean scores for the individual items and total score were calculated. Items were derived from an experience

sampling study by Goodman et al. (2018), chosen from a more extensive scale by Kashdan and Steger (2006) to fit the requirements of daily measurements. The items showed good psychometric qualities, including good inter-item correlation and convergent validity with the Social Interaction Anxiety Scale (Goodman et al., 2018; Kashdan et al., 2014). Similarly, in this study good internal consistency was detected with $\alpha = .84$.

Procedure

A pilot test with both participants and researchers was conducted, leading to some adjustments in the settings, the informed consent and study information. After these adjustments were made and the set-up of the study was tested, the data collection period was set to go from the 24th of April to the 2nd of May 2023. The length of the study was deemed appropriate, given that most ESM studies span over three days to three weeks (Connor & Lehmann, 2012), and the identified median length is 14 days (van Berkel et al., 2017). Having a length of nine days kept the burden on participants low and their engagement high.

Participants were invited to the study a week prior to the start of data collection. They received a link guiding them directly to the study registration. Regardless of when they joined the study, the informed consent and baseline questionnaire only became available on the 24th. Participants had to agree to the informed consent to pursue the rest of the study and were then asked some demographic questions and the survey measuring trait FOMO. Only the afternoon questionnaire measuring state social anxiety was posed on the second day. From that day on, both the 8 am survey measuring *sedentary time* and the 5 pm questionnaire on *state social anxiety* were presented. Only the measure of *sedentary time* was administered on the last day of data collection. This way, data on *sedentary time* and *state social anxiety* were measured for the

same seven days. Participants who signed up through the Sona system were granted 1.25 credits for completing the study.

Time-contingent sampling with a fixed schedule ensured consistency in the investigated time intervals and comprehensiveness of collected data (Myin-Germeys et al., 2018). Participants received notifications when the questionnaires opened, reminders two hours after they were made available and 30 minutes before they became unavailable if participants did not complete the surveys until then. Table 1 shows the full schedule of data collection.

Table 1

An overview over the study set-up

Date	Questionnaire	Construct	Trigger	Expiration	Reminder
April 24th	Informed consent, baseline questionnaire	Informed consent, FOMO (Fear of Missing Out)	8 am	never	Onset, 15 minutes, 1 hour, 6 hours
April 25th	Afternoon	State social anxiety	5 pm	4 hours	Onset, 2 hours, 3.5 hours
April 26th – May 1st	Morning, afternoon	Sedentary time, state social anxiety	8 am; 5 pm	4 hours	Onset, 2 hours. 3.5 hours
May 2nd	Morning	Sedentary time	8 am	4 hours	Onset, 2 hours, 3.5 hours

Data analysis

The data were exported from Ethica as three datasets and imported into RStudio version 4.3.0 for data management and analysis. One coherent dataset that included the three surveys

was made by adding the variable *Day* for the measuring point in all three datasets and then merging the data by *Day* and *Participant ID*.

Participant's scores for items of *sedentary time*, *state social anxiety* and *trait FOMO* were summed, to have total scores for each of the variables. *Sedentary time* was converted to time in hours instead of minutes. Observations within a participant where *daily total sedentary time* exceeded 24 hours were deleted. Afterwards, participants with a response rate under 60% were deleted. Descriptive statistics of the sample characteristics were identified and reported as means and standard deviations (M/SD).

For the analysis, linear mixed models (LMMs) were chosen for their ability to deal with missing values and variability within and between participants (Brown, 2021). Additionally, they can deal with clustered observations dependent on individuals and the measurement point, which is common in ESM studies (Brown, 2021). First, estimated marginal means (EMMs) were calculated. Here, data were grouped once by either *Participant ID* or *Day.* To obtain EMMs grouped by *Participant ID*, an LMM with *Participant ID* as the fixed factor was defined, while *Day* was treated as the fixed factor for EMMs grouped by *Day*. S*edentary time* and *state social anxiety* were used as outcome variables. Excel was then used for visualisation.

