Generalized Anxiety Mediates the Relationship Between Loneliness and Sleep Quality Amongst Young Adults During the COVID-19 Pandemic

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Abstract

Since the outbreak of COVID-19, restrictions to minimize its spread have had a profound effect. Government instigated restrictions, such as social isolation, have affected millions worldwide, and the downstream consequences of perceived loneliness upon mental health and sleep are largely unknown. A total of 1662 individuals participated in an online survey. Loneliness, anxiety, and sleep quality were assessed using the UCLA Loneliness Scale, the Generalized Anxiety Disorders scale, and the Pittsburgh Sleep Quality Index, respectively. Higher levels of perceived loneliness, as well as each one-unit increase in anxiety, were independent predictors of poor sleep quality, where OR = 1.16 (95% CI: 1.03–1.31) and 1.16 (1.11–1.21), respectively, and after adjustment. In our path analysis, we revealed significant direct effects between

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loneliness and sleep quality (β = 0.25, p < .001), as well as generalized anxiety and sleep quality (β = 0.28, p < .001), and generalized anxiety mediated the relationship between loneliness and sleep quality (β = 0.33, p < .001). Heightened anxiety and perceived loneliness appear to be significant drivers of poor sleep quality during the COVID-19 pandemic. Digital media platforms that encourage support groups for those experiencing social isolation are encouraged, along with self-help and meditative practices, which may minimize an increase of mental health and sleep disorder diagnoses post COVID-19.

Keywords
loneliness, anxiety, sleep quality, COVID-19

Introduction

Since the outbreak of COVID-19 in Wuhan, China, in December 2019, it has spread rapidly across the globe, and currently, the virus is active in over 215 countries/territories. The pandemic has brought about extraordinary changes to societal, work, and home lifestyles. Whilst initial research efforts focused on identifying the physical symptoms of COVID-19, the concentration of subsequent research has expanded to also address aspects of mental health among different populations. In particular, the prevalence of anxiety has been examined amongst healthcare workers (Kang et al., 2020), patients with a confirmed COVID-19 diagnosis (Nguyen et al., 2020), as well as the general population (Huang et al., 2019). Meta-analytic reviews have identified prevalence rates of anxiety during the pandemic ranging between 28% (Arora et al., 2020) and 32% (Salari et al., 2020). A number of studies have also investigated mental health outcomes associated with anti-pandemic measures such as social distancing and restrictions on social gatherings (Gonzalez-Sanguino et al., 2020; Nguyen et al., 2020; Pulvirenti et al., 2020; Roy et al., 2020, Wolf et., 2020).

Although a number of published studies have focused on the psychological impact of COVID-19 (Gonzalez-Sanguino et al., 2020; Huang et al., 2019; Kang et al., 2020; Liu et al., 2020; Nguyen et al., 2020; Pappa et al., 2020; Pulvirenti et al., 2020; Roy et al., 2020; Wolf et al., 2020; Xiao et al., 2020a; Xiao. et al., 2020b; Yuan et al., 2020), it is important to note that sleep is closely entwined with mental health, yet it is often viewed as being of secondary importance, or even sometimes neglected (Nguyen et al., 2020; Pulvirenti et al., 2020; Wolf et al., 2020). Fortunately, some recent studies have incorporated sleep measures to examine the effect of imposed social isolation restrictions amongst the general population (Huang et al., 2019; Liu et al., 2020; Roy et al., 2020; Yuan et al., 2020). These studies have revealed some concerning observations. For example, over 36% of 939 participants in China reported that their sleep quality had become seriously poorer during the outbreak (Yuan et al., 2020). Sleep issues appear to be even more concerning amongst healthcare workers during the

