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Nightmare Content During the COVID-19 Pandemic:

Influence of COVID-Related Stress and Sleep Disruption in the United States

Running Head: Nightmare Themes During the COVID Pandemic

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ABSTRACT

Nightmares are often associated with psychiatric disorders and acute stress. This study explores how the COVID-19 pandemic may have influenced the content of nightmares. A sample of N=419 US adults completed online surveys about sleep and COVID-19 experiences. Participants were asked the degree to which they agreed with statements linking greater general stress, worse overall sleep, and more middle-of-the-night insomnia with the COVID-19 pandemic. They were also asked if, during the pandemic, they experienced nightmares related to various themes. Logistic regression analyses examined each nightmare content as outcome and increased stress, worse sleep, and more middle-of-the-night insomnia as predictors, adjusted for age, sex, and race/ethnicity. Those who reported greater general COVID-related stress were more likely to have nightmares about confinement, failure, helplessness, anxiety, war, separation, totalitarianism, sickness, death, COVID, and apocalypse. Those who reported worsened sleep were more likely to have nightmares about confinement, oppression, failure, helplessness, disaster, anxiety, evil forces, war, domestic abuse, separation, totalitarianism, sickness, death, COVID, and apocalypse. Those who reported worsened middle-of-the-night insomnia were more likely to have nightmares about confinement, oppression, failure, helplessness, disaster, anxiety, war, domestic abuse, separation, totalitarianism, sickness, death, COVID, and apocalypse. These results suggest that increased pandemic-related stress may induce negatively-toned dreams of specific themes. Future investigation might determine whether (and when) this symptom indicates an emotion regulation mechanism at play, or the failure of such a mechanism.

Keywords: sleep, nightmares, dreams, COVID-19, stress, pandemic

INTRODUCTION

The COVID-19 pandemic has affected sleep and dreams for many individuals and has been linked to changes in mental health, lifestyle habits, and social interactions (Pérez-Carbonell et al., 2020; Shillington et al., 2021). Insomnia severity during this time has been linked to suicide ideation (Killgore et al., 2020) and much of the anxiety and stress associated with health and general wellbeing has played out in dreams and nightmares with pandemic-related themes (Guerrero-Gomez et al., 2021; MacKay & DeCicco, 2020; Mota et al., 2020; Ruby, 2021).

A nightmare is a bad dream that evokes a strong emotional response in the sleeper and leads to being awoken. Nightmares are associated with particular personality types more susceptible to threat perception and proposed by Nielsen and Levin (2007) to involve dysfunction of a network comprising the limbic, paralimbic, and prefrontal regions of the brain involved in emotion regulation. A nightmare may either be idiopathic (of unknown cause) or posttraumatic (following a traumatic event) and typically takes place during REM sleep (Fisher et al., 1970; Spoormaker et al., 2006). Nightmares are more common in children than adults (20-30% vs 11% of the general population) (Bixler et al., 1979; Leung & Robson, 1993), but those who experience them in adulthood are most likely to be young females (Spoormaker et al., 2006). This prevalence in females is thought to decline with age (Spoormaker et al., 2006). Nightmares are significantly associated with psychiatric disorders and anxiety, with persistence of nightmares linked to irregular sleep schedules, avoidance addressing them, and fear of going to sleep (Hublin et al., 1999; Spoormaker et al., 2006). Sleep deprivation can then result, increasing anxiety levels and thus perpetuate the cycle (Pires et al., 2016).

Robert and Zadra (2014) conducted a study to assess the most common nightmare themes and found these to include aggression, fear, and unfortunate endings. Interestingly, they found that nightmares were less likely to reflect issues of personal competence and more likely to reflect negative external triggers. This falls in line with the Threat Simulation Theory, which suggests that