To investigate the association between variables, an additional LMM was used, accounting for the autocorrelation of repeated measures. A first-order autoregressive structure with *Day* as the time variable was used here. *Sedentary time* was treated as the fixed covariate, while *state social anxiety* was the outcome measure. *Participant ID* was the random effect in the model. Lastly*,* a moderation analysis was conducted by adding *trait FOMO* and the interaction term to the LMM to test for an interaction effect of sedentary time and trait FOMO. A p-value of $\leq .05$ was used as the critical cut-off point for assessing statistical significance.

Results

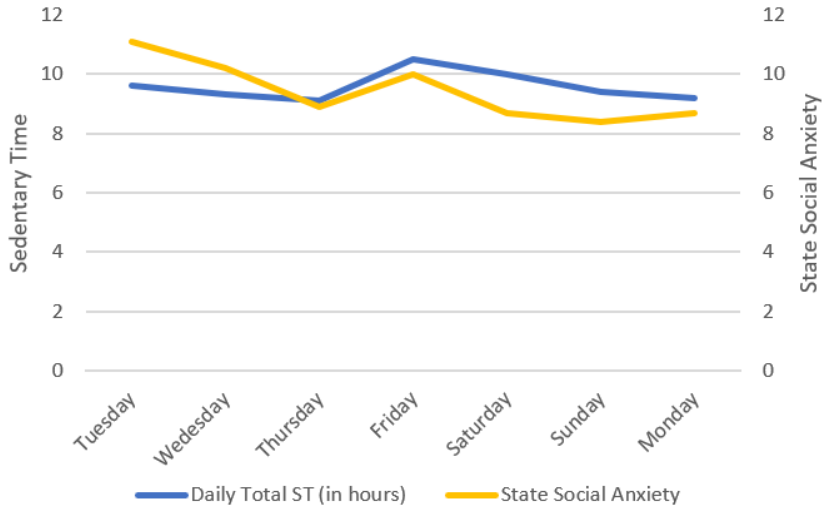
Descriptive Statistics

The descriptive statistics of the FOMO scale, as well as the state social anxiety scale and daily sedentary time, can be found in Appendix E. Generally, participants scored moderately on the FOMO ($M = 14.0$, $SD = 4.6$) and the state social anxiety scale ($M = 9.3$, $SD = 5.7$). Further, on average, subjects spent 9.6 hours per day engaging in sedentary behaviours. The majority of sedentary time in hours was spent in social activities ($M = 2.1$, $SD = 2.3$), watching TV ($M = 1.4$, $SD = 1.6$) or using the computer ($M = 1.2$, $SD = 1.6$).

EMMs plotted by day can be seen in Figure 1. It can be seen that the fluctuations of state social anxiety throughout the week are relatively subtle. Similarly, total daily sedentary time does not vary significantly over the week.

Figure 1

Estimated Marginal Means of state social anxiety and total sedentary time plotted by day

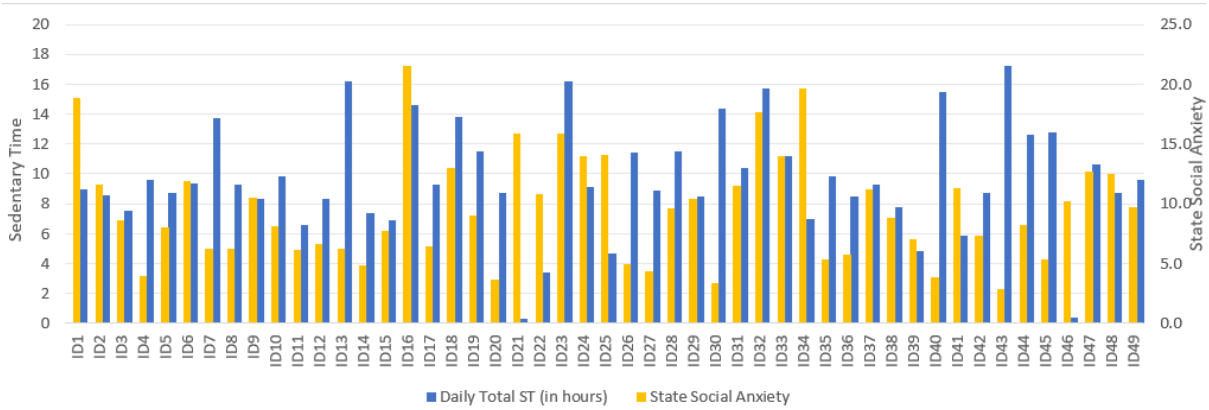


Besides, EMMs were also calculated and plotted by participants (Figure 2). Between-participant differences are discernable, with scores of sedentary time and state social anxiety

varying strongly among subjects. Still, no clear association between state social anxiety and total sedentary time can be observed on a within-participant level.

