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Sleep quality and in-person versus online social interaction during the early COVID-19 pandemic lockdown: Impact on affect and interpersonal needs among young adults

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Abstract

We examined relationships among sleep quality and forms of social interaction (in-person vs. online) as predictors of change in affect and interpersonal needs (perceived burdensomeness, thwarted belongingness) – correlates of suicidal thoughts and behaviors – during the early COVID-19 pandemic lockdown. New York City undergraduates ($N = 58$) from four public colleges completed a baseline survey and daily diaries up to 30 days in April-June 2020. Adjusting for relevant covariates, better sleep quality and in-person communication predicted greater positive affect and lower negative affect over time, but online social interaction only predicted greater positive affect and did not predict negative affect. Better sleep quality predicted lower perceived burdensomeness but not thwarted belongingness. Both in-person and online social interaction – but not total hours on social media – predicted lower thwarted belonging and perceived burdensomeness. Greater hours spent on social media each day lessened the relationship between in-person interaction and positive affect and lessened the buffering effect of in-person interaction on perceived burdensomeness. Improving sleep quality and increasing in-person interaction may ameliorate psychological variables that increase risk for suicidal thoughts and behaviors. However,

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Authors' contributions

EZ: Analyzed the data and wrote the manuscript draft. SF: Analyzed the data and wrote the manuscript draft. SS: Wrote the manuscript draft. AOP: Conceived and designed the study, supervised analyses, reviewed and edited the manuscript. EJ: Assisted with data collection, reviewed and edited the manuscript. RM: Conceived and designed the study, supervised analyses, reviewed and edited the manuscript. AB: Supervised analyses, reviewed and edited the manuscript. All authors approved the final article.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

when in-person interaction is limited, such as during the COVID-19 pandemic, online social interaction might be encouraged – depending on the nature of the interactions – to increase positive affect and buffer against suicide-related factors.

Keywords

Sleep quality; Social media; Affect; Perceived burdensomeness; Thwarted belongingness

1. Introduction

The prevalence of suicidal thoughts and behaviors (STB) increased during the COVID-19 pandemic among young, college-aged individuals (Dubé et al., 2021). College students reported reductions in social interactions, increases in social media use, and increases in loneliness during the pandemic (Reyes-Portillo et al., 2022), along with disruptions in sleep (Son et al., 2020). Disruptions in sleep and social interactions are thought to increase STBs via their impact on mood and interpersonal needs, such as perceived burdensomeness and thwarted belongingness (Littlewood et al., 2017). However, no research of which we are aware has examined how daily fluctuations in sleep and social interactions impacted mood and interpersonal needs during the early months of the COVID-19 lockdown in a city that was an epicenter of the pandemic in the United States (Thompson et al., 2020).

1.1. Sleep, affect, and interpersonal needs

Sleep disturbances, including insomnia and poor sleep quality, have been repeatedly found to impact emotional well-being, including risk for STBs, and preliminary evidence suggests there were high levels of sleep disturbances during the COVID-19 pandemic (Breslau et al., 1996; Fernandes et al., 2021; Jahrami et al., 2021; Littlewood et al., 2017). Sleep, in turn, impacts mood and affect, which are known to impact STBs, with negative affect associated with STBs and positive affect being protective against STBs (Apter et al., 1993; Nierenberg et al., 2001). Prospective studies using ecological momentary assessment (EMA) and daily diary methods suggest that sleep quality and duration predict next-day mood and anxiety more strongly than the inverse relationship, with a few exceptions (Cox et al., 2018; Garcia et al., 2014; Kalmbach et al., 2017; Triantafillou et al., 2019). For example, in a 7-day daily diary study of 75 undergraduate students, self-reported sleep quality predicted next-day positive and negative affect, but neither type of affect predicted subsequent sleep quality (Simor et al., 2015). Given that large studies revealed increased negative affect and decreased positive affect among college students during the COVID-19 pandemic (Copeland et al., 2021; Tasso et al., 2021), additional research is needed to understand the role of sleep and interpersonal factors in contributing to these changes in affect in this population, and to develop ways of buffering against risk of STBs during chronic stressors like a global pandemic.

Loneliness and related constructs, specifically the unmet interpersonal needs of thwarted belongingness and perceived burdensomeness, have long been identified as suicide-related risk factors (Chu et al., 2017a). According to the Interpersonal Theory of Suicide, perceived burdensomeness involves beliefs that one is a burden to friends, family, and

society, and thwarted belongingness involves feelings of isolation, loneliness, and/or a lack of belonging (Joiner, 2005; Van Orden et al., 2010). Beyond impacting STBs directly, thwarted belongingness and perceived burdensomeness serve as mediators of the relationship between other risk factors, namely sleep disturbances, and STBs according to past literature (Littlewood et al., 2017; Zullo et al., 2017). Indeed, a number of cross-sectional studies connect presence and/or severity of sleep disturbances with heightened perceived burdensomeness and thwarted belongingness in young adults (Chu et al., 2016; Nadorff et al., 2014). Longitudinal studies investigating these relationships are much more limited, but support similar findings (Chu et al., 2017b; Hom et al., 2017).

1.2. Digital interaction and interpersonal needs

Increase in COVID-19-related news was associated with increased time spent on digital devices such as smartphones during the early months of the pandemic among college students (Huckins et al., 2020). Past research has been mixed with regard to whether increased use of digital devices and social media increases risk of depression and STBs among young people (e.g., Kreski et al., 2021; Twenge et al., 2018), although recent systematic reviews and a meta-analysis suggest a small positive relationship between social media use and risk of STBs (Macrynikola et al., 2021; Nesi et al., 2021), with mechanisms explaining this relationship still not well-understood. Cross-sectional studies suggest an association between problematic social media use and unmet interpersonal needs. A cross-sectional study of a racially diverse sample of college undergraduates conducted before the pandemic found that high negative interactions on social media sites were associated with thwarted belongingness but not with perceived burdensomeness, when adjusting for depressive symptoms and other relevant covariates (Moberg and Anestis, 2015). Similarly, a recent survey of college students found that thwarted belongingness was more strongly associated with suicide ideation among individuals who engaged in greater negative social comparison on social media (Spitzer et al., 2023). No research of which we are aware has examined how young adults' in-person social interactions, relative to their online social interactions, might have contributed to changes in perceived burdensomeness and thwarted belongingness early in the COVID-19 pandemic (and thus potentially contributed to risk for STBs), using intensive longitudinal monitoring methods like daily diaries.