pandemic. One recent study, using the Pittsburgh Sleep Quality Index (PSQI), reported poor quality sleep in almost 64% of healthcare workers (Xiao et al., 2020a). Persistent impaired sleep quality may result in subsequent insomnia diagnosis and one study of 1250 healthcare workers reported that insomnia was present in 34% of the sample (Zhang & Ma, 2020). It is therefore vital to better understand the driving factors behind sleep impairments during the pandemic so that appropriate interventions can be developed to help prevent escalation of sleep issues becoming subsequent diagnoses. Specifically, sleep quality, as well as sleep duration, appears to have declined in significant proportions of the population during the COVID-19 pandemic. This may be driven by heightened generalized anxiety levels (Xiao et al., 2020a), as well as virus-specific anxiety and its impact on individual's daily lives. It is feasible to further suggest that these observations may also be propelled by social factors such as loneliness, stemming from diminished social contact due to increased social restrictions associated with anti-pandemic measures (Grey et al., 2020).

The relationship between anxiety and sleep has been documented previously (Baglioni et al., 2016; Cox & Olatunji, 2020; Pires et al., 2016). One potential mechanism underlying this relationship proposes that the autonomic nervous system becomes vulnerable to repeated and prolonged stress (Staner, 2003). This, in turn, leads to hyperarousal causing profound effects on sleep outcomes (Staner, 2003). Another proposed mechanism is that of loneliness, which is typically defined as a distressing feeling that people experience when they perceive their social relationships to be inadequate, which may, in turn, contribute to heightened anxiety. Loneliness has been previously associated with multiple mental health outcomes (Domenech-Abella et al., 2019), as well as sleep quality across different age groups (Ben & Walker, 2018; Griffin et al., 2019; Majeno et al., 2018; Matthews et al., 2017). Furthermore, findings from one large community study in Germany (Beutel et al., 2017) indicated that after controlling for a wide range of potential confounders, loneliness was linked to 91% increased odds of depression, 21% increased odds of anxiety, and 35% increased odds for suicidal ideation.

An additional large-scale study examined 2232 twins from a birth cohort also assessed the association between loneliness and sleep (Matthews et al., 2017). The authors measured subjective sleep quality using the Pittsburgh Sleep Quality Index (PSQI) and loneliness using the UCLA Loneliness Scale, and results indicated that loneliness was associated with poorer sleep quality as well as impaired daytime functioning (Matthews et al., 2017). These, and a number of other studies, suggest that loneliness appears to be linked to poor sleep quality, while active socializing is associated with better sleep quality (Ben & Walker, 2018; Carney et al., 2006). Despite the mounting evidence of a relationship between loneliness and sleep outcomes, the underlying mechanisms remain somewhat obscure (Griffin et al., 2019).

It has been proposed that distinct pathological cognitive processes may in fact mediate the relationship between loneliness and impaired sleep outcomes. For example, Zawadzki et al. (2013) demonstrated across a series of studies that greater loneliness was associated strongly with higher rumination and trait anxiety and that both

rumination and trait anxiety fully mediated the associations between loneliness and impaired sleep outcomes. The authors suggest that rumination and trait anxiety act in a reciprocally determinative manner and that it is possible that loneliness itself serves as a chronic stressor via ruminative and anxiety processes closely linked with 'lonely' cognitions. Additional support for the mediational role of anxiety is provided by Grossman et al. (2021) who reported that higher levels of COVID-19-related loneliness was associated with higher levels of sleep problems among older adults and that this relationship was mediated by anxiety in relation to COVID-19. In light of these findings, it is possible that anxiety mediates the relationship between loneliness and sleep quality during the COVID-19 pandemic. This is particularly pertinent to determine during the global pandemic given that millions are experiencing various levels of social isolation due to governmental restrictions and concerns over personal safety. Moreover, the evidence to date points to substantial negative ramifications in the domain of mental health as well as impairments to sleep, which is likely to further exacerbate psychological outcomes (Pappa et al., 2020; Krystal, 2012).

