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Loneliness and Bedtime Procrastination: Exploring a Model of Interconnectedness Among Young Adults in Germany

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Abstract

Background/Aim

This study aimed to examine the relationship between loneliness and bedtime procrastination in young adults in Germany, offering critical insights into the development and maintenance of both conditions. Specifically, it sought to test a new model that connects these two psychological constructs.

Materials and Methods

A quantitative online survey was conducted with 500 young adults (M_{age} = 23.3, 83.6% female). Loneliness was assessed using the UCLA Loneliness Scale, while bedtime procrastination was measured using the Bedtime Procrastination Scale.

Results

The results show a significant positive correlation between loneliness and bedtime procrastination in young adults. Sleep quality was also found to significantly correlate positively with loneliness as well as with bedtime procrastination.

Conclusion

The findings provide a crucial framework for understanding the relationship between the two psychological constructs of loneliness and bedtime procrastination. Implications for possible future interventions are discussed.

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Introduction

Perlman and Peplau [1] define loneliness as "the unpleasant experience that occurs when a person's network of social relations is deficient in some important way, either quantitatively or qualitatively" (p. 31). Loneliness, therefore, is the aversive emotional state accompanying the perception that one's social needs are inadequately met [2]. While social relationships provide resources and support [3], loneliness is linked more to the quality than the quantity of these relationships [4]. Individuals feel lonely when there is a gap between actual and desired social connections [5].

Loneliness has become a widely discussed topic in psychological research, especially since the recent coronavirus SARS-CoV-2 (COVID-19) pandemic, which increased social isolation and thus also loneliness (see e.g., the systematic review by Su et al. [6]). It is considered the "next critical public health issue" [7] (p. 793) in many countries. However, while research has so far largely focused on

older adults, findings are likely not applicable to younger adults [8]. Social interactions, needs, and experiences of younger adults differ significantly from those of older adults, which contribute to a distinct experience of loneliness that may not be adequately captured by research focused on older populations [9]. There is thus limited knowledge about the relationship between loneliness and the health of young adults, even though young adults have been most affected by feelings of loneliness since the pandemic [10; 11]. Surkalim et al.'s [12] review of loneliness across 113 countries exemplifies this, showing that 36% of young adults reported serious loneliness frequently or almost all the time during the pandemic, which represented a significant increase compared to pre-pandemic levels.

Loneliness is a multidimensional construct. Bouwman et al. [13] differentiate between social loneliness (lack of qualitative relationships) and emotional loneliness (absence of intimate relationships). Cacioppo et al. [14] extend this perspective to include collective loneliness, which refers to the unmet need to belong to a larger group or community. Additionally, loneliness can be classified by duration and nature. State loneliness is situation-specific and felt at a particular moment, typically arising from immediate circumstances such as being alone or feeling socially excluded at a specific event. In contrast, trait loneliness is a more stable, long-term tendency to feel lonely across different situations and over time, often considered a personality trait or disposition towards loneliness [15]. Temporary loneliness is short-term and usually tied to specific, transient events such as experiencing a brief period of social isolation and typically resolves once the individual adapts to the new situation or the specific event passes. Chronic loneliness, on the other hand, is prolonged and persistent. It leads to significant distress and behavioral changes, including impaired social processing, hypervigilance – a heightened state of constant alertness for potential social threats –, and social withdrawal [16].

As a transdiagnostic construct, loneliness can cause and result from mental and physical illnesses [17]. For example, chronic loneliness increases the risk of personality disorders, substance abuse, suicidality, reduced executive control, and cognitive decline [2; 7; 18]. It also predicts anxiety and depression [19; 20] and can lead to a self-reinforcing loop of loneliness, mental disorders, self-stigma, and social withdrawal [2]. Chronic loneliness disrupts the regulation of the hypothalamic-pituitary-adrenal (HPA) axis, negatively affecting the immune response [21]. Various studies further suggest that chronic loneliness negatively impacts the autonomic nervous system, increasing the risk of various physical illnesses including a range of cardiovascular and metabolic diseases [7; 22; 23].