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3 a key function of dreams is to play out threatening scenarios while asleep to thus help prepare for
4 and avoid or confront a threat in waking life (Revonsuo, 2000).
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8 A general increase in dream and nightmare frequency during the COVID-19 pandemic has been
9 reported around in the world. Scarpelli and colleagues (2021) and Gorgoni and colleagues (2021)
10 both noted an increase in dreams with strong emotional content in Italy. In a sample of Canadian
11 university students, an increase in nightmares was reported, with females disproportionately
12 affected (Kilius et al., 2021). Another Canadian study noted an increase in dream imagery related
13 to pandemic themes among participants (MacKay & DeCicco, 2020).
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17 In the survey during the first lockdown in France, an increase in nightmare frequency was also
18 observed (Ruby, 2021). Themes related to the health crisis were the most frequently reported.
19 This was also seen in a Brazilian study which analyzed dream themes and found a higher
20 proportion of themes around contamination and cleanliness (Mota et al., 2020), and in a Finnish
21 study where participants reported more nighttime awakenings and nightmares as compared to
22 pre-pandemic times, with over 50% of these nightmares about pandemic-specific themes
23 including sickness, physical distancing, and family concerns (Pesonen et al., 2020). Among
24 adolescents living in Italy, Croatia and Romania, an increase in nightmares and dreams with
25 pandemic-related themes were also reported (Guerrero-Gomez et al., 2021).
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29 General sleep disturbances during the pandemic have been particularly prevalent among
30 healthcare workers (Wang et al., 2020), while other studies have found females in general to be
31 at higher risk (Dal Santo et al., 2021; Kilius et al., 2021; Pinto et al., 2020; Scarpelli et al., 2021).
32 A large study using Fitbit data from approximately 160,000 users across 6 major US cities found
33 that compared to 2019, sleep duration had increased during the 2020 pandemic (Rezaei and
34 Grandner 2021). Bedtime also shifted later and variability in sleep duration decreased. Increased
35 sleep time was also observed in France during the first lockdown as seen in a survey that covered
36 all regions of the country (N=3337 (Ruby, 2021)).
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3 In another study comparing pandemic-related sleep to pre-pandemic norms, a team from the
4 Netherlands recruited a population consisting of both good and bad sleepers (for which previous
5 data existed) and assessed subjective sleep quality changes during the pandemic. Kocевska and
6 colleagues (2020) found no uniform effect on sleep, with some individuals experiencing
7 improvements as compared to pre-pandemic times, while others noted worse sleep that was often
8 associated with pandemic anxiety. This was also seen in Italy, France, and Spain, where worse
9 sleep quality was more frequently-reported than improved sleep quality (Alfonsi et al., 2021; Dal
10 Santo et al., 2021; Ruby, 2021).
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21 More time than usual spent indoors could be responsible for some of the sleep disturbances that
22 have been seen. Morin and colleagues (2020) postulated that not only could stress be
23 responsible, but also disturbed circadian rhythms as a result of confinement. The usual light and
24 social cues used for circadian entrainment are no longer present when individuals are restricted
25 to extended periods of social distancing, at home, indoors. With this lifestyle change has also
26 come increased reliance on screen use for work and social connections (Majumdar et al., 2020).
27 Blue-light emitting devices are known to suppress melatonin production and thus disturb sleep
28 (Cajochen et al., 2011). These factors may have contributed to the increase in sleep medication
29 use seen during confinement by Alfonsi and colleagues (2021).
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41 Given the known implications of stress and sleep loss on health and wellbeing, and the need for
42 further understanding of the pathology of nightmares, the aim of the present study was to
43 determine whether COVID-related general, family, or media stress, subjective perception of
44 worsened sleep, increased onset insomnia, or middle-of-the-night insomnia were associated with
45 specific nightmare themes in a United States sample after seeing similar effects in other parts of
46 the world. We hypothesized that pandemic-related worsening of sleep quality and pandemic-
47 related increased stress would be associated with increased frequency of nightmares that would
48 similarly reflect pandemic-related themes.
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METHODS

Data Source

These data were collected as part of the Coronavirus and Impact on Dreams (CoVID) study which was approved by the Institutional Review Board (IRB) of the University of Arizona. Data were collected from June to November 2020. Adults aged 18 and older who were also fluent in English were eligible. Recruitment included flyers posted locally in Tucson, Arizona, as well as social media and online advertisements accessible nationwide. Data were collected in the form of a REDCap survey, for which informed consent was required to proceed. Analyses were conducted on all completed surveys (N=419).