We sought to examine the potential associations between anxiety, loneliness, and sleep quality in adults during the COVID-19 outbreak. We also assessed if generalized anxiety was a mediator of the relationship between loneliness and sleep quality. We hypothesized that both higher levels of anxiety and loneliness would be significantly associated with poorer sleep quality. We further hypothesized that anxiety would mediate the relationship between perceived loneliness and sleep quality during COVID-19.

Methods

Participants

A total of 1662 participants provided consent to take part in the study. Demographic information was obtained related to age group (18–24, 25–34, and 35+), gender (male, female, and prefer not to say), annual household income (USD), highest education level (high school or less, undergraduate, postgraduate, and other), knowing someone personally who had tested positive for COVID-19 (yes or no), and living with children under age 8 years (yes or no). Full demographic details can be found in Table 1. Of the 1655 participants who provided information about self-isolation, 17% ($n = 277$) were not self-isolating at the time of responding and 83% ($n = 1,378$) reported being in isolation as a result of government restrictions. Data were collected between April 8th and April 25th, 2020. No incentives were offered to participants in the study.

Instruments

In addition to the demographic questions outlined above, the following instruments were also utilized:

Table 1. Characteristics of the sample.

Characteristic	N (%)
Gender, *n* (%)	
Male	925 (56)
Female	696 (42)
Prefer not to answer	41 (2)
Isolation	
Reported isolation	1378 (83)
Not in isolation	277 (17)
Age (years)	
18–24	1380 (84)
25–34	182 (11)
35+	88 (5)
Highest education level	
High school or less	1212 (73)
Undergraduate	297 (18)
Postgraduate	83 (5)
Other	68 (4)
Annual household income ($)	
< 25,000	374 (23)
25,000–50,000	323 (20)
50,000–100,000	355 (21)
100,000–200,000	219 (13)
> 200,000	78 (5)
Prefer not to answer	306 (18)
Social support	
Low	360 (26)
Moderate	743 (53)
High	290 (21)
Know someone with COVID-19	
Yes	429 (26)
No	1226 (74)
Living with children < 8 years	
Yes	120 (11)
No	1014 (89)
Sleep quality	
Good	294 (26)
Poor	843 (74)
Sleep duration (hours)	7.4 ± 1.7
Global PSQI	8 ± 4
Loneliness (based on UCLA)	6 ± 2

Table 1. (continued)

Characteristic	N (%)
Anxiety (based on GAD-7)	9 (4–14)
GAD-7	
Minimal symptoms	275 (22)
Mild symptoms	355 (29)
Moderate symptoms	297 (24)
Severe symptoms	314 (25)

Data are presented as *n* (%), mean (standard deviation), or median (IQR).
GAD-7 = Generalized Anxiety Disorder scale 7 items; PSQI = Pittsburgh Sleep Quality Index; UCLA = University of California, Los Angeles.

Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) is a commonly used tool to estimate subjective sleep quality based on the previous month (Buysse et al., 1989). The PSQI contains 19 items making up seven individual components or sub-scales: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency (i.e., the percentage of time in bed that one is asleep), sleep disturbances, use of sleeping medication, and degree of daytime dysfunction. The sum of these sub-scales is added to derive a global score (0–21). A binary variable can be calculated, based on the global PSQI score, to indicate good (≤ 5) and poor (> 5) sleep quality. The instrument has been the focus of substantial psychometric evaluation. Sensitivity and specificity are reported as high (Backhaus et al., 2002) in addition to high testretest reliability (Buysse et al., 1989) Popević et al., 2018). Construct validity of the instrument is also reported as high (Mollayeva et al., 2016).