1.3. The present study

We examined daily sleep quality and in-person vs. online social interaction as predictors of affect and interpersonal needs. We expected higher levels of sleep quality to predict higher positive affect, lower negative affect, thwarted belongingness, and perceived burdensomeness. Furthermore, we expected that time spent interacting with others in person or online would be associated with higher positive affect, lower negative affect, lower perceived burdensomeness and lower thwarted belongingness, and that hours spent on social media would be associated with lower positive affect, higher negative affect, and perceived burdensomeness and thwarted belongingness. Finally, we examined whether time spent interacting with others online and hours spent on social media would moderate the relationship between time spent interacting with others in person and positive affect, negative affect, thwarted belongingness, and perceived burdensomeness.

2. Methods

2.1. Participants

Fifty-eight students (42 female), ages 18 to 35 ($M = 20.4$, $SD = 3.3$), were recruited from a diverse sample of 584 college undergraduates who participated in a larger study examining social relationships and coping responses to the COVID-19 pandemic, between April and early June of 2020, the time during which New York City was an epicenter of the pandemic in the United States (Thompson et al., 2020). Participants were from introductory psychology courses across four public New York City colleges. Racial distribution included Asian ($n = 13$; 22%), Black ($n = 11$; 19%), White ($n = 15$; 26%), and other/multi-racial ($n = 15$; 26%), with 4 participants not reporting race. Forty-three percent of the sample ($n = 25$) identified as Hispanic/Latine (note that this included the 15 participants whose race was classified as “other/multiracial”). Most participants ($n = 51$; 88%) identified as heterosexual, with 7 (12%) identifying as a sexual minority.

2.2. Procedure

All participants provided informed consent online to take part in the study. Participants completed a baseline survey and received a survey link each day for the subsequent 30 days. They received one research credit at their university for the baseline survey and one dollar per daily survey completed, assuming they completed at least 15 daily surveys, as compensation. This study was approved by the City University of New York Institutional Review Board.

2.3. Baseline measures

2.3.1. Thwarted belongingness and perceived burdensomeness—Thwarted belongingness and perceived burdensomeness were assessed via the Interpersonal Needs Questionnaire, 10-item version (INQ-10; Bryan, 2010), which includes 5 items measuring thwarted belongingness (e.g., *These days, I feel like I belong; These days, I feel disconnected from other people*) and 5 items that assess perceived burdensomeness (e.g., *These days, I think the people in my life would be better off if I were gone; These days, I think my death would be a relief to the people in my life*). Items were rated on a scale from 1 (“Not at all true for me”) to 9 (“Very true for me”), and positively-worded items were reverse-scored prior to computing totals, which could range from 5 to 35 for each subscale.

2.3.2. Depression, anxiety, and stress—The 21-item Depression, Anxiety, and Stress Scale-21 (DASS-21) measures depression, anxiety, and stress symptoms (Lovibond and Lovibond, 1995). Subscale scores were summed and doubled, as per scoring guidelines.

2.4. Daily diary measures

2.4.1. Sleep quality—Sleep quality of the prior night was assessed daily via the question: “Overall, how well did you sleep last night?” rated on scale from (1) “very badly” to (5) “very well.”

2.4.2. Affect—Six dimensions of affect were assessed daily on scales ranging from (1) “not at all” to (5) “extremely.” The six dimensions were combined into averaged positive affect (i.e., happy, calm, hopeful) and averaged negative affect (i.e., sad, anxious, stressful).

2.4.3. In-person social interaction—Amount of time interacting with others in person was assessed with the question: “How much have you talked to people in person today?” Participants selected either not at all (1), some of the time (2), or most of the time (3).

2.4.4. Online social interaction—Amount of time talking to people online was assessed with the question: “How much have you talked to people via Whatsapp, Facebook Messenger, Zoom, Skype, text messages, etc. today?” rated as not at all (1), some of the time (2), or most of the time (3).

2.4.5. Time on social media—Hours spent on social media were assessed daily via the question: “About how many hours have you spent on social media?” (with a possible range of 0–10 h).

2.4.6. Interpersonal needs—Two questions each from the Interpersonal Needs Questionnaire (INQ) (Van Orden et al., 2012) were used to assess perceived burdensomeness (i.e., “How much did you feel like you were a burden on the people in your life?” and “How much did you feel like you mattered to the people in your life?”), and thwarted belongingness (i.e., “How much did you feel like you belonged?” and “How much did you feel connected to other people?”), on scales ranging from (1) “not at all” to (5) “extremely.” Scores were calculated by averaging the two items for each subscale, respectively.

2.5. Data analysis

Multilevel mixed models were run using maximum likelihood estimation using Jamovi v.1.6.23 (The Jamovi Project, 2021). Continuous variables at the between-person level (i.e., covariates) were grand-mean centered. Continuous variables at the within-person level (i.e., predictors) were person-mean centered. Random intercepts for participants were included in the models, as well as a random slope for time.

We conducted four multilevel analyses examining the independent effects of sleep quality, time spent interacting with others in person, time spent in online interaction, and hours spent on social media on same-day positive affect, negative affect, thwarted belongingness, and perceived burdensomeness, respectively (Note that while we examined sleep quality ratings made the same day as ratings of affect and interpersonal needs, the sleep quality ratings were actually capturing ratings of sleep from the previous night). We also tested the interactions of in-person social interaction with online social interaction and hours spent on social media.