Measures

Participants were asked to indicate the degree to which they agreed or disagreed with the following statements about COVID-related stress: "COVID-19 is increasing my general stress," "COVID-19 is increasing stress about my family," and "The media coverage of COVID-19 has increased my stress." They were also asked to indicate the degree to which they agreed or disagreed with the following statements about their sleep: "Since quarantine, my sleep has worsened," "Since quarantine, I'm struggling to fall asleep," and "Since quarantine, I'm waking up more during the night." These six items, which record general stress, family stress, media stress, worsened sleep, onset insomnia, and middle of the night insomnia, respectively, had the following response options: "Strongly Disagree," "Disagree," "Agree," and "Strongly Agree." These were coded numerically as 0-3.

Participants were also asked, "Have you had nightmares about any of the following during quarantine?" They indicated yes or no to the following themes inspired from the French survey (Ruby, 2021): "confinement," "claustrophobia," "suffocation," "oppression," "drowning," "failure," "feeling helpless," "natural disasters," "anxiety," "evil forces," "war," "domestic abuse," "separation

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3 from loved ones,” “totalitarian regime,” “being chased,” “dangerous animals,” “sickness,” “death,”
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5 “covid-19 virus,” and “end of the world.”
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8 Participants completed the Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001), which
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10 screened for depression and Generalized Anxiety Disorder 7-item instrument (GAD-7) (Spitzer et
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12 al., 2006). Participants also completed the Mannheim Dreams questionnaire (MADRE) (Shredl et
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14 al., 2014) which asked about dream and nightmare experiences, including frequency of
15
16 nightmares.
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19 Additional variables included age, sex, and self-reported race/ethnicity (Non-Hispanic White,
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21 Hispanic/Latino, Black/African-American, Indian/Subcontinent, Asian, or Multiracial/Other).
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24 *Statistical Analyses*

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27 Logistic regression analyses examined the likelihood of each nightmare as a binary variable,
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29 predicted by each of the stress and sleep variables, treated as pseudo-linear independent
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31 variables. All logistic regression analyses were adjusted for age, sex, and race/ethnicity. Results
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33 are displayed as adjusted Odds Ratios (OR) and 95% Confidence Intervals (CI), along with z
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35 score of the OR and p-value. Since there were 20 different outcomes, all p-values were subject
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37 to Holm-Bonferonni adjustment (Holm, 1979). Adjusted p values were computed by weighting the
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39 observed p value by the Holm-Bonferonni cutoffs, relative to 0.05. All analyses were performed
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41 in STATA 14.2 (STATA CORP, College Station, TX), except for Holm-Bonferonni adjustments,
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43 which were computed in Microsoft Excel 365.
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46 **RESULTS**

47 *Characteristics of the Sample*

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50 Characteristics of the sample are reported in Table 1. A total of N=419 individuals provided data.
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53 The sample was predominantly female and non-Hispanic White. The mean age was 46 (range
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3 18-80). The most commonly reported nightmare content was “anxiety” (41.2%), with more than
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5 1/5 of respondents reporting nightmares that had themes of helplessness (40.0%), separation
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7 from loved ones (28.1%), failure (27.4%), being chased (24.3%), and death (22.1%). COVID-
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9 related stress was common, with about 86.2% endorsing some increase in general stress, 67.6%
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11 reporting media-related stress, and 83.8% reporting family-related stress. Sleep disturbances
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13 were also common, with 60.5% reporting that their sleep worsened in general, 43.6% reporting
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15 that they had more difficulties with sleep onset insomnia, and 55.2% reporting that they were
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17 having more difficulties with middle insomnia.

20 21 *Associations between COVID-Related Stress and Nightmare Content*

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23 Results of logistic regression analyses investigating relationships between COVID-related stress
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25 and nightmare content are reported in Table 2. In unadjusted analyses, following p-value
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27 adjustment for multiple comparisons, greater increase in general stress was associated with an
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29 increased likelihood of nightmares about failure, helplessness, anxiety, war, separation from loved
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31 ones, totalitarian regimes, sickness, death, COVID-19, and apocalypse. After adjustment for
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33 demographic covariates, the relationships with failure, death, and COVID-19 were no longer
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35 statistically significant in Holm-Bonferroni-adjusted analyses. Z-score plots for each stress and
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37 nightmare theme are presented in Figure 1.

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40 An increase in family stress was associated with an increased likelihood of nightmares about
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42 confinement, suffocation, oppression, failure, helplessness, anxiety, evil forces, war, domestic
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44 abuse, separation from loves ones, totalitarian regimes, being chased, sickness, death, COVID-
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46 19, and apocalypse. After adjustment for demographic covariates, the relationships with
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48 suffocation, evil forces, domestic abuse, being chased, sickness, and COVID-19 were no longer
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50 statistically significant in Holm-Bonferroni-adjusted analyses.