Generalized Anxiety Disorder

The Generalized Anxiety Disorder (GAD-7) is one of the most commonly used di-agnostic subjective scales for screening, effective diagnosis, and severity assessment of GAD (Spitzer et al., 2006). Participants rate the frequency of anxiety symptoms based on the previous 2 weeks. A Likert scale is used for responses to each item. Scores to each item are added to derive a total score ranging from 0 to 21. Severity of anxiety is determined using the following accepted cut-points based on the overall score: 1–4 indicates "minimal symptoms," 5–9 represents "mild symptoms," 10–14 is suggestive of "moderate symptoms," and 15–21 indicates "severe symptoms." The GAD-7 can also be dichotomized, where < 10 is characteristic of "mild anxiety" and ≥ 10 indicates "moderate to severe anxiety." The GAD-7 has good reliability and validity across different populations (Johnson et al., 2019; Staples et al., 2019; Munoz-Navarro et al., 2017). In the present study, Cronbach's alpha coefficient was 0.91.

UCLA Loneliness Scale

This is a three-item scale assessing loneliness, which was derived from an original 20-item instrument (Hughes et al., 2004). The three items were selected as they demonstrated the highest loading on each respective factor of a three-factor model, based on the original measure (Hughes et al., 2004). Participants are asked to indicate how they feel at the time of responding based on three specific domains: (1) relational connectedness, (2) social connectedness, and (3) perceived self-isolation. Scores are added for each item to derive a total score range of 3–9. Scores of 3–5 are considered as "not lonely" and those with a score of 6–9 as considered to be "lonely." The Cronbach's alpha coefficient for this tool in our study was moderate (Cronbach α = .67).

Multidimensional Scale of Perceived Social Support

This 12-item scale is a measure of perceived social support. It captures information pertaining to family, friends, and significant others (Zimet et al., 1990). Participants are asked to specify their agreement with statements on a seven-point Likert scale. Responses are added to derive a score which can range from 12 through to 84. Those with a score of 12–48 are suggestive of "low social support." Scores of 49–68 indicate "moderate social support" and scores 69–84 indicate "high social support." In the current study, the Cronbach's alpha coefficient for this instrument was 0.89, and the intra-class coefficient was 0.92.

Procedure

The research study was conducted in accordance with the Declaration of Helsinki and was approved by the institutional review board (Approval number: LAU.SAS.IG6.2/Apr/2020). The weblink to the online survey (www.surveymonkey) was disseminated through a range of social media platforms as well as by emails to professional networks of the research team who were encouraged to complete the survey as well as distribute the link to their own networks. Those who clicked the link were presented with study-related information and subsequently asked to indicate consent to participate in the survey.

Statistical Analyses

All statistical analyses were performed in StataCorp, 2013 (*Stata Statistical Software: Release 13*. College Station, TX: StataCorp LP). We visually inspected continuous variables to assess distribution and performed Spearman's bivariate correlations for sleep quality (PSQI global score), loneliness (UCLA), anxiety (GAD-7), and sleep duration (hours). We conducted logistic regression analyses to examine independent predictors of sleep quality. Sleep quality was dichotomized based on accepted PSQI cut-points (≤ 5 vs. > 5) and considered as the dependent variable in subsequent

analyses. Within the logistic regression model, we entered the following variables: loneliness (based on the UCLA and treated as a continuous variable), anxiety (based on the GAD-7 and also treated as a continuous variable), age group (years), gender, highest education level, annual household income, perceived social support level, knowing someone who had tested positive for COVID-19, and whether living with children under the age of 8 years or not. We performed an additional linear regression with the same variables but with sleep duration (hours) as the dependent variable. We subsequently conducted path analysis using continuous variables to assess the direct effects of (1) loneliness and anxiety, (2) anxiety and sleep quality, and (3) loneliness and sleep quality. We also assessed the indirect effect of loneliness on sleep quality, whilst considering anxiety as a potential mediator of the relationship.

Data Sharing Statement

Data sharing requests can be made directly to the first or corresponding author by email.

Results

The characteristics of the participants who responded to the online survey are presented in Table 1. The majority of participants were male (56%), 18–24 years old (84%), were poor quality sleepers (74%), and 29% had mild anxiety symptoms; 24% reported moderate anxiety, and 25% reported severe anxiety symptoms. We observed significant correlations between sleep quality and anxiety level ($r = 0.52$, $p < 0.001$), sleep quality and loneliness ($r = 0.28$, $p < 0.001$), as well as anxiety and loneliness ($r = 0.35$, $p < 0.001$). Sleep duration (hours) was negatively correlated with global sleep quality ($r = -0.48$, $p < 0.001$), anxiety ($r = -0.24$, $p < 0.001$), and levels of perceived loneliness ($r = -0.11$, $p = 0.001$).