While previous research on loneliness has largely focused on health behaviors, loneliness has also been shown to directly impact recovery phases like sleep [24]. Sleep deprivation and reduced sleep quality impair the recuperative function of sleep, negatively affecting health, quality of life, and productivity [25]. High social connectedness correlates with better sleep, while loneliness is linked to poorer sleep quality [26]. Loneliness-induced hypervigilance negatively affects sleep onset and quality [27]. Poor sleep quality and sleep deprivation may lead to social withdrawal and loneliness [28]. From a neuropsychological perspective, the reciprocal influence of loneliness and sleep can be attributed to the function of the amygdala and the prefrontal cortex, both of which influence and regulate emotions. As noted by Lam et al. [29] there are significantly smaller volumes of gray matter in the amygdala of lonely individuals. Sleep deprivation results in a dysfunctional response of the amygdala, which then reacts more strongly to negative stimuli and processes more negative stimuli. Moreover, the connection between the amygdala and the prefrontal cortex is weakened, impairing emotion regulation.

In addition to loneliness, another behavior linked to sleep disruption is bedtime procrastination (BP),

which involves delaying sleep despite knowing this will have negative consequences [30]. BP specifically refers to going to bed later than intended without external reasons. Much like loneliness, BP appears to be a common issue among young adults, with up to half of this population group regularly engaging in such behavior [31; 32]. As a chronic behavior, it negatively affects psychological well-being and goal achievement [32]. BP can be either unconscious or conscious: almost half of procrastinators lack a fixed bedtime, and some temporarily lose awareness of their planned bedtime [30; 33]. When bedtime is knowingly delayed, BP occurs consciously [30]. BP combines health behavior conflicts with leisure pursuits and leads to sleep deprivation, poor sleep quality, and daytime fatigue [32; 34].

BP is linked to lower self-regulation, making individuals susceptible to distractions [35]. Evening depletion of self-regulation resources increases BP likelihood [36]. BP is also linked to executive functions, which manage emotions, thoughts, and behaviors [37]. Another explanation is circadian system desynchronization [38; 39]. The circadian rhythm regulates sleep-wake cycles, influenced by light exposure. Chronotypes, or individual sleep-wake patterns, can lead to discrepancies between biological sleep times – the natural sleep-wake cycle dictated by the internal circadian rhythm – and social sleep times – the sleep schedule due to societal obligations, such as work or school schedules, which often require waking up earlier or staying up later than one's biological sleep pattern would naturally dictate. The conflict between these two can result in 'social jetlag', where the body's internal clock is misaligned with external social demands. Procrastinators also often use electronic devices longer before bed, delaying sleep as the increased artificial lighting and screen use in the evening desynchronize circadian rhythms, with the blue light from screens suppressing melatonin, which affects tiredness and sleep quality [32]. Evening screen use, while relieving stress, therefore also contributes to chronic sleep deprivation and increased BP [34].

Research highlights a strong link between BP, sleep, and stress. Yang et al. [40] found a positive association between stress and BP among young adults during COVID-19. The HPA axis, regulated by the circadian rhythm, contributes to sleep disorders and releases stress hormones, negatively impacting the immune and cardiovascular systems [41]. BP also correlates with higher cortisol levels, leading to immune suppression, and increases risks for obesity, diabetes, and insulin sensitivity [30]. BP affects mental health as well. Geng et al. [42] linked it to smartphone addiction, which mediates relationships with depression and anxiety. Both Chung et al. [43] and Hou and Hu [44] found higher levels of anxiety and depression associated with BP, with mutual influences noted. Sleep disorders can both cause and result from depression [45; 46]. Bedtime rumination and perceived stress moderate the relationship between procrastination and depression [44]. Additionally, BP is associated with lower optimism and social competence [30].

Loneliness and BP both impact mental and physical health through stress and sleep disruption. Both are associated with experiences of stress, sleep duration, and sleep quality. During sleep, lonely individuals perceive stimuli from their environment with increased attention and react more sensitively to threats. The hypervigilance associated with loneliness negatively impacts sleep quality. At the same time, disturbed sleep affects the regulation and processing of emotions [27]. Sleep deprivation resulting from BP negatively affects cognitive abilities [47]. Both constructs can predict anxiety, depression, cardiovascular diseases, immune system disorders, and diabetes [26]. Recent research suggests that both are associated with the use of screen media [42]. Lonely individuals often use smartphones to feel connected, which negatively impacts sleep [48]. Xu et al. [36] found that loneliness predicts BP, mediated by depleted self-regulation resources.