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54 Media stress was not associated with an increased likelihood of any specific nightmare content.
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Associations between COVID-Related Sleep Disturbance and Nightmare Content

Results of logistic regression analyses investigating relationships between COVID-related sleep disturbances and nightmare content are reported in Table 3. In unadjusted analyses, following a p-value adjustment for multiple comparisons, worse sleep was associated with an increased likelihood of nightmares about confinement, oppression, failure, helplessness, natural disasters, anxiety, evil forces, war, domestic abuse, separation from loved ones, totalitarian regimes, sickness, death, COVID-19, and apocalypse. After adjustment for demographic covariates, the relationships with evil forces and domestic abuse were no longer statistically significant in Holm-Bonferroni-adjusted analyses. Z-score plots for sleep disturbances and nightmare theme associations are presented in Figure 2.

Early onset insomnia was associated with an increased likelihood of nightmares about all topics except dangerous animals. After adjustment for demographic covariates, the relationships with suffocation, drowning, evil forces, being chased, sickness, and COVID-19 were no longer statistically significant in Holm-Bonferroni-adjusted analyses.

Middle insomnia was associated with an increased likelihood of nightmares about confinement, oppression, failure, helplessness, anxiety, war, domestic abuse, separation from loved ones, sickness, death, COVID-19, and apocalypse. After adjustment for demographic covariates, the relationships with confinement, COVID-19, and apocalypse were no longer statistically significant in Holm-Bonferroni-adjusted analyses.

Associations Between Depression and Anxiety and Nightmare Content

To determine the effects of depression and anxiety on nightmare content, logistic regression analyses investigating relationships between PHQ-9 and GAD-7 scores and nightmare themes were performed. These are reported in Table 4. In unadjusted analyses, following a p-value adjustment for multiple comparisons, depression and anxiety were significantly associated with

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3 all nightmare themes. This persisted following adjustment for demographic covariates, with the
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5 exception of what are presumed to be two spurious results (natural disasters and COVID-19).
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8 *Association Between Nightmare Frequency and Content*

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11 Nightmare frequency was assessed using the Mannheim Dream questionnaire (MADRE) with the
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13 question, “How often have you experienced nightmares recently (in the past several months)?”
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15 with answer options including: several times a week, about once a week, two to three times a
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17 month, once a month, two to four times a year, once a year, less than once a year, and never.
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19 Data were grouped into: more than once a week, more than one a month, more than one a year,
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21 and less than one a year and assessed as an additional covariate in the models. In almost all
22
23 cases, the relationship between stressor and nightmare content, or sleep complaint and
24
25 nightmare content was maintained, indicating there was no influence of nightmare frequency on
26
27 specific nightmare theme (unreported data).
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30 **DISCUSSION**