The models examining positive and negative affect as outcomes adjusted for the DASS-21 depression, anxiety, and stress scales. In addition, the model examining thwarted belongingness as outcome adjusted for baseline thwarted belongingness, while the model examining perceived burdensomeness as outcome adjusted for baseline perceived burdensomeness, as measured by the INQ. Simple effects were tested if there were significant interactions.

3. Results

Sample characteristics are shown in Table 1. Participants completed an average of 21 daily diaries (range: 7–30), with a total of 1205 responses. Overall, there was no change in positive affect over time, $b = -0.004$, $p = .18$, but negative affect decreased significantly over time, $b = -0.01$, $p < .05$. There was no change in thwarted belongingness, $b = 0.003$, $p = .24$, but perceived burdensomeness increased significantly over time, $b = 0.07$, $p < .01$.

3.1. Sleep quality, affect, and interpersonal needs

In general, students reported good sleep quality, $M = 3.53$, $SD = 1.05$ (corresponding to a rating of “fairly well”). Higher sleep quality significantly predicted higher positive affect and lower negative affect. Sleep quality did not significantly predict thwarted belongingness, but better sleep quality predicted lower perceived burdensomeness (see Table 2).

3.2. In-person vs. online social interaction and affect

On average, students reported spending “some of the time” interacting with others in person during each day, $M = 2.23$, $SD = 0.67$, and online, $M = 1.83$, $SD = 0.65$, and they spent an average of 3.29 h ($SD = 2.57$) on social media each day. Time spent interacting with others in person and online were associated with higher positive affect over time. In addition, there was a significant interaction between time spent interacting in person and hours spent on social media (see Table 2). Tests of simple effects suggested more strongly positive relationships between in-person interaction and positive affect at low levels (1 SD below the mean) of time spent on social media, $b = 0.32$, 95% CI [0.23, 0.40], $p < .01$, than at high levels (1 SD above the mean) of time spent on social media, $b = 0.18$, 95% CI [0.09, 0.28], $p < .01$. This interaction is plotted in Fig. 1.

Neither hours spent on social media nor time interacting with others online were associated with negative affect. However, time spent interacting with others in person was associated with lower negative affect; this relationship was not moderated by time in online interaction or hours spent on social media (see Table 2).

3.3. In-person vs. online social interaction and interpersonal needs

More time spent interacting with others in person and online were associated with lower thwarted belongingness, but hours spent on social media was not significantly associated with thwarted belongingness. The relationship between in-person interaction and thwarted belongingness was significantly stronger than that of online interaction and thwarted belongingness, as evidenced by non-overlapping confidence intervals (see Table 2). However, there were no significant interactions between in-person communication and either online interaction or hours on social media in predicting thwarted belongingness.

Similarly, time spent interacting in person and time spent interacting online were associated with lower perceived burdensomeness, though hours on social media was not associated with perceived burdensomeness. However, there was an interaction between time interacting in person and hours on social media in predicting perceived burdensomeness (see Table 2). Examination of simple effects suggested that there was a more strongly negative association

between time spent interacting with others in person and perceived burdensomeness at low (1 SD below the mean), $b = -0.21$, 95% CI $[-0.28, -0.15]$, $p < .01$, compared to high (1 SD above the mean) hours on social media, $b = -0.10$, 95% CI $[-0.17, -0.03]$, $p = .01$. Individuals who spent more time interacting with others in person and spent less than average number of hours on social media had the lowest levels of perceived burdensomeness. In contrast, individuals who spent little time interacting with others in person and little time on social media had the highest levels of perceived burdensomeness. This interaction is plotted in Fig. 2.

4. Discussion

The present study examined the impact of daily changes in sleep and in-person vs. online social interaction on positive and negative affect, thwarted belongingness, and perceived burdensomeness using daily diary methods in a diverse sample of college students from New York City. Data were collected in the months following the onset of the COVID-19 pandemic.

4.1. Sleep quality, affect, and interpersonal needs

Consistent with our hypotheses, higher sleep quality predicted higher positive affect and lower negative affect. These findings agree with past literature and suggest that these relationships hold true even in the context of COVID-19 (Simor et al., 2015; Triantafyllou et al., 2019). Our findings also supported a relationship between sleep quality and lower perceived burdensomeness, though there was no significant relationship between sleep quality and thwarted belongingness. These findings are partially consistent with large cross-sectional studies in which sleep disturbances, thwarted belongingness, and perceived burdensomeness were significantly related (Chu et al., 2016; Nadorff et al., 2014). Additional research is needed to replicate and clarify these relationships.

When considering implications, results from this study suggest that interventions focusing on improving sleep quality may help increase positive affect, decrease negative affect, and decrease perceived burdensomeness and thus STB-related risk, but would not impact thwarted belongingness in this specific context of diverse individuals amidst the pandemic. Nonetheless, there is past literature from before COVID-19 supporting significant relationships among sleep, thwarted belongingness, and perceived burdensomeness using cross-sectional and, more limited, prospective designs (Chu et al., 2017b; Nadorff et al., 2014). Given that both sleep problems (Jahrami et al., 2021) and suicidal thoughts were elevated during the pandemic, especially among Hispanic/Latinx and Black young adults (18-15 years; Czeisler et al., 2020), research is needed to understand whether improving sleep would be a tractable and effective avenue for targeting thwarted belongingness and perceived burdensomeness and decreasing suicide risk. Furthermore, a study of a clinical sample of 59 adolescents and emerging adults from an intensive outpatient program in the mid-Atlantic US that used ecological momentary assessment and actigraphy to track changes in sleep suggested that lower-than-usual sleep quality may affect whether adolescents and/or emerging adults think about suicide by lowering how much they react to positive interpersonal events, and that shorter sleep than usual may impact the presence and

intensity of adolescent and/or emerging adults' next-day suicide ideation by increasing how much they react to negative interpersonal events (Hamilton et al., 2023). While the sample was from a clinical setting and was predominantly White – with replication needed with racially and ethnically diverse community samples – such research suggests that addressing sleep is one avenue to impact suicide-related risk via not only changes in affect but also interpersonal factors.