Despite the similarities between BP and loneliness, there is no known model that explains the relationship between the two. Therefore, a model – shown in Figure 1 – was developed to conceptualize loneliness and BP, considering self-regulation resources, coping with negative emotional states, use of electronic devices, sleep and stress experiences, as well as their health effects. The model assumes that coping with negative emotional states is a crucial aspect for the joint understanding of BP and loneliness, and that people can use bedtime procrastination as a strategy to regulate their negative emotions. The aversive state of loneliness is experienced as unpleasant and burdensome [1; 49]. Perceived loneliness and the need for connection both motivate lonely individuals to regulate their own emotions and engage in social relationships [50]. The regulation of loneliness depletes self-regulation resources [36]. Consequently, the likelihood of BP increases [51]. BP is a short-term, active emotion regulation strategy through which an individual can adjust their emotions to a state suitable for sleep [36]. This suggests a direct connection between loneliness and BP. The use of screen media likely mediates the relationship between loneliness and BP. Thus, loneliness and BP influence sleep and stress experiences, leading to known negative physical and mental health effects.

To begin examining the assumptions of the proposed theoretical model, the present study explored the following question: Is there a relationship between loneliness and BP among young adults in Germany? It was hypothesized that a significant relationship exists between loneliness and BP in young adults. To test this hypothesis, a survey was conducted among young adults which included self-assessment questionnaires on loneliness and BP.

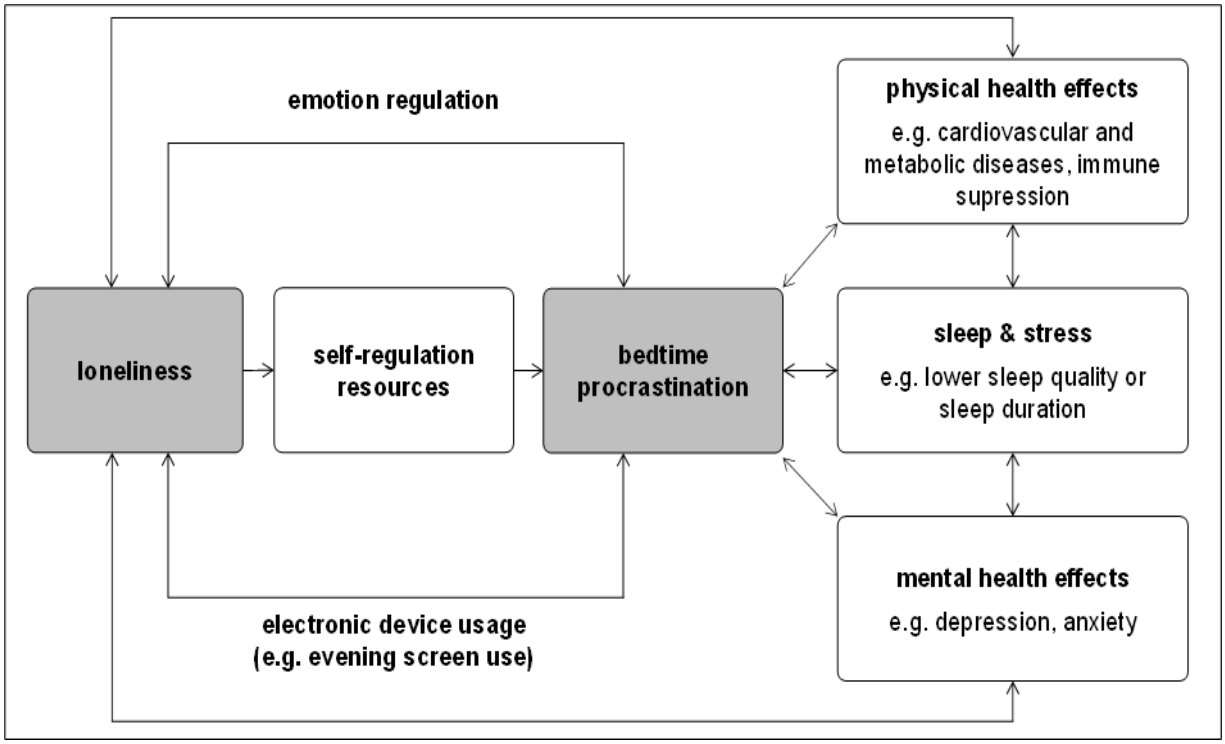

Figure 1. Conceptual model illustrating the relationship between loneliness and BP