The results of the multivariate binary logistic regression analysis assessing the predictors of poor sleep quality and sleep duration (hours) are depicted in Table 2. Significant independent predictors for sleep quality included loneliness, anxiety, and social support. Specifically, anxiety and loneliness exhibited the same effect sizes, where OR = 1.16 (95% CI: 1.11–1.21), $p < 0.001$, and OR = 1.16 (95% CI: 1.03–1.31), $p < 0.001$, respectively. Interestingly, only anxiety and female gender were found to be significant independent predictors of sleep duration (hours).

The path diagram is shown in Figure 1. The total, direct, and indirect effects are presented in Table 3. The root mean squared error of approximation (RMSEA) = 0.00, the comparative fit index (CFI) = 1.00, and the standardized root mean squared residual (SRMR) = 0.00, suggesting a good fit for the model. The strongest effect was observed between loneliness and anxiety, where $\beta = 1.16$, $p < 0.001$. Moreover, anxiety was a significant mediator of the relationship between loneliness and sleep quality amongst adults living through the COVID-19 outbreak, where $\beta = 0.33$, $p < 0.001$.

Table 2. Multivariate logistic regression model to determine significant predictors of poor sleep quality and sleep duration (hours).

	OR (95% CI) Poor Sleep Quality	B (SE) Sleep Duration (hours)
Loneliness	1.16 (1.03–1.31)*	−0.02 (0.04)
Anxiety score	1.16 (1.11–1.21)**	−0.08 (0.01)***
Age		
25–34 years	1.36 (0.49–3.80)	−0.48 (0.31)
35–44 years	0.26 (0.02–2.94)	−0.12 (0.79)
Gender		
Female	1.18 (0.78–1.77)	0.43 (0.12)**
Prefer not to answer	2.47 (0.29–20.90)	−0.76 (0.43)
Highest education		
Bachelor's degree	0.74 (0.41–1.37)	−0.15 (0.20)
Postgraduate degree	0.48 (0.11–2.10)	−0.54 (0.48)
Other education	1.88 (0.53–6.71)	0.02 (0.32)
Annual income (USD)		
25,00–50,000	0.96 (0.54–1.69)	0.06 (0.18)
50,000–100,000	0.74 (0.43–1.28)	−0.02 (0.17)
100,000–200,000	0.79 (0.44–1.41)	0.06 (0.19)
More than 200,000	0.72 (0.28–1.84)	0.49 (0.29)
Prefer not to answer	1.11 (0.59–2.06)	−0.01 (0.19)
Social support		
Moderate	0.56 (0.34–0.92)*	0.14 (0.14)
High	0.54 (0.30–0.99)*	0.12 (0.19)
COVID-19 (no)	0.95 (0.62–1.45)	0.13 (0.13)
Children < 8 years (no)	0.80 (0.40–1.57)	0.02 (0.20)

*$p < 0.05$ **$p < 0.001$.
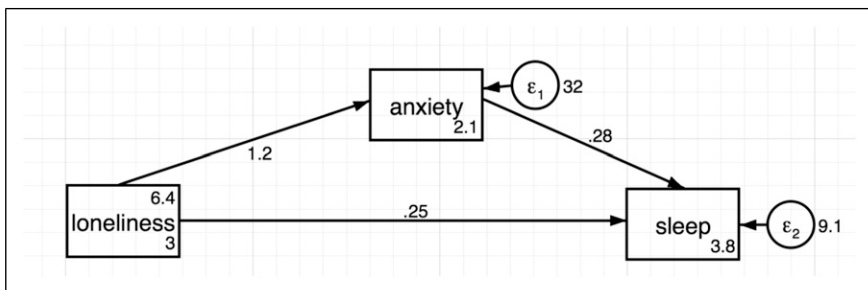OR = odds ratio; CI = confidence intervals; B = beta coefficient; SE = standard error.