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33 This study shows that individuals who reported greater general COVID-related stress were more
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35 likely to have nightmares about confinement, helplessness, anxiety, war, separation,
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37 totalitarianism, sickness, death and apocalypse scenarios. Those who reported worsened sleep
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39 were more likely to have nightmares about confinement, oppression, failure, helplessness,
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41 disaster, anxiety, evil forces, war, domestic abuse, separation, totalitarianism, sickness, death,
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43 COVID, and apocalypse scenarios. Those who reported worsened middle-of-the-night insomnia
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45 were also more likely to have nightmares about confinement, oppression, failure, helplessness,
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47 disaster, anxiety, war, domestic abuse, separation, totalitarianism, sickness, death, COVID, and
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49 apocalypse scenarios. The strongest associations included greater general COVID-related stress
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51 or worsened sleep and totalitarianism-themed nightmares, greater general COVID-related stress
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3 and war-themed nightmares, and greater general COVID-related stress and helplessness
4 nightmares. Depression and anxiety scores were positively associated with all nightmare themes.
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8 These findings suggest that increased stress or dysregulated emotions may result in more
9 frequent nightmares and that the pandemic may have given rise to specific associated nightmare
10 themes. While this was also seen in locations outside the United States (Gorgoni et al., 2021;
11 Mota et al., 2020; Ruby, 2021; Scarpelli et al., 2021), unique sociopolitical stressors specific to
12 the United States occurring in parallel may have also influenced the themes of totalitarianism,
13 war, and helplessness.
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21 Data from Germain and Nielsen (2003) indicating that posttraumatic nightmares were more
22 closely associated with insomnia than idiopathic nightmares suggests that the findings seen in
23 the present study are indicative of traumatic responses to pandemic-related events. Uncertainty
24 about the future could have led to nightmares about helplessness, totalitarianism, or war.
25 Experiencing concerns regarding personal or familial sickness are also possible sources of
26 anxiety that can manifest in negatively-toned dreams. Interestingly, media stress was generally
27 not associated with an increased likelihood of any specific nightmare themes. Rather, general
28 and family stress seemed to evoke the strongest responses. This suggests that nightmares could
29 be less influenced by societal issues portrayed in the media and more closely influenced by
30 personal issues that pose imminent threats to an individual's health and wellbeing.
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43 Negatively-toned dreams are associated with higher stress levels (De Koninck & Brunette, 1991),
44 and nightmares are accompanied by increased autonomic activity and sympathetic tone (Paul et
45 al., 2019; Perogamvros et al., 2019). While it's unclear which specific mechanisms are involved
46 in the brain that experiences frequent nightmares, as outlined by Nielsen and Levin (2007),
47 norepinephrine may be involved. The success of the drug, Prazosin, in reducing PTSD-related
48 nightmare frequency could be a result of decreased norepinephrine, though this remains to be
49 determined (Spoormaker et al., 2006).
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3 The hormone, cortisol, may also play a role in nightmares. One study found that frequent
4 nightmares were associated with a blunted cortisol awakening response in women, which
5 comprised 74% of our sample (Nagy et al., 2015). Cortisol is known to act on the hypothalamic-
6 pituitary-adrenal (HPA) axis, suggesting that the HPA may be involved in nightmare generation.
7
8 The association between disrupted cortisol levels and sleep disturbances including insomnia has
9 also been well-documented (Drake et al., 2017; Grimaldi et al., 2020). If individuals have
10 insufficient or poor quality sleep, emotion processing in the brain can become impaired (Walker
11 & van der Helm, 2009). This may then perpetuate the risk of increased nightmare frequency.
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15 While the COVID-19 pandemic experience has been unique for each individual in the United
16 States, the sleep disturbances and nightmare themes reported in this study are similar to what
17 has been observed in other countries. This provides further insight into the causes of negatively-
18 toned dreams during a global health crisis, as well as perhaps some of the most common fear
19 responses despite sociopolitical differences in various parts of the world. Further investigation is
20 required to elucidate the mechanisms underpinning the relationship between stress, sleep
21 disturbances and nightmares and might look more closely at dimensions of emotion regulation
22 and personality, as well as social support available to individuals experiencing stress and
23 nightmares, along with other lifestyle factors.
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40 *Limitations*

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42 While this survey was open to all adults over the age of 18, the specific location of participants
43 was unknown. However, while any location-specific variability in COVID-19 related circumstances
44 could not be accounted for, this sample represents a general or collective effect of the pandemic
45 on nightmares within the US. Similarly, the extent to which participants were affected by other
46 potentially stressful sociopolitical circumstances which may have had an impact on nightmares
47 that occurred during the study period remains unknown. While survey questions included those
48 about dreams and nightmares prior to the COVID-19 pandemic, previous data for these
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3 individuals does not exist, thus preventing accurate comparisons from being made in the realms
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5 of sleep quality, nightmare content and frequency before and after the pandemic. Also, the
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7 difference between a bad dream and a nightmare was not specified in the survey, therefore it's
8
9 unclear whether individuals were awoken by these reported nightmares, thus leading to sleep
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11 difficulties, or whether they remembered the dream content once they were awake and were thus
12
13 unable to return to sleep. Regardless, there was a general increase in sleep difficulties that
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15 accompanied these negatively-toned dreams. Measures of sleep were also limited to very few
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17 questions, thus limiting the extent to which disturbances and poor sleep could be determined.
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19 Lastly, this survey was advertised largely online and those without internet access, or those
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21 without social media accounts will have been less likely to have participated. While online survey
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23 distribution is now commonplace, it's important that future studies take this portion of the
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25 population into account, so as not to exclude any individuals.
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28 29 *Conclusions*