Method and Materials

Participants and procedure

This study investigated the relationship between BP and loneliness using a non-experimental, cross-sectional design. Participants were recruited through non-probabilistic convenience sampling via various channels, including the university participant management system Sona Systems, social media, university courses, and the website of the German magazine 'Psychologie Heute'.

An a priori power analysis conducted with G*Power [52] determined that a minimum of 138 participants was needed to detect a medium effect size (r = .3) with 95% power and a significance level of .05. This ensured the study was sufficiently powered to detect meaningful relationships between BP and loneliness. Out of 525 individuals who accessed the survey, 500 completed it, resulting in a 95% completion rate after excluding incomplete responses.

Inclusion criteria for participation were that participants needed to be young adults aged 18-29 years and living in Germany. Based on this, the final sample comprised 418 participants (83.6%) who identified as female, 79 (15.8%) as male, and 3 (0.6%) as diverse. The mean age of participants was 23.3 years (SD = 3.0). In terms of relationship status, 53% reported being in a relationship, while 47% were single. Regarding living arrangements, 38% lived with family members, 36% with a partner, 14% alone, and 10% in shared apartments or dormitories.

The survey, administered via the online platform ESF Surveys [53], was targeted at emerging adults aged 18 to 29 years. It took approximately 5 minutes to complete. Participants accessed the survey through a link provided in recruitment messages. Before starting the survey, participants had to consent by agreeing to an informed consent form that explained the study's purpose, the voluntary nature of participation, and the anonymity of their responses.

Measures

Sleep duration

Participants reported their average sleep duration over the past week by indicating the number of hours slept per night. This measure was recorded in whole hours.

Sleep quality

Sleep quality was assessed using an item from the Athens Insomnia Scale for Non-Clinical Application (AIS-NCA) [54]. Participants rated their sleep quality over the past week on a five-point Likert scale from 1 ("very good") to 5 ("very poor").

UCLA Loneliness Scale (UCLA-LS)

The UCLA Loneliness Scale, initially developed by Russell et al. [55] and adapted into German by Döring and Bortz [56], was used to measure loneliness. The scale comprises 20 items, with ten positive and ten negative statements, rated on a five-point Likert scale from 1 ("not at all true") to 5 ("completely true"). The scale is divided into three subscales: 'feelings of loneliness' (nine items), 'perceived emotional isolation' (five items) and 'perceived social isolation' (six items). Higher scores indicate greater loneliness, with the scale demonstrating high internal consistency (Cronbach's α = .89) [57]. The items comprising the three subscales were averaged to create an indicator for each subscale, as well as an overall loneliness score.

Bedtime Procrastination Scale (BPS)

The BPS, developed by Kroese et al. [32] and translated into German by Bernecker and Job [35],

consists of nine items measuring procrastination behaviours before bedtime. Participants responded on a five-point Likert scale ranging from 1 ("never") to 5 ("always"), with four items reverse-scored. The scale's items were averaged to create a single indicator of bedtime procrastination, with higher scores indicating greater procrastination, and the scale demonstrating high internal consistency (Cronbach's $\alpha = .89$) [57].

Data Analysis

Data were analysed using JASP [58]. Pearson's correlation coefficients were calculated to assess the relationships between loneliness and bedtime procrastination. If the data were not normally distributed, Spearman's rank-order correlation was used as an alternative. The significance level was set at $\alpha = .05$.

Data Cleaning and Handling

Data were checked for completeness and accuracy. An anomaly was found in the 'marital status' variable, where a frequency of '0' was observed. This value was incorrect as the questionnaire only allowed '1' (single) or '2' (in a relationship). The discrepancy was resolved by cross-referencing with the 'living situation' variable, which indicated that the respondent lived with a partner. The value was corrected accordingly. Univariate outliers were identified in the loneliness scores using box plots. Four outliers with notably high values on the UCLA Loneliness Scale (range 1 to 5) were detected. These outliers were confirmed to be accurate measurements. To assess their impact, Spearman's rank correlation was conducted in addition to Pearson's correlation. The consistent results between Spearman and Pearson correlations indicated that the outliers did not significantly affect the Pearson correlation results. Therefore, outliers were retained in the analysis, and Pearson correlations are reported due to their greater statistical power.