4.2. In-person vs. online social interaction, affect, and interpersonal needs

In terms of how people communicated, time spent interacting with others in person and online (but not hours spent on social media) were associated with higher positive affect, but only in-person social interaction was associated with lower negative affect. Importantly, the highest positive affect was reported by individuals who had high in-person interaction but low time spent on social media. At the same time, low levels of in-person and online social interaction were associated with the lowest positive affect. In-person and online communication (though not hours on social media) were also associated with lower thwarted belongingness and perceived burdensomeness. There were significant interactions between in-person communication and hours on social media in predicting perceived burdensomeness but not thwarted belongingness. Thus, while any form of social interaction is associated with lower thwarted belongingness and perceived burdensomeness, individuals who fared best in terms of having lower perceived burdensomeness were those who interacted with others in person most while spending the least number of hours on social media, and those who fared worst were those with combined low amounts of in-person interaction and time on social media.

These findings suggest that increasing in-person social interaction would be the most effective way to increase positive affect, lower negative affect, and decrease thwarted belongingness and perceived burdensomeness. Furthermore, individuals with high levels of in-person social interaction may reap the most benefit if they limit their time spent on social media. However, in cases where in-person social interaction may not be possible, such as during the pandemic or if an individual is unable to meet others in person for a variety of reasons (i.e., physical, mental health challenges), online social interactions should be encouraged, as they were also found to increase positive affect and to decrease variables associated with suicide-related risk. At the same time, past research suggests that it is the actual experiences people have on social media, and not merely the use of social media, itself, that might make a difference for suicide-related outcomes. Online interactions might have deleterious effects to the degree that they lead to social comparison online (e.g., Macrynika, 2022; Spitzer et al., 2023) or even to experiences of online racism (Keum, 2023). A cross-sectional study of 18-19-year-olds who identified as racial or ethnic minorities and lived in the US found that experiencing online racism was indirectly associated with frequency of suicide ideation, as experienced in the previous two weeks, through perceived burdensomeness but not through thwarted belongingness (Keum, 2023). Relationships between in-person social interactions and online interactions in predicting interpersonal outcomes associated with risk of STBs may vary depending on the nature of those interactions and should thus be investigated in future research.

Finally, these findings may have implications for the use of online interventions for suicide prevention. Currently, there is increasing momentum to develop online tools to conduct suicide prevention and intervention, as they can reach large numbers of at-risk youth and they are considered to be easily disseminated and implemented (e.g., La Sala et al., 2021). Meta-analytic evidence suggests that online interventions and mobile apps targeting suicide risk and safety planning can be effective at decreasing suicidal thoughts and behaviors (Büscher et al., 2020; Melia et al., 2020; Nuij et al., 2021; Torok et al., 2020). However, these studies have not focused on individuals who identify as racial and ethnic minorities, and some of these interventions (e.g., La Sala et al., 2021) rely on delivery via social media. In light of the findings of the present study, additional research should be conducted to assess the effectiveness of online interventions specifically for youth who identify as racial and ethnic minorities, to consider the best ways of combining in-person with online interactions to optimize outcomes, and to address the circumstances under which social media might be beneficial vs. harmful.

4.3. Strengths and limitations

Study strengths and limitations must be considered. Daily diaries helped collect granular data. In addition, participants were ethnically and racially diverse, but were all undergraduate students from a community-based sample in New York City; thus, findings from this study may not generalize to characteristically different groups such as non-college students, young adults living in small towns, or students attending private colleges. Nonetheless, focusing on a diverse population is important in achieving research inclusivity (Nielsen et al., 2017). Additionally, preliminary findings suggest that the mental health consequences of the pandemic increased over time (Veldhuis et al., 2021). The current study was designed to assess the immediate impacts of COVID-19, and data were collected in the early months of the pandemic's onset; thus, long-term effects of COVID-19 and lockdown were not captured. Furthermore, it is possible that asking participants to report on how they were feeling repeatedly, in and of itself, may have had an impact on them, such as improving their affect (although it should be noted that while there was a statistically significant decrease in negative affect over time, there was no change in positive affect). Finally, this was a small sample of only one cohort of individuals, and findings should thus be interpreted with caution. Importantly, these limitations present an opportunity for future studies examining relationships among sleep, social media, affect, and interpersonal needs in other populations, larger samples, and across different time frames.

These findings support targeting sleep quality and increasing in-person over social media as forms of communication to ameliorate STB risk, specifically in terms of increasing positive affect and lowering perceived burdensomeness. Further studies may clarify whether these findings differ months and years into and following the COVID-19 pandemic.