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31 The mechanisms underpinning the emotion processing involved in dream manifestation - or
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33 perhaps the lack thereof - during a stress response, or as seen in sleep loss, are not yet fully
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35 understood. However, this study highlights the effects of stress and reported sleep difficulties on
36
37 specific nightmare themes, particularly with regards to a global pandemic or similar health crisis
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39 and the sociopolitical stressors that occurred in parallel within the United States. This may be
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41 beneficial for future sleep and mental health interventions.
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TABLE 1. Characteristics of the Sample

<u>Variable</u>	<u>Category / Units</u>	<u>Value</u>
Age	Years	45.97 (SD=16.07)
Sex	Male	25.95%
	Female	74.05%
Race/Ethnicity	Non-Hispanic White	75.42%
	Hispanic/Latino	12.41%
	Black/African-American	1.19%
	Indian/Subcontinent	3.10%
	Asian	1.91%
	Multiracial/Other	5.97%
Nightmare Content	Confinement	14.52%
	Claustrophobia	5.24%
	Suffocation	7.86%
	Oppression	10.48%
	Drowning	6.19%
	Failure	27.38%
	Helplessness	40.24%
	Natural disasters	11.43%
	Anxiety	41.19%
	Evil forces	16.90%
	War	10.24%
Domestic abuse	6.67%	

	Separation from loved ones	28.10%
	Totalitarian regimes	5.95%
	Being chased	24.29%
	Dangerous animals	7.14%
	Sickness	18.33%
	Death	22.14%
	COVID-19	11.67%
	Apocalypse	11.67%
General COVID Stress	Strongly Disagree	2.14%
	Disagree	11.67%
	Agree	50.48%
	Strongly Agree	35.71%
COVID Media Stress	Strongly Disagree	2.38%
	Disagree	30.00%
	Agree	45.95%
	Strongly Agree	21.67%
COVID Family Stress	Strongly Disagree	3.33%
	Disagree	12.86%
	Agree	54.52%
	Strongly Agree	29.29%
Sleep Worsened	Strongly Disagree	3.57%
	Disagree	35.95%
	Agree	45.00%
	Strongly Agree	15.48%

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Onset Insomnia	Strongly Disagree	10.95%
	Disagree	45.48%
	Agree	33.33%
	Strongly Agree	10.24%
Middle Insomnia	Strongly Disagree	5.95%
	Disagree	38.81%
	Agree	40.00%
	Strongly Agree	15.24%

For Peer Review

TABLE 2. Associations between COVID-Related Stress and Nightmare Content, Unadjusted and Adjusted, with Standard and Holm-Bonferroni Adjusted p Values

	<u>Unadjusted</u>					<u>Adjusted for Age, Sex, and Race/Ethnicity</u>				
	<u>OR</u>	<u>z</u>	<u>95% CI</u>	<u>p</u>	<u>p adj</u>	<u>OR</u>	<u>z</u>	<u>95% CI</u>	<u>p</u>	<u>p adj</u>
GENERAL STRESS										
Confinement	1.78	2.65	(1.16, 2.72)	0.008	0.080	1.66	2.21	(1.06, 2.59)	0.027	0.270
Claustrophobia	1.30	0.80	(0.69, 2.43)	0.421	0.421	1.33	0.85	(0.69, 2.54)	0.393	0.786
Suffocation	2.01	2.36	(1.12, 3.59)	0.018	0.162	1.82	1.92	(0.99, 3.34)	0.055	0.495
Oppression	1.66	2.04	(1.02, 2.69)	0.041	0.246	1.55	1.68	(0.93, 2.60)	0.093	0.744
Drowning	1.86	1.91	(0.98, 3.52)	0.056	0.224	1.45	1.07	(0.74, 2.84)	0.284	0.852
Failure	1.85	3.63	(1.33, 2.58)	<0.0005	<0.0005	1.64	2.79	(1.16, 2.33)	0.005	0.065
Helplessness	2.97	6.40	(2.13, 4.15)	<0.0005	<0.0005	2.89	5.93	(2.04, 4.11)	<0.0005	<0.0005
Natural disasters	1.61	2.01	(1.01, 2.55)	0.044	0.220	1.46	1.55	(0.90, 2.37)	0.121	0.726
Anxiety	2.57	5.79	(1.87, 3.54)	<0.0005	<0.0005	2.37	5.07	(1.70, 3.30)	<0.0005	<0.0005
Evil forces	1.31	1.43	(0.90, 1.90)	0.152	0.304	1.11	0.51	(0.75, 1.63)	0.612	0.612
War	3.63	4.21	(1.99, 6.61)	<0.0005	<0.0005	3.42	5.76	(1.80, 6.49)	<0.0005	<0.0005
Domestic abuse	2.08	2.27	(1.11, 3.92)	0.023	0.184	1.72	1.61	(0.89, 3.33)	0.106	0.742
Separation from loved ones	2.43	4.94	(1.71, 3.46)	<0.0005	<0.0005	2.23	4.22	(1.54, 3.24)	<0.0005	<0.0005
Totalitarian regimes	4.55	3.55	(1.97, 10.50)	<0.0005	<0.0005	3.78	2.94	(1.56, 9.15)	0.003	0.045