Ethical considerations

Participation in the survey was voluntary and anonymous. Informed consent was obtained electronically before participants could proceed with the survey. The consent form detailed the study's purpose, the voluntary nature of participation, and the anonymity of responses. Participants were informed that they could withdraw from the study at any time without penalty.

Results

Table 1 presents the mean values and standard deviations for sleep duration, sleep quality, BP, and loneliness. Regarding sleep duration, 92% of participants reported sleeping between six and nine hours per night over the preceding week. Specifically, 5% of respondents slept less than five hours per night, while 2% slept ten or more hours per night. In terms of sleep quality, 7% of participants reported sleeping very well, 39% reported sleeping well, 43% reported a mix of good and poor sleep, and 11% reported sleeping poorly (10%) or very poorly (1%).

Further analyses indicate that loneliness scores were similar between male and female participants. However, individuals identifying as diverse exhibited higher loneliness scores compared to male and female participants. Additionally, emerging adults living alone ($M = 2.4$, $SD = 0.6$) or in dormitories ($M = 2.5$, $SD = 0.6$) reported higher levels of loneliness compared to those in other living arrangements.

The distribution of the data was assessed graphically using Q-Q plots, revealing that the data approximated a normal distribution. The scatter plot analysis confirmed a linear relationship between loneliness and BP. The correlation between loneliness and BP was found to be significant and positive ($r = .12$, $p < .05$), indicating that higher levels of loneliness are associated with increased BP.

Table 1. Means and standard deviations of sleep duration, sleep quality, BP, loneliness, feelings of loneliness, perceived social isolation and perceived emotional isolation

	M	*SD*
sleep duration	7.3	1.2
sleep quality	2.6	0.8
BP	3.1	0.8
feelings of loneliness	2.1	0.6
perceived social isolation	2.3	0.5
perceived emotional isolation	2.2	0.7
loneliness	2.2	0.5

Note. BPS: BP. UCLA-LS: loneliness (total scale), feelings of loneliness (subscale), perceived social loneliness (subscale) and perceived emotional isolation (subscale).

According to Cohen's [59] guidelines, this correlation represents a weak effect. Consequently, the null hypothesis, which posited no correlation between loneliness and BP, was rejected.

A significant positive correlation was observed between BP and sleep quality (r = .29, p < .001). This result suggests a small to medium effect [59], with higher BP associated with poorer sleep quality. The correlation is monotonic and positive.

Loneliness also showed a significant positive correlation with sleep quality (r = .25, p < .001). This correlation is considered a small to medium effect [59], indicating that greater loneliness is associated