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References

- Apter A, Plutchik R, van Praag HM, 1993. Anxiety, impulsivity and depressed mood in relation to suicidal and violent behavior. *Acta Psychiatr. Scand* 87, 1–5. [PubMed: 8424318]
- Breslau N, Roth T, Rosenthal L, Andreski P, 1996. Sleep disturbance and psychiatric disorders: a longitudinal epidemiological study of young adults. *Biol. Psychiatr* 39, 411–418.
- Bryan C, 2010. The clinical utility of a brief measure of perceived burdensomeness and thwarted belongingness for the detection of suicidal military personnel. *J. Clin. Psychol* 67, 981–992. [PubMed: 20715022]
- Büscher R, Torok M, Terhorst Y, Sander L, 2020. Internet-based cognitive behavioral therapy to reduce suicidal ideation: a systematic review and meta-analysis. *JAMA Netw. Open* 3 e203933–e203933. [PubMed: 32343354]
- Chu C, Buchman-Schmitt JM, Stanley IH, Hom MA, Tucker RP, Hagan CR, Rogers ML, Podlogar MC, Chiurliza B, Ringer FB, Michaels MS, Patros CHG, Joiner TE, 2017a. The interpersonal theory of suicide: a systematic review and meta-analysis of a decade of cross-national research. *Psychol. Bull* 143, 1313–1345. [PubMed: 29072480]
- Chu C, Hom MA, Rogers ML, Ringer FB, Hames JL, Suh S, Joiner TE, 2016. Is insomnia lonely? Exploring thwarted belongingness as an explanatory link between insomnia and suicidal ideation in a sample of South Korean university students. *J. Clin. Sleep Med* 12, 647–652. [PubMed: 26857060]
- Chu C, Hom MA, Rogers ML, Stanley IH, Ringer-Moberg FB, Podlogar MC, Hirsch JK, Joiner TE, 2017b. Insomnia and suicide-related behaviors: a multi-study investigation of thwarted belongingness as a distinct explanatory factor. *J. Affect. Disord* 208, 153–162. [PubMed: 27770645]
- Copeland WE, McGinnis E, Bai Y, Adams Z, Nardone H, Devadanam V, Rettew J, Hudziak JJ, 2021. Impact of COVID-19 pandemic on college student mental health and wellness. *J. Am. Acad. Child Adolesc. Psychiatry* 60, 134–141. [PubMed: 33091568]
- Cox RC, Sterba SK, Cole DA, Upender RP, Olatunji BO, 2018. Time of day effects on the relationship between daily sleep and anxiety: an ecological momentary assessment approach. *Behaviour Research and Therapy* 111, 44–51.
- Czeisler MÉ, Lane RI, Petrosky E, et al. , 2020. Mental health, substance use, and suicidal ideation during the COVID-19 pandemic—United States, June 24–30, 2020. *MMWR (Morb. Mortal. Wkly. Rep.)* 69, 1049–1057. [PubMed: 32790653]
- Dubé JP, Smith MM, Sherry SB, Hewitt PL, Stewart SH, 2021. Suicide behaviors during the COVID-19 pandemic: a meta-analysis of 54 studies. *Psychiatr. Res* 301, 113998.
- Fernandes SN, Zuckerman E, Miranda R, Baroni A, 2021. When night falls fast: sleep and suicidal behavior among adolescents and young adults. *Child and Adolescent Psychiatry Clinics of North America* 30, 269–282.
- Garcia C, Zhang L, Holt K, Hardeman R, Peterson B, 2014. Latina adolescent sleep and mood: an ecological momentary assessment pilot study. *J. Child Adolesc. Psychiatr. Nurs* 27, 132–141. [PubMed: 25103724]
- Hamilton JL, Tsypes A, Zelazny J, Sewall CJR, Rode N, Merranko J, Brent DA, Goldstein T, Franzen PL, 2023. Sleep influences daily suicidal ideation through affective reactivity to interpersonal events among high risk adolescents and young adults. *JCPP (J. Child Psychol. Psychiatry)* 64, 27–38. [PubMed: 35778912]
- Hom MA, Hames JL, Bodell LP, Buchman-Schmitt JM, Chu C, Rogers ML, Chiurliza B, Michaels MS, Ribeiro JD, Nadorff MR, Winer ES, Lim IC, Rudd MD, Joiner TE, 2017. Investigating insomnia as a cross-sectional and longitudinal predictor of loneliness: findings from six samples. *Psychiatr. Res* 253, 116–128.