Figure 2

EMMs of state social anxiety and total sedentary time plotted by participant



Associations Between Sedentary Time, State Social Anxiety and FOMO

A linear mixed model investigated the association between total sedentary time and state social anxiety. No significant association between total sedentary time and state social anxiety was found (b = 0.06, SE = 0.08, 95% CI [-0.10, 0.23]), which rejects the first hypothesis.

The results of the LMM investigating the interaction effect between FOMO and total sedentary time showed that there is a statistically significant association between FOMO and state social anxiety (b = 0.6, SE = 0.16, 95% CI [0.28, 0.92]), while there does not seem to be a significant interaction effect between trait FOMO and total sedentary time (b = -0.008, SE = 0.01, t(131.47) = -0.54, p = .59).

Discussion

This study's aim was to investigate the association between daily sedentary time and state social anxiety in young adults through the experience sampling method. Results showed no

significant association between the two variables, indicating that variation in state social anxiety is not connected to the variation in sedentary time. Further, the moderating effect of individuals' trait FOMO on this association was analysed. No interaction effect of sedentary time and trait FOMO was detected, suggesting that the influence of sedentary time on state social anxiety is not stronger for people exhibiting high levels of FOMO. Still, a significant effect of trait FOMO on state social anxiety was found, implying that high FOMO individuals are also more prone to higher levels of state social anxiety.

The Association of Daily Sedentary Time and State Social Anxiety

It was hypothesised that there would be a significant association between daily sedentary time and state social anxiety. In contrast to expectations based on previous studies (Allen et al., 2019; Abdollahi & Talib, 2015), no significant association between total daily sedentary time and state social anxiety was identified in this sample. A possible reason for the lack of significant association might be that state social anxiety is a highly fluctuant and context-dependent experience (Kashdan & Steger, 2006). It is influenced by moment-to-moment interactions and concrete stimuli related to social settings (Kashdan & Steger, 2006). Sedentary time outside these potentially triggering social cues, social performance or rejection, therefore, has little influence on state social anxiety.

Further, people with elevated trait social anxiety tend to ruminate about social situations, which sedentary activities could enable (Heimberg & Hofmann, 2014; Hallgren et al., 2020). However, it might simply not be present in people who only experience state social anxiety, who can refrain from contemplating interactions. Future research could consequently explore whether there is an association between rumination and state social anxiety. Further, investigating

whether there is a link between sedentary time and state social anxiety in the clinical population, where rumination might be more prevalent, could also be valuable.

Still, seeing that feelings of social anxiety are highly prevalent in young adults, the non-significant association can be regarded positively. Daily sedentary time does not seem to pertain to experiences of social anxiety. This is exceptionally fortunate for this sample, as subjects showed high levels of sedentary time.

The Influence of Trait Fear of Missing Out

Regarding the second research question, it was expected that participant's trait level of Fear of Missing Out would have a moderating effect on the association of total daily sedentary time and state social anxiety. While a main effect of FOMO on state social anxiety was found, the expected interaction effect of total daily sedentary time and FOMO was not detected.

Association Between FOMO and State Social Anxiety

This study found a main effect of FOMO on state social anxiety. This finding may be unexpected with a superficial understanding of state social anxiety, which is merely shyness and the avoidance of social situations (Stein & Stein, 2008). However, this would disregard the inner longing for social relatedness common in both state social anxiety and FOMO (Lim et al., 2016; Roberts & David, 2020). Indeed, this study's findings fit well into prior research by Barry and Wong (2020), who suspected a correlation based on emotional correlates.