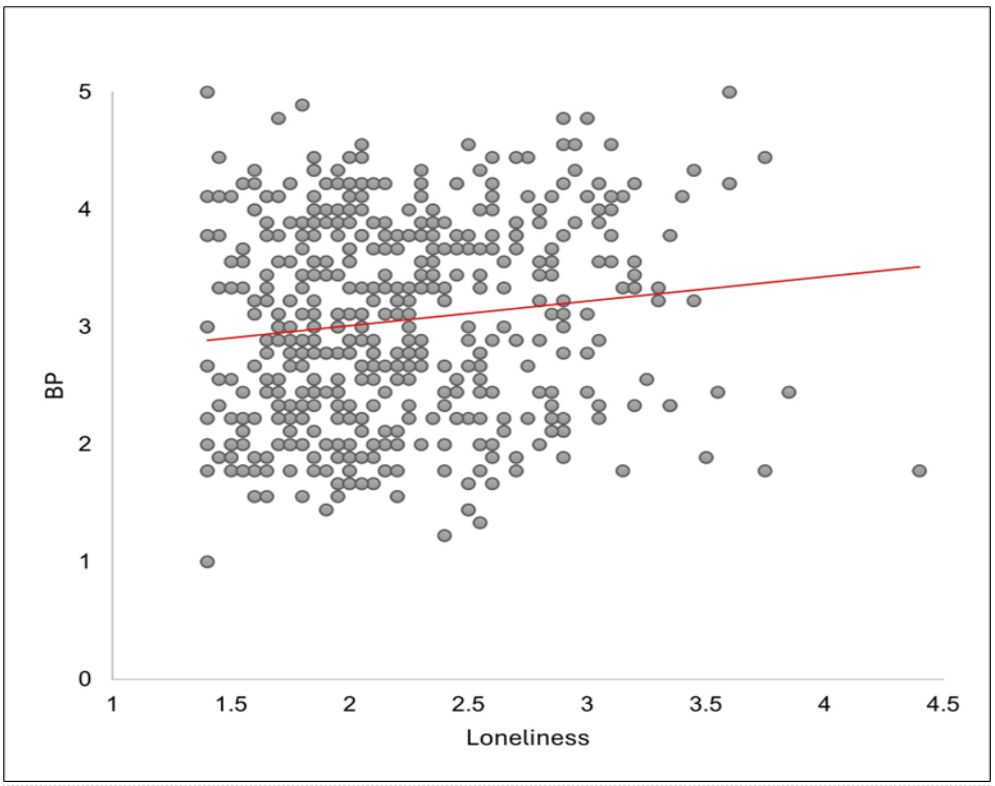

Figure 2. Relationship between loneliness and BP showing a significant positive correlation

with poorer sleep quality. The relationship is monotonic and positive.

The correlation between feelings of loneliness and BP was significantly positive (r = .15, p < .001), indicating a weak effect [59]. Additionally, social isolation was positively correlated with BP, with a small effect size (r = .14, p < .01). However, the correlation between emotional isolation and BP (r = .05) was not statistically significant.

Discussion

The pervasive impact of loneliness and BP on mental and physical health, particularly among young adults, has become increasingly critical, especially in the aftermath of the COVID-19 pandemic [6; 10]. The pandemic exacerbated social isolation and disrupted daily routines, intensifying both loneliness and BP, and highlighting their roles in sleep disturbances, stress, and broader health concerns [30; 36]. As these behaviours continue to rise, understanding their interplay is crucial for addressing the emerging public health challenges they present. To address this, the present study investigated the relationship between loneliness and BP among young adults in Germany. The results indicate a positive linear relationship between the two variables. Exploratory data analysis also revealed a positive linear relationship between sleep quality and loneliness as well as between sleep quality and BP. Furthermore, the study examined the relationship between the subscales of loneliness (feelings of loneliness, social, and emotional isolation) and BP, finding that feelings of loneliness and social isolation positively correlate with BP. Due to the low effect size, the influence of the two variables is only slight or irregular. One possible reason for the low effect size is the moderate manifestation of loneliness and BP. This could be attributed to the cross-sectional design with only one measurement point. The study captured the subjectively perceived state-loneliness, so no conclusions can be drawn about enduring feelings of loneliness.

The results show that the young adults were not especially lonely during the survey period although expressed a moderate level of loneliness. Participants also showed lower levels of feelings of loneliness, social isolation, and emotional isolation. At the same time, participants stayed up later than intended and reported a moderate degree of BP overall, which is supported by Xu et al. [36]. Notably, despite the extent of BP, the participants did not exhibit sleep deprivation, which was a significant feature of BP in past studies. The average sleep duration in the sample was approximately seven hours, which comes in at the lower end of the recommended range for young adults [60]. However, sleep needs are individual. It is possible that some participants have a higher sleep requirement and thus still suffer from sleep deprivation, highlighting the subjectivity of these data. The participants' information pertained only to a period of seven days. Moreover, a sleep deficit may have occurred before the seven days, retroactively affecting the well-being of the participants [61].

The results further show that the young adults slept both well and poorly in the seven days prior to the survey. Notably, sleep quality was only in the middle range, although the participants' sleep duration was within the recommended range. Therefore, the lack of sleep quality is presumably not due to sleep duration. The exploratory analysis examined whether sleep quality is related to BP and loneliness. In the first part of the exploratory analysis, a relationship between sleep quality and loneliness among young adults was suspected. Sleep quality significantly positively correlates with loneliness. High values of sleep quality are associated with high values of loneliness. The assumption of a relationship between sleep quality and loneliness was confirmed. Consequently, lonely young adults have lower sleep quality than non-lonely young adults.