- Huckins JF, daSilva AW, Wang W, Hedlund E, Rogers C, Nepal SK, Wu J, Obuchi M, Murphy EI, Meyer ML, Wagner DD, Holtzheimer PE, Campbell AT, 2020. Mental health and behavior of college students during the early phases of the COVID-19 pandemic: longitudinal smartphone and ecological momentary assessment study. *J. Med. Internet Res* 22, e20185. [PubMed: 32519963]
- Jahrami H, BaHammam AS, Bragazzi NL, Saif Z, Faris M, Vitiello MV, 2021. Sleep problems during the COVID-19 pandemic by population: a systematic review and meta-analysis. *J. Clin. Sleep Med* 17, 299–313. [PubMed: 33108269]
- Joiner TE, 2005. *Why people die by suicide*. Harvard University Press, Cambridge, MA.
- Kalmbach DA, Arnedt JT, Swanson LM, Rapier JL, Ciesla JA, 2017. Reciprocal dynamics between self-rated sleep and symptoms of depression and anxiety in young adult women: a 14-day diary study. *Sleep Med.* 33, 6–12. [PubMed: 28449907]
- Keum BT, 2023. Impact of online racism on suicide ideation through interpersonal factors among racial minority emerging adults: the role of perceived burdensomeness and thwarted belongingness. *J. Interpers Violence* 38, 4537–4561. [PubMed: 35942944]
- Kreski N, Platt J, Rutherford C, Olfson M, Odgers C, Schulenberg J, Keyes KM, 2021. Social media use and depressive symptoms among United States adolescents. *J. Adolesc. Health* 68, 572–579. [PubMed: 32798102]
- La Sala L, The Z, Lamblin M, Rajaram G, Rice S, Hill NTM, Thorn P, Krysinka K, Robinson J, 2021. Can a social media intervention improve online communication about suicide? A feasibility study examining the acceptability and potential impact of the #chatsafe campaign. *PLoS One* 16 (6), e0253278. [PubMed: 34129610]
- Littlewood D, Kyle SD, Pratt D, Peters S, Gooding P, 2017. Examining the role of psychological factors in the relationship between sleep problems and suicide. *Clin. Psychol. Rev* 54, 1–16. [PubMed: 28371648]
- Lovibond PF, Lovibond SH, 1995. The structure of negative emotional states: comparison of the depression anxiety stress scales (DASS) with the beck depression and anxiety inventories. *Behav. Res. Ther* 33, 335–343. [PubMed: 7726811]
- Macrynikola N, 2022. Problematic Social Media Use, Social Comparison, and Defeat: An Intensive Longitudinal Investigation. *CUNY Academic Works*. https://academicworks.cuny.edu/gc_etds/4986.
- Macrynikola N, Auad E, Menjivar J, Miranda R, 2021. Does social media use confer suicide risk: a systematic review of the evidence. *Computers in Human Behavior Reports* 3, 1000094.
- Melia R, Francis K, Hickey E, Bogue J, Duggan J, O'Sullivan M, Young K, 2020. Mobile health technology interventions for suicide prevention: systematic review. *JMIR mHealth and uHealth* 8, e12516. [PubMed: 31939744]
- Moberg FB, Anestis MD, 2015. A preliminary examination of the relationship between social networking interactions, internet use, and thwarted belongingness. *Crisis* 36, 187–193. [PubMed: 26088827]
- Nadoff MR, Anestis MD, Nazem S, Harris HC, Winer ES, 2014. Sleep disorders and the interpersonal-psychological theory of suicide: independent pathways to suicidality? *J. Affect. Disord* 152–154, 505–512.
- Nesi J, Burke TA, Bettis AH, Kudinova AY, Thompson EC, MacPherson HA, Fox KA, Lawrence HR, Thomas SA, Wolff JC, Altemus MK, Soriano S, Liu RT, 2021. Social media use and self-injurious thoughts and behaviors: a systematic review and meta-analysis. *Clin. Psychol. Rev* 87, 102038. [PubMed: 34034038]
- Nielsen M, Haun D, Kärtner J, Legare CH, 2017. The persistent sampling bias in developmental psychology: a call to action. *J. Exp. Child Psychol* 162, 31–38. [PubMed: 28575664]
- Nierenberg AA, Gray SM, Grandin LD, 2001. Mood disorders and suicide. *J. Clin. Psychiatr* 62 (Suppl. 25), 27–30.
- Nuij C, van Ballegooijen W, De Beurs D, Juniar D, Erlangsen A, Portzky G, O'Connor RC, Smit JH, Kerkhof A, Riper H, 2021. Safety planning-type interventions for suicide prevention: meta-analysis. *Br. J. Psychiatr* 219, 419–426.
- Reyes-Portillo JA, Masia Warner C, Kline EA, Bixter MT, Chu BC, Miranda R, Nadeem E, Nickerson A, Ortin Peralta A, Reigada L, Rizvi SL, Roy AK, Shatkin J, Kalver E, Rette D, Denton E, Jeglic

- EL, 2022. The psychological, academic, and economic impact of COVID-19 on college students in the epicenter of the pandemic. *Emerg. Adulthood* 10, 473–490.
- Simor P, Krietsch KN, Köateles F, McCrae CS, 2015. Day-to-day variation of subjective sleep quality and emotional states among healthy university students—A 1-week prospective study. *Int. J. Behav. Med* 22, 625–634. [PubMed: 25622815]
- Son C, Hegde S, Smith A, Wang X, Sasangohar F, 2020. Effects of COVID-19 on college students' mental health in the United States: interview survey study. *J. Med. Internet Res* 22, e21279. [PubMed: 32805704]
- Spitzer EG, Crosby ES, Witte TK, 2023. Looking through a filtered lens: negative social comparison on social media and suicide ideation among young adults. *Psychology of Popular Media* 12, 69–76.
- Tasso AF, Hisli Sahin N, San Roman GJ, 2021. COVID-19 disruption on college students: academic and socioemotional implications. *Psychological Trauma* 13, 9–15. [PubMed: 33382329]
- The Jamovi Project, 2021. Jamovi. (version 1.6) [computer software]. Retrieved from. <https://www.jamovi.org>.
- Thompson CN, Baumgartner J, Pichardo C, et al. , 2020. COVID-19 outbreak – New York City, February 29—June 1, 2020. *MMWR Morbidity and Mortality Weekly Report* 69, 1725–1729. Retrieved from. https://www.cdc.gov/mmwr/volumes/69/wr/mm6946a2.htm?s_cid=mm6946a2_w. Retrieved from. [PubMed: 33211680]
- Torok M, Han J, Baker S, Werner-Seidler A, Wong I, Larsen ME, Christensen H, 2020. Suicide prevention using self-guided digital interventions: a systematic review and meta-analysis of randomised controlled trials. *The Lancet Digital Health* 2, e25–e36. [PubMed: 33328037]
- Triantafyllou S, Saeb S, Lattie EG, Mohr DC, Kording KP, 2019. Relationship between sleep quality and mood: ecological momentary assessment study. *JMIR Mental Health* 6, e12613. [PubMed: 30916663]
- Twenge JM, Joiner TE, Rogers ML, Martin GN, 2018. Increases in depressive symptoms, suicide-related outcomes, and suicide rates among U.S., adolescents after 2010 and links to increased new media screen time. *Clin. Psychol. Sci* 6, 3–17.
- Van Orden KA, Cukrowicz KC, Witte TK, Joiner TE, 2012. Thwarted belongingness and perceived burdensomeness: construct validity and psychometric properties of the Interpersonal Needs Questionnaire. *Psychol. Assess* 24, 197–215. [PubMed: 21928908]
- Van Orden KA, Witte TK, Cukrowicz KC, Braithwaite SR, Selby EA, Joiner TE, 2010. The interpersonal theory of suicide. *Psychol. Rev* 117, 575–600. [PubMed: 20438238]
- Veldhuis CB, Nesoff ED, McKowen ALW, Rice DR, Ghoneima H, Wootton AR, Papautsky EL, Arigo D, Goldberg S, Anderson JC, 2021. Addressing the critical need for long-term mental health data during the COVID-19 pandemic: changes in mental health from April to September 2020. *Prev. Med* 146, 106465. [PubMed: 33647353]
- Zullo L, Horton S, Eaddy M, King J, Hughes J, Diederich A, Kennard B, Emslie G, Stewart S, 2017. Adolescent insomnia, suicide risk, and the interpersonal theory of suicide. *Psychiatr. Res* 257, 242–248.