Being chased	1.44	2.17	(1.04, 2.00)	0.030	0.210	1.31	1.55	(0.93, 1.84)	0.121	0.726
Dangerous animals	1.59	1.59	(0.90, 2.82)	0.113	0.339	1.44	1.21	(0.80, 2.59)	0.227	0.908
Sickness	2.26	3.91	(1.50, 3.40)	<0.0005	<0.0005	1.92	2.99	(1.25, 2.95)	0.003	0.045
Death	1.84	3.32	(1.28, 2.64)	0.001	0.012	1.66	2.58	(1.13, 2.43)	0.010	0.120
COVID-19	2.10	2.98	(1.29, 3.43)	0.003	0.033	1.96	2.59	(1.18, 3.26)	0.010	0.120
Apocalypse	3.18	4.17	(1.85, 5.48)	<0.0005	<0.0005	2.92	3.63	(1.64, 5.20)	<0.0005	<0.0005
FAMILY STRESS										
Confinement	2.19	3.53	(1.42, 3.40)	<0.0005	<0.0005	2.01	2.99	(1.27, 3.16)	0.003	0.039
Claustrophobia	2.29	2.31	(1.13, 4.64)	0.021	0.063	2.20	2.12	(1.06, 4.55)	0.034	0.170
Suffocation	2.58	3.10	(1.42, 4.68)	0.002	0.012	2.36	2.70	(1.26, 4.41)	0.007	0.070
Oppression	2.79	3.76	(1.63, 4.75)	<0.0005	<0.0005	2.51	3.18	(1.42, 4.41)	0.001	0.017
Drowning	1.73	1.76	(0.94, 3.18)	0.078	0.156	1.30	0.79	(0.68, 2.49)	0.429	0.429
Failure	1.98	4.04	(1.42, 2.77)	<0.0005	<0.0005	1.72	3.04	(1.21, 2.43)	0.002	0.028
Helplessness	2.08	4.77	(1.54, 2.81)	<0.0005	<0.0005	1.80	3.67	(1.32, 2.47)	<0.0005	<0.0005
Natural disasters	1.73	2.33	(1.09, 2.73)	0.020	0.080	1.54	1.76	(0.95, 2.48)	0.079	0.237
Anxiety	2.09	4.83	(1.55, 2.83)	<0.0005	<0.0005	1.81	3.75	(1.33, 2.47)	<0.0005	<0.0005
Evil forces	1.97	3.32	(1.32, 2.93)	0.001	0.009	1.68	2.46	(1.11, 2.55)	0.014	0.098
War	2.89	3.82	(1.68, 4.97)	<0.0005	<0.0005	2.70	3.35	(1.51, 4.83)	0.001	0.017
Domestic abuse	2.98	3.20	(1.53, 5.83)	0.001	0.009	2.36	2.35	(1.15, 4.82)	0.019	0.114