Furthermore, the second part of the exploratory analysis suspected a relationship between sleep quality and BP. The results show a significantly positive relationship between sleep quality and BP among young adults. High values of sleep quality are associated with high values of BP. The assumption was also confirmed. Consequently, young adults who exhibit a high degree of procrastination behaviour before bedtime have lower sleep quality than young adults with a lower degree of BP. These results are consistent with the literature, which concludes that loneliness among young adults is often associated with reduced sleep quality [62], as well as that BP is associated with lower sleep quality [34]. These results suggest a connection between bedtime behaviour, sleep quality, and loneliness, which can be attributed to the fact that sleep plays a crucial role in emotion regulation and social processes. People who feel less connected and those who do not have close social relationships exhibit poorer sleep quality [26]. At the same time, people who sleep poorly at night feel lonelier the next morning [28]. Additionally, people who experience loneliness have impaired social security. Consequently, psychophysiological arousal increases, which can lead to later sleep onset or poorer sleep [63].

However, the correlation results do not allow for causal conclusions about the cause or effect of the variables. Thus, no statement can be made about whether sleep quality is a cause or consequence of loneliness or BP. It is unclear whether sleep quality mediates the relationship between loneliness and BP. The relationship could also be attributed to other factors that affect both sleep quality and BP or loneliness. For instance, mental or physical illnesses could have influenced the variables in the sample (e.g., depression, sleep disorders, etc.). These were not captured within the scope of the study.

A connection between BP and the subscales of loneliness was hypothesized. The results of the exploratory data analysis show a correlation between BP and feelings of loneliness. The relationship is significantly positive. High levels of BP are associated with high levels of loneliness. Additionally, a significant relationship was found between BP and perceived social isolation, with higher levels of BP associated with higher levels of isolation. Consequently, BP is associated with an inadequate social network, lack of sociability, and sense of belonging [64]. The social isolation of young adults may possibly be a consequence of the COVID-19 pandemic, during which people had fewer social interactions due to lockdowns and contact restrictions [36]. Furthermore, the evening use of screen media was closely linked to BP [65]. The hypothesis that there is a relationship between BP and perceived emotional isolation, on the other hand, could not be confirmed. Since emotional loneliness is associated with a lack of close or intimate relationships [2] this would suggest that intimate relationships do not contribute to BP. However, this relationship has not yet been researched. Additionally, the result may also be constrained by construct validity.

The present study is based on a newly developed hypothetical model to explain the relationship between loneliness and BP. The model assumes that dealing with negative emotional states, such as loneliness, leads to typical behaviours of BP. People procrastinate at bedtime to regulate their negative emotions. Based on the current research literature, assumptions were made about the connections between loneliness and BP with self-regulation resources, dealing with negative emotional states, the use of electronic devices, sleep and stress experiences, and health impacts. The most important prerequisite for the validity of the model is the connection between loneliness and BP. Therefore, this research examined whether there is a connection between loneliness and BP among young adults in Germany.

The results show a positive relationship between loneliness and BP among young adults in the sample. In previous research literature, sleep deprivation was a significant indicator of BP [30; 32].

Surprisingly, it was found that the impact on sleep was only evident in sleep quality, not in sleep duration. The sleep duration of young adults was within the normal range, although participants reported a moderate level of BP. The hypothetical model assumes that regular procrastination before bedtime leads to sleep deprivation, which in turn affects people's mental and physical health and well-being. The statistical results contradict this assumption of the model. However, sleep duration was measured in only one item of the self-report questionnaire. It is conceivable that the reported sleep duration does not correspond to the actual sleep duration but was overestimated. Previous psychological research shows that people who postponed bedtime in the evening temporarily had a reduced awareness of their planned bedtime. They were distracted, inattentive, and had a reduced sense of time [33]. This reduced sense of time in the evening may have influenced the estimation of sleep duration in the sample.

Furthermore, the model assumes that sleep quality is affected by BP and loneliness. The results show that the sleep quality of young adults in the seven days prior to the survey was very heterogeneous. As a result, a moderate level of BP was associated with moderate sleep quality. Additionally, a connection between the three variables was found. These results are consistent with the assumption of the model.