Figure 1. Path analysis model assessing the direct and indirect pathways.

Table 3 . The standardized and unstandardized coefficients of the direct, indirect, and total effects of the path analysis model amongst 1126 adults during the COVID-19 outbreak.

Direct Effect	Unstd. (se) Std.
Loneliness and sleep quality	0.25 (0.05) 0.12***
Anxiety and sleep quality	0.28 (0.02) 0.48***
Loneliness and anxiety	1.16 (0.01) 0.34***
Indirect effect	
Loneliness and sleep quality	0.33 (0.03) 0.16***
Total effect	
Loneliness and sleep quality	0.58 (0.06) 0.28***
Anxiety and sleep quality	0.28 (0.02) 0.48***
Loneliness and anxiety	1.16 (0.01) 0.34***

*** $p < 0.001$
Unstd. = unstandardized coefficient; std. = standardized coefficient; se = standard error.

Discussion

The current study set out to assess the prevalence of generalized anxiety and sleep impairments and also to determine the direct and indirect relationships between anxiety, loneliness, and sleep quality amongst a large cohort of individuals during the COVID-19 pandemic. The prevalence of those with generalized anxiety, as indicated by those reporting moderate to severe symptoms of anxiety was high at almost 50% and 74% of the participants reported impaired sleep. Previous research has suggested a direct relationship between loneliness and sleep and a mediational role played by both trait anxiety and COVID-19 specific anxiety (Zawadzki et al., 2013) (Grossman et al., 2021). Our observations are consistent with these previous studies suggesting (1) higher levels of anxiety are associated with poorer sleep quality, (2) higher levels of perceived loneliness are related to poorer sleep quality, and (3) higher levels of anxiety are associated with greater perceived loneliness. In addition, we also highlight generalized anxiety as a key mediator of the relationship between loneliness and sleep quality during the COVID-19 outbreak amongst the young adult population.

Previous research has highlighted a negative relationship between loneliness and sleep quality (Griffin et al., 2019; Hawkley et al., 2010; Yu et al., 2018) and between social support and sleep quality (Grey et al., 2020). Our findings indicate that higher levels of social support are associated with improved sleep quality and also suggest that perceived loneliness is directly associated with sleep quality and also with generalized anxiety, with the strongest effect observed for anxiety. This is consistent with existing studies and suggests that elevated generalized anxiety is significantly associated with poorer subjective sleep quality during the COVID-19 pandemic. The relationship between anxiety and sleep disturbance has been a specific focus of research interest and indeed a recent meta-analytic review indicated that generalized anxiety disorder in particular, is strongly characterized by increased subjective sleep disturbance (Cox &

Olatunji, 2020). The inter-connectedness of loneliness, anxiety sensitivity, and stress reactivity may go some way to providing a mechanistic explanation for the results observed in the current study. Existing research suggests that trait anxiety increases as a function of loneliness and that lonely individuals may have an increased predisposition to react fearfully to physiological symptoms of anxiety (Hawkley et al., 2003). More importantly, elevated levels of loneliness appear to predict higher negative stress appraisals which, in turn, may contribute to sleep impairment via the effects of heightened anxiety (Hawkley et al., 2003).

It is plausible to suggest that the COVID-19 pandemic is likely to cause acute stress for a substantial proportion of the population, albeit for a variety of different reasons. Depending on an individual's coping mechanisms, attributions, and personal circumstances, some will undoubtedly experience elevated symptoms of anxiety, in line with existing cognitive models of anxiety (Wells, 1999). As previously suggested, loneliness is associated with increased stress reactivity (Nowland et al., 2018), underpinned by negative acute stress appraisals, which may cause downstream effects such as increased anxiety and hyperarousal. Hyperarousal becomes particularly significant when attempting sleep and is commonly accompanied by intrusive thoughts, both of which are known to delay sleep initiation and impair sleep quality (Kalmbach et al., 2018). As such, impairments to sleep quality are likely to be driven by loneliness and mediated via the effects of generalized anxiety, both of which are likely to have been elicited by the global pandemic.