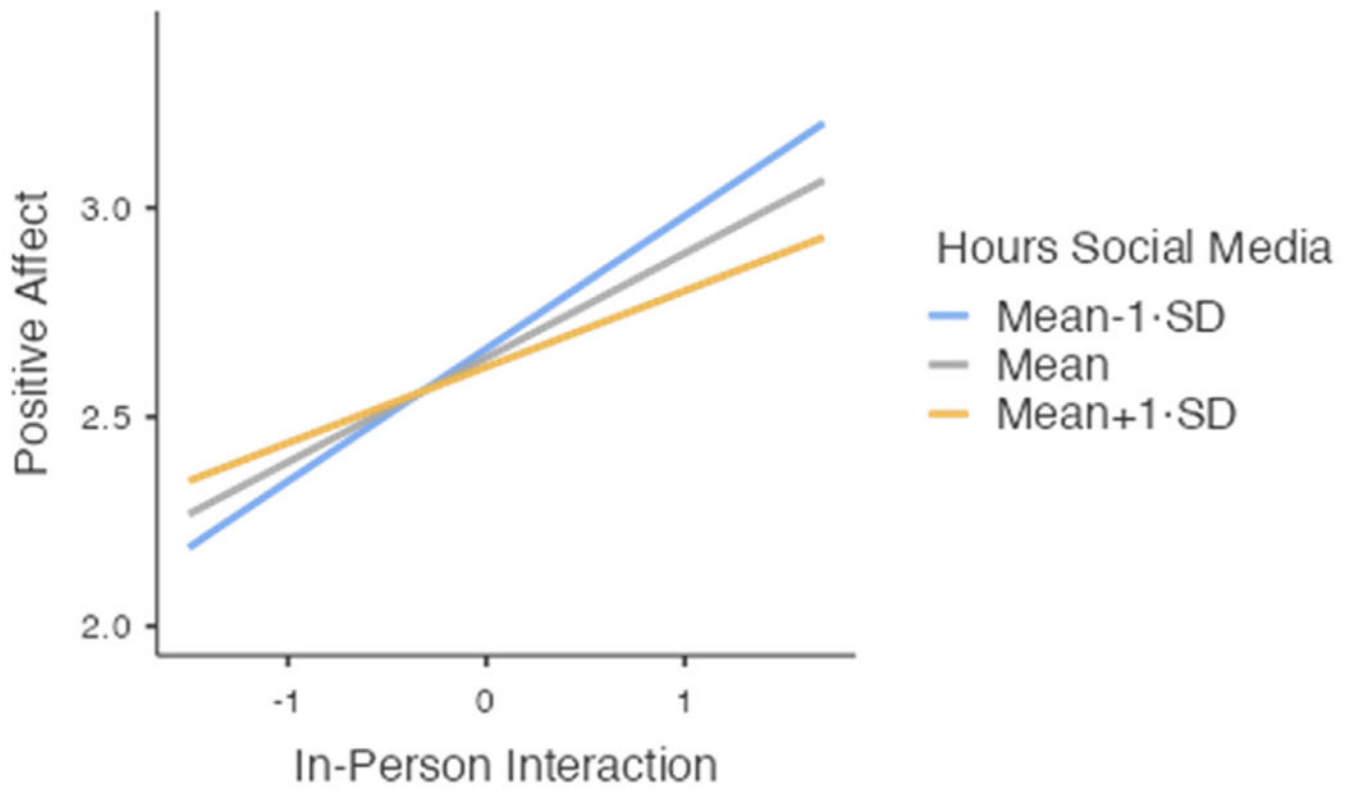


Fig. 1. Interaction between time spent talking to others in person and hours spent on social media in predicting same-day positive affect.

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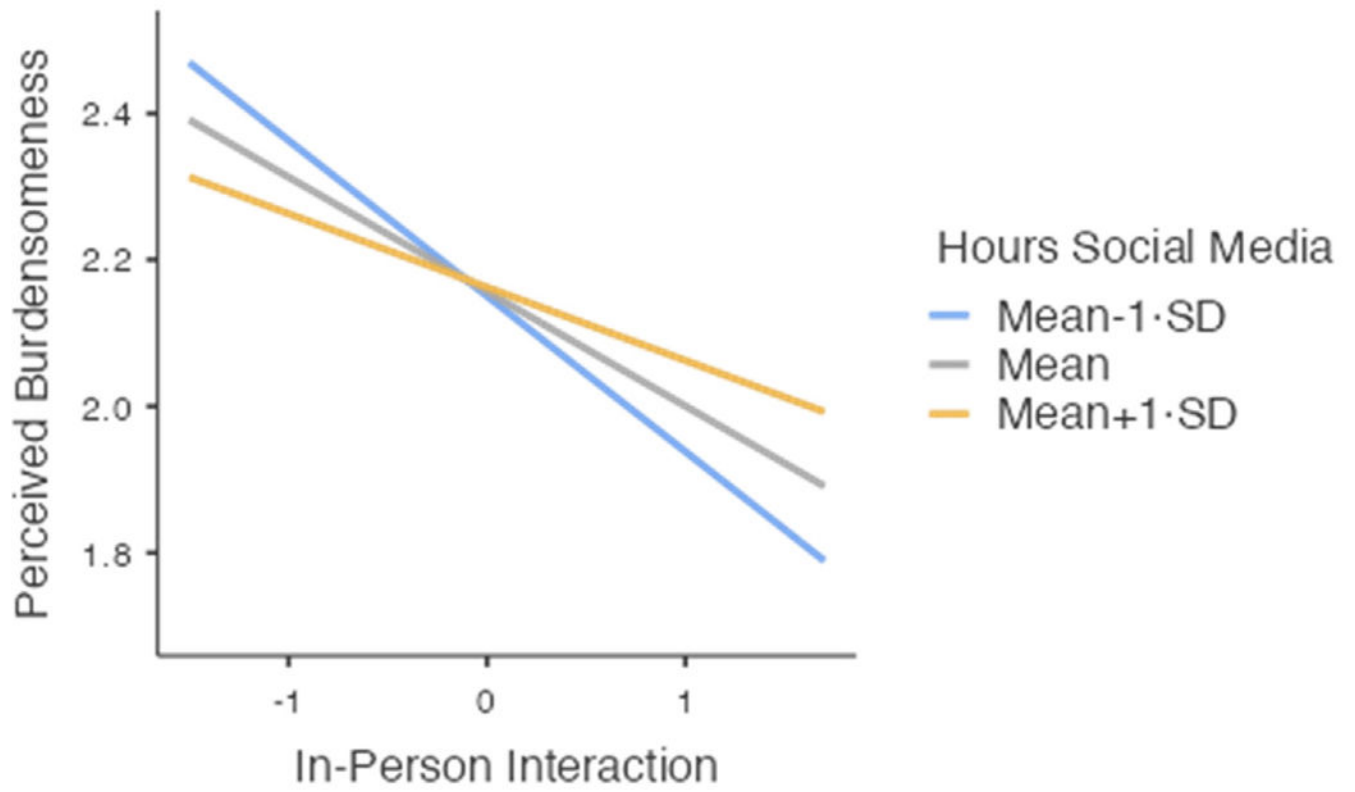