Shared emotional correlates include, for example, the lack of self-compassion related to heightened self-criticism (Barry & Wong, 2020; De Jong, 2002). In the case of trait FOMO, this self-criticism mainly relates to being judgmental of how one spends their time (Luca et al., 2020), while it pertains to judging one's social performance in state social anxiety (Morrison & Gross, 2013). Alternatively, the self-judgement common in people with high levels of trait

FOMO might increase the fear of other people judging them as well, which is essential in state social anxiety (Kashdan & Steger, 2006). Therefore, the link might also stem from the assumption that other people will be similarly judgmental as oneself. Research has also shown that feelings of social anxiety and FOMO are associated with low self-esteem (Barry & Wong, 2020; De Jong, 2002). Thus, there are several possibilities of how FOMO and state social anxiety could be related. The exact factors involved could be subject of future research.

Interaction Effect Between Sedentary Time and FOMO

Besides, the moderation effect was expected based on self-judgment of daily activities, which is common in people who show high levels of FOMO (Luca et al., 2020). This judgment directed towards sedentary behaviour was thought to enhance state social anxiety. While self-judgment was assumed in the theoretical framework of this study, it was not controlled for in this sample. Possibly, the sample was unaware of their sedentary time, as sedentary activities are deeply embedded in young adults' daily lives (Tremblay et al., 2017; Bertrand et al., 2021). Thus even though participants were asked to self-report their daily sedentary time, they might not have questioned their daily amounts, not perceiving it negatively. This lack of awareness of daily sedentary time and its pervasiveness could have precluded self-judgement related to sedentary behaviour. This could explain the lack of an interaction effect between FOMO and sedentary time on state social anxiety. Future research here could consider self-judgment or awareness of sedentary time as moderators rather than FOMO or at least control for those variables. A different approach here could also be to examine state instead of trait FOMO since this experience would give better insights into acute feelings of missing out on experiences.

Strengths and Limitations

This study has strengths and benefits. Firstly, the associations explored in this study have not been investigated before. The association between sedentary time and state social anxiety was so far only investigated in obese individuals. Thus, this study is the first to offer insights into this association in the general population. Further, exploring the interaction effect of sedentary time and FOMO is entirely novel, as these two variables have not been analysed in a shared context before. Additionally, the study's use of the ESM gives excellent benefits, collecting data in real-world settings and thereby increasing ecological validity. This study also had a sample size sufficient for ESM studies, increasing the generalisability of the results.

Besides these strengths, this study also bears some limitations. First of all, this study only had one measuring point per construct in 24 hours. While subjects could have difficulties recalling their sedentary time, the more prominent issue pertains to measuring state social anxiety. Items asked to recall how a person felt during social interactions they had in the past 24 hours, not taking into account that subjects might have felt differently in different social interactions. Hence, answers could be biased towards their most recent interaction or one that was more or less difficult for them. On that note, another limitation is that the context of the interactions was also missing. This is limiting since state social anxiety is highly susceptible to moment-to-moment changes influencing feelings of social inadequacy, and only reporting on the level of state social anxiety does not reflect the entire experience.

Additionally, the cut-off points for sedentary time were set to 24 hours, meaning that observations were included as long as a person's total daily sedentary time did not exceed this threshold. No minimum of total daily sedentary time was set as the lower threshold. However, this led to the inclusion of participants whose average daily total sedentary time was less than an hour, which is somewhat unrealistic, considering the daily activities that make up sedentary time

(Tremblay et al., 2017; Bertrand et al., 2021). Including these observations could have skewed the results.

Implications for Future Research

Future research on sedentary time, state social anxiety and Fear of Missing Out could benefit from this study's identified strengths and limitations. Firstly, applying the ESM is appropriate in assessing sedentary time and state social anxiety. However, it is advisable to have multiple measuring points per day or allow subjects to freely enter feelings of social anxiety during the day. Further, to better understand fluctuations of state social anxiety throughout the week, collecting data on participants' activities might also be beneficial. Thereby, both the quality and the quantity of social interactions could be taken into account. For sedentary time, a tracking device that monitors sedentary behaviour is recommended to increase the accuracy of the accumulated data. Still, additionally asking participants to recall their sedentary time would be beneficial to explore the context of the sedentary activities. Regarding exploring an interaction with FOMO, information on how subjects view their sedentary time would also be advantageous. For the data analysis, adding lower and upper thresholds for daily sedentary time could also be beneficial for avoiding extreme outliers.