Moreover, the model explains the relationship between loneliness and BP through other psychological characteristics, which were not measured in the study. Self-regulation resources mediated the relationship between loneliness and BP in the current model. This assumption can only be confirmed based on previous research literature and not on statistical results. It remains unclear whether emotion regulation, self-regulation resources, and evening screen media use are indeed associated with BP and loneliness, as they were not captured in the online survey. However, the importance of emotion regulation can be preliminarily demonstrated. The connection between the aversive emotional state of loneliness and BP indicates that BP influences emotion regulation. Nevertheless, no valid statement can be made about whether emotion regulation mediates the relationship between loneliness and BP. No further results were found in the data analysis to draw conclusions about the model. It cannot be ruled out that the relationship between loneliness and BP is also due to a third variable that was not captured in the model.

Due to the composition of the sample, limitations regarding the generalizability of the research findings emerged. In addition to the limitations of external validity due to the non-probabilistic sample, most participants identified as female. This ratio significantly limits the representativeness of the results. Therefore, future research on the relationship between loneliness and BP should be conducted with a more representative sample. Another aspect contributing to the study's limitation is the selection of measurement instruments. The variables loneliness and BP were each measured using only one scale. Although the instruments were deemed reliable and valid, the construct validity of the study is limited. Further limitations arose from the research design and theoretical approach. A quantitative cross-sectional design was chosen to collect the data, meaning the data only reflect the temporary states of loneliness, sleep quality, and BP of the participants. Furthermore, the quantitative approach alone does not provide deep insights into the behaviours, cognitions, and emotions of the participants. Since the psychological traits of loneliness and BP have scarcely been studied together, a qualitative approach would have been a suitable addition to investigate the research question.

Since the study only addressed whether there is a relationship between loneliness and BP, no statements about causality can be made. To clearly determine the cause and effect of the relationship, further studies are needed. The next step could be to investigate whether there is a causal relationship between BP and loneliness among young adults and what influence these variables have on each other.

A significant advantage of this study is the hypothetical model explaining the relationship between loneliness and BP. To accept the model in the future, further studies are necessary. One question requiring further investigation is whether self-regulation, the use of screen media, and emotion regulation mediate the effect between BP and loneliness. Therefore, it would be worthwhile investigating the relationships between the psychological traits of the model in a multivariate analysis. Additionally, the model's relationships could be examined using a mixed-methods approach. Complementary to the quantitative research design, qualitative data could be collected. In a sleep diary, participants could document their sleep habits, sleep quality, sleep duration, the extent of BP, and experiences of loneliness. This could provide important insights into sleep hygiene and individual sleep needs as well as offer the possibility to capture the causes of BP behaviour.

Finally, initial practical recommendations for health psychology can be derived from the model, and the findings from this study form the basis for developing future intervention programs. The first step to improving the quality of life and well-being of young adults is to raise awareness of the issue. One way to reach the target group of young adults is through a social media campaign. The campaign should first educate about the characteristic features, protective and risk factors, and consequences of loneliness and BP. Building on this, initial recommendations for healthy sleep hygiene and a restful sleep routine could be provided. Furthermore, relaxation techniques such as progressive muscle relaxation or autogenic training can be recommended, as they help regulate feelings of loneliness before sleep. Extending the campaign to colleges and universities to reach a larger number of young adults is also conceivable.

Conclusion

The central research question was whether there is a relationship between loneliness and BP among young adults in Germany. This question can only be partially answered within the scope of the study. However, although further research is needed, parts of the proposed model have already been substantiated through the present study, forming a substantial foundation for understanding the two psychological constructs of BP and loneliness. The model provides initial practical recommendations for health psychology.

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Author Contributions Statement

Author 1: Conceptualization, methodology, validation, investigation, formal analysis. Author 2: Supervision, writing. Both authors have read and agreed to the published version of the manuscript.

Statements and Declarations

Ethical considerations

All ethical standards were adhered to.

Consent to participate

All participants gave informed written consent.

Consent for publication

Not applicable.

Declaration of conflicting interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Data availability statement

Data can be made available upon request to the authors.

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