Our observations concerning the relationship between high levels of anxiety and poor sleep quality amongst the general population mirror those of a recent systematic review and meta-analysis in healthcare workers during the COVID-19 pandemic (Pappa et al., 2020). Whilst large segments of the population report clinically significant levels of anxiety and sleep disturbance (Qui et al., 2020; Xiao. et al., 2020b), others appear to be relatively unaffected. This raises an important question about why there are differential responses amongst individuals living through the same pandemic. While the answer to this question is likely to be complex and the result of a myriad of interacting factors, social support and loneliness may be partial contributors. For example, emerging research on the initial psychological impact of the pandemic suggests that loneliness is associated with heightened anxiety and depression, while social support and a sense of belonging are protective factors against increased negative psychological impact (Gonzalez-Sanguino et al., 2020). It is, however, essential to gather and review as much high quality evidence as possible about these factors during the global pandemic. This will enable a better understanding of the factors that are potentially driving high levels of sleep impairment. Enhanced knowledge may also support interventions to minimize the probability of poor sleep quality from further escalating into insomnia diagnoses during the post-pandemic phase of COVID-19.

Study Limitations

Whilst the current study points to important relationships between generalized anxiety, loneliness, and sleep quality amongst a large sample of individuals, there are a number of limitations. Firstly, we assessed the presence of generalized anxiety and did not attempt to identify specific sources of anxiety amongst participants. While previous studies have explicitly assessed levels of COVID-19 anxiety in older adults and its relationship with sleep (Grossman et al., 2021), we considered that the sources of anxiety in younger adults were more likely to be diffuse and that anxiety-specific measures would not capture this range. Secondly, of the 1662 individuals who consented to take part in the online survey, complete information was available for a total 1126 (68%) participants for this study. We acknowledge that this may have introduced some bias (sampling and non-response) into the study and influenced the overall findings. Furthermore, given that the study was an online survey, all responses were self-reported and thus may be subject to further biases (social desirability and recall). However, the majority of research studies conducted during the COVID-19 pandemic have been largely forced to rely upon subjective reports via online surveys given the restrictions on face-to-face contact. Facilitating objective measures of outcomes such as sleep is therefore logistically impossible during these times. Thirdly, as our data is cross-sectional in nature, temporal inferences cannot be made. However, given that we employed path analysis, this does imply the nature and direction of pathways within the model we have presented. Finally, our sample is unlikely to be representative of the general population given that the majority were young adults with lower levels of education. That said, our findings are important, and highlight that loneliness and its impact on sleep is not unique to elderly individuals (Grossman et al., 2021). It is imperative to consider the connections between loneliness, mental health, and sleep across all age groups during the COVID-19 pandemic. Loneliness is a particularly pertinent factor given that governments have implemented significant restrictions surrounding social interaction to minimize the spread of the virus.

In conclusion, we found anxiety to be a mediator of the relationship between loneliness and sleep quality in a large sample of individuals during the COVID-19 pandemic. Whilst there are likely to be other factors involved, it is crucial to ensure that poor sleep quality does not escalate and place further burden on healthcare systems. In the meantime, interventions that can help individuals to adapt to the situation which target the reduction of anxiety and loneliness may be needed to minimize the onset and progression of mental health and sleep disordered outcomes. These could incorporate the use of digital media platforms to enhance social interaction, such as online support groups or meditative practices, which are likely to help alleviate a subsequent influx of mental health and sleep-disordered diagnoses during the post COVID-19 phase.

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Declaration of Conflicting Interests

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