Conclusion

No significant association between sedentary time and state social anxiety was found in this sample, as well as no interaction effect between sedentary time and trait FOMO. Moreover, a significant association between trait FOMO and state social anxiety was found, contributing to understanding both phenomena. This study offers novel insights, as these associations have not been explored yet. Future research should consider mental health concerns other than state social anxiety in exploring the impact of daily sedentary time. Still, the non-significant association

between sedentary time and state social anxiety can be regarded positively, considering the high levels of sedentary time that are common in this age group.

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Appendix A – Sample Demographics

Demographics (N = 49)

Baseline Characteristic	***n***	**%**
Gender		
Male	21	42.9
Female	27	55.1
Non-binary	1	2.0
Nationality		
Dutch	6	12.2
German	31	63.3
Other EU	6	12.2
Other non-EU	6	12.2
Occupation		
Full-time student	25	51.0
Working	14	28.6
Student and working	9	18.4
Not working	1	2.0

Appendix B – Informed Consent

Dear participant,

you are asked to participate in a study conducted by Theodora Buzulica, Hannah C. Schäfer, and Luisa Wiggeshoff from the psychology department of the University of Twente. The study is part of an undergraduate project, and we thank you for taking the time to participate in our study! You may participate in this study if you are 18 to 35 years old, and proficient in English. Please read the information below about the details of our study.

Purpose

The purpose of this study is to investigate the relationship between daily sitting time and emotional eating, mood states and feelings of social anxiety. By participating in this study, you will help us contribute to the scientific knowledge about sitting and its relationship to mental health.

Procedure

The study will be conducted over a period of nine days. On the first day of the study (April 24th), you will be asked to complete a baseline questionnaire, which will take about ten minutes to fill out. Starting the following day (April 25th), you will receive one afternoon survey at 5:00pm. From April 26th on, you will receive two daily questionnaires: one morning survey at 8:00am, and one afternoon survey at 5:00pm. On the last day, May 2nd, you will receive the morning survey only.

Each survey should take no longer than 3 and 1 minute(s), respectively, and can be completed within 4 hours. For example, the first questionnaire can be answered from 8:00am until 12pm. All surveys will be completed via the Ethica App. Please make sure that permanent notifications for Ethica are enabled on your device.

Participant Rights

Your participation in this study is completely voluntary. If you wish to withdraw from this study, you may do so at any time without giving a reason. To withdraw from participation after the study, please inform the researchers via email within 10 days of your participation.

Risks or Discomforts

Participation in this study should not pose any risks. One possible consequence is an increased awareness of your daily feelings, behaviors, and/or emotions. If you are sensitive to these issues, or if you are suspected of having or have been diagnosed with a mood and/or anxiety disorder, or an eating disorder, please consider your participation in this study carefully.

Confidentiality

Your responses will be kept confidential: All personal data will be anonymised and will not be published and/or shared with third parties. The data will only be used for this study, and will be kept in locked files. Only research personnel will have access to these files.

The study has been approved by the ethics committee of the University of Twente. If you have any questions or concerns before, during or after your participation, please do not hesitate to contact the researchers:

t.buzulica@student.utwente.nl (Theodora Buzulica)

h.c.schafer@student.utwente.nl (Hannah Schäfer)

l.wiggeshoff@student.utwente.nl (Luisa Wiggeshoff)

(g.schaap@utwente.nl) (Gerko Schaap, supervisor)

After having read the information above, do you agree with the following statements and at the same time confirm that you are participating in this study and that your data will be used for research as described?

I understand that my participation is voluntary and that I am free to withdraw my participation, without explaining, until 10 days after participation.

I understand that any information given by me may be used in future reports or presentations by the researcher/s, but that my data will not be identifiable.