Fig. 2. Interaction between time spent talking to others in person and hours spent on social media in predicting same-day perceived burdensomeness.

Table 1

Descriptive statistics for covariates, predictors, and outcome variables.

	<i>M(SD)</i>	Min	Max
Interpersonal Needs (baseline) – Level 2 Covariates			
Thwarted Belonging	8.16 (6.70)	5	35
Perceived Burdensomeness	17.24 (5.35)	5	28
Depression, Anxiety, and Stress (baseline) – Level 2 Covariates			
Depression	11.62 (9.94)	0	42
Anxiety	7.38 (7.60)	0	42
Stress	12.93 (8.90)	0	40
Day Daily Diary (Level 1 Predictors)			
Sleep Quality	3.53 (1.05)	1	5
Time Spent Interacting in Person	2.23 (0.67)	1	3
Time Spent Interacting Online	1.83 (0.65)	1	3
Hours Spent on Social Media	3.29 (2.57)	0	10
Outcomes			
Positive Affect	2.62 (1.02)	1	5
Negative Affect	2.02 (1.01)	1	5
Thwarted Belongingness	3.05 (1.16)	1	5
Perceived Burdensomeness	2.12 (0.85)	1	5

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Table 2

Predictors of positive and negative affect, thwarted belonging, and perceived burdensomeness (fixed effects).

Variable	<i>b</i>	SE	<i>p</i>	95% CI	R^2_{marginal}	$R^2_{\text{conditional}}$
Dependent Variable: Positive Affect					.14	.71
Sleep Quality	0.07	0.02	< .001	0.04, 0.11		
Time Spent Interacting in Person	0.25	0.03	< .001	0.18, 0.32		
Time Spent Interacting Online	0.09	0.04	.02	0.01, 0.16		
Hours Spent on Social Media	-0.02	0.02	.19	-0.05, 0.01		
Time in Person X Time Online	-0.10	0.07	.17	-0.23, 0.04		
Time in Person X Hours Social Media	-0.06	0.03	.02	-0.12, -0.01		
Dependent Variable: Negative Affect					.18	.66
Sleep Quality	-0.11	0.02	< .001	-0.15, -0.07		
Time Spent Interacting in Person	-0.11	0.04	.004	-0.18, -0.04		
Time Spent Interacting Online	-0.04	0.04	.25	-0.13, 0.03		
Hours Spent on Social Media	0.02	0.02	.27	-0.01, 0.05		
Time in Person X Time Online	-0.10	0.08	.19	-0.03, 0.05		
Time in Person X Hours Social Media	0.01	0.03	.86	-0.05, 0.07		
Dependent Variable: Thwarted Belongingness					.29	.78
Sleep Quality	-0.02	0.02	.27	-0.06, 0.02		
Time Spent Interacting in Person	-0.36	0.03	< .001	-0.43, -0.29		
Time Spent Interacting Online	-0.21	0.04	< .001	-0.28, -0.14		
Hours Spent on Social Media	0.01	0.02	.74	-0.02, 0.03		
Time in Person X Time Online	0.13	0.07	.07	-0.01, 0.26		
Time in Person X Hours Social Media	0.03	0.03	.25	-0.02, 0.09		
Dependent Variable: Perceived Burdensomeness					.36	.79
Sleep Quality	-0.03	0.01	.02	-0.06, -0.01		
Time Spent Interacting in Person	-0.16	0.03	< .001	-0.21, -0.11		
Time Spent Interacting Online	-0.12	0.03	< .001	-0.17, -0.06		
Hours Spent on Social Media	0.01	0.01	.62	-0.02, 0.03		
Time in Person X Time Online	-0.01	0.05	.90	-0.11, 0.10		
Time in Person X Hours Social Media	0.05	0.02	.01	0.01, 0.09		

Note. Models predicting positive and negative affect additionally adjusted for depression, anxiety, stress, and time. Models predicting thwarted belonging and perceived burdensomeness adjusted for baseline thwarted belonging and perceived burdensomeness, respectively, along with time. R^2_{marginal} = proportion of variance explained by the fixed effects; $R^2_{\text{conditional}}$ = proportion of variance explained by the fixed and random effects.