I understand that anonymised data will be kept according to university guidelines for up to 10 years after the end of the study.

I agree to take part in the study.

Appendix C – Baseline Questionnaires

Demographics

How do you identify?

- Female
- Male
- Other
- Prefer not to say

What is your age? (In numbers)

What is your nationality?

- Dutch
- German
- Other-EU
- Other Non-EU

What is your current occupation? Please consider what applies most to you.

- Full-time student
- Full-time working
- Student and working
- Not working
- Other

Fear of Missing Out

I fear others have more rewarding experiences than me

I fear my friends have more rewarding experiences than me

I get worried when I find out my friends are having fun without me

I get anxious when I don't know what my friends are up to

When I miss out on a planned get-together it bothers me

Appendix D – Daily Measures

PAST-U: Past-day Adults' Sedentary Time - University

Good morning, we hope you had a great start of the day!

The following questions aim to assess your sitting time of the past 24 hours. Please consider the amounts of time spent sitting while being awake. Please report the amounts in minutes.

For example, if you've watched television while sitting on the couch for 1 hour, please fill out '60'.

Please note: you can enter the minutes directly using the mobile phone keypad, you do not have to use the arrows.

1. How long were you sitting while studying yesterday? (include the time in minutes at university, during lectures, tutorials, meetings, group discussions, self-study, study from home, etc.)

2. How long were you sitting at your workplace or working from home in a paid position yesterday (in minutes)?

3. Please estimate the total time that you spent sitting to travel from one place to another. Please include sitting and waiting for transport in minutes. Do not include any time you were standing up while travelling or waiting.

4. Please estimate the total time you spent sitting or lying down to watch TV or DVDs or play games on the TV, such as PlayStation/Xbox yesterday (in minutes). This includes if you watch TV in bed.

5. Please estimate the total time yesterday that you spent sitting or lying down and using the computer. (For example, include time spent playing games on you Iphone/Ipad/tablet, using the internet or activities that were not for studying or working purposes, like Facebook, Twitter, Skype, YouTube, online-shopping, etc. Please indicate the time in minutes.)

6. Please estimate the total time yesterday that you spent sitting or lying down while reading during your leisure time. Include reading in bed but do not include time spent reading for paid work or for study. Please estimate the time in minutes.

7. Please estimate the total time yesterday that you spent sitting down for eating and drinking, including meals and snack breaks, in minutes.

8. Please estimate the total time yesterday that you spent sitting down to socialise with friends or family, regardless of location (at university, at home or in a public place), in minutes. Include time on the telephone.

9. We are interested in any other sitting or lying down that you may have done that you have not already told us. For example this could include; hobbies such as doing art and craft, playing board games; listening to music or for religious purposes.

Again thinking of yesterday, please estimate the total time that you spent sitting or lying down in minutes, NOT including time that you have told us about in the previous answers

State social anxiety

I worried about what other people thought of me

I was worried that I would say or do the wrong thing

During the interaction I felt nervous/anxious

Appendix E – Descriptive Statistics

	Mean	SD
"I fear others have more rewarding experiences than me"	3.1	1.3
"I fear my friends have more rewarding experiences than me"	2.7	1.1
"I get worried when I find out my friends are having fun without me"	2.8	1.2
"I get anxious when I don't know what my friends are up to"	1.9	0.9
"When I miss out on a planned get-together it bothers me"	3.3	1.2
Total Fear of Missing Out	13.9	4.5
Study sedentary time	1.2	2.0
Work sedentary time	1.2	2.4
Travel sedentary time	0.7	1.4
TV sedentary time	1.4	1.6
Computer sedentary time	1.2	1.6
Reading sedentary time	0.3	0.6
Eating sedentary time	1.1	0.8
Social sedentary time	2.1	2.3
Other sedentary time	0.3	0.7
Daily Total Sedentary Time in hours	9.5	4.6
"I worried about what other people thought of me"	3.2	2.1
"I was worried that I would say or do the wrong thing"	3.3	2.2

′”During the interaction I felt nervous/anxious”	2.8	2.1
Total State Social Anxiety	9.3	5.7