Separation from loved ones	2.90	5.76	(2.02, 4.17)	<0.0005	<0.0005	2.53	4.78	(1.73, 3.71)	<0.0005	<0.0005
Totalitarian regimes	4.28	3.68	(1.97, 9.28)	<0.0005	<0.0005	3.50	3.01	(1.55, 7.93)	0.003	0.039
Being chased	1.78	3.35	(1.27, 2.50)	0.001	0.009	1.61	2.67	(1.14, 2.29)	0.008	0.072
Dangerous animals	1.55	1.55	(0.89, 2.70)	0.121	0.121	1.44	1.25	(0.81, 2.55)	0.213	0.426
Sickness	2.06	3.62	(1.39, 3.04)	<0.0005	<0.0005	1.75	2.63	(1.15, 2.65)	0.009	0.072
Death	2.13	4.05	(1.48, 3.07)	<0.0005	<0.0005	1.90	3.21	(1.28, 2.81)	0.001	0.017
COVID-19	1.90	2.70	(1.19, 3.02)	0.007	0.035	1.68	2.11	(1.04, 2.73)	0.035	0.140
Apocalypse	2.56	3.70	(1.56, 4.22)	<0.0005	<0.0005	2.25	3.00	(1.33, 3.83)	0.003	0.039
MEDIA STRESS										
Confinement	1.39	1.79	(0.97, 1.99)	0.074	0.888	1.37	1.66	(0.94, 2.00)	0.097	>0.999
Claustrophobia	1.63	1.65	(0.91, 2.92)	0.098	0.980	1.66	1.67	(0.91, 3.02)	0.095	>0.999
Suffocation	1.61	1.94	(0.99, 2.60)	0.052	0.676	1.55	1.70	(0.94, 2.55)	0.089	>0.999
Oppression	1.40	1.60	(0.93, 2.12)	0.110	0.880	1.38	1.42	(0.89, 2.13)	0.154	>0.999
Drowning	1.46	1.41	(0.86, 2.48)	0.158	>0.999	1.27	0.85	(0.73, 2.20)	0.393	>0.999
Failure	1.42	2.41	(1.07, 1.89)	0.016	0.304	1.34	1.89	(0.99, 1.81)	0.058	0.986
Helplessness	1.25	1.69	(0.97, 1.61)	0.091	>0.999	1.18	1.21	(0.90, 1.55)	0.225	>0.999
Natural disasters	1.40	1.64	(0.94, 2.08)	0.101	0.909	1.35	1.43	(0.89, 2.05)	0.153	>0.999
Anxiety	1.34	2.26	(1.04, 1.74)	0.024	0.408	1.32	2.00	(1.01, 1.73)	0.045	0.855
Evil forces	1.04	0.22	(0.75, 1.45)	0.827	>0.999	0.91	-0.52	(0.64, 1.29)	0.602	>0.999

War	1.12	0.55	(0.74, 1.69)	0.583	>0.999	0.96	-0.19	(0.62, 1.49)	0.852	>0.999
Domestic abuse	1.92	2.41	(1.13, 3.28)	0.016	0.304	1.76	2.00	(1.01, 3.07)	0.045	0.855
Separation from loved ones	1.48	2.72	(1.12, 1.97)	0.007	0.140	1.40	2.17	(1.03, 1.89)	0.030	0.600
Totalitarian regimes	1.86	2.18	(1.06, 3.25)	0.029	0.435	1.76	1.84	(0.96, 3.22)	0.066	>0.999
Being chased	1.10	0.64	(0.82, 1.47)	0.520	>0.999	1.05	0.29	(0.77, 1.41)	0.771	>0.999
Dangerous animals	1.00	-0.02	(0.62, 1.61)	0.986	0.986	0.94	-0.25	(0.57, 1.54)	0.802	>0.999
Sickness	1.43	2.13	(1.03, 1.98)	0.033	0.462	1.26	1.30	(0.89, 1.78)	0.195	>0.999
Death	1.10	0.64	(0.82, 1.49)	0.524	>0.999	0.98	-0.13	(0.71, 1.35)	0.895	0.895
COVID-19	1.29	1.26	(0.87, 1.90)	0.207	>0.999	1.21	0.94	(0.81, 1.82)	0.349	>0.999
Apocalypse	1.58	2.23	(1.06, 2.36)	0.026	0.416	1.42	1.61	(0.93, 2.17)	0.107	>0.999

TABLE 3. Associations between COVID-Related Sleep Disturbance and Nightmare Content, Unadjusted and Adjusted, with Standard and Holm-Bonferroni Adjusted p Values

	<u>Unadjusted</u>					<u>Adjusted for Age, Sex, and Race/Ethnicity</u>				
	<u>OR</u>	<u>z</u>	<u>95% CI</u>	<u>p</u>	<u>p_adj</u>	<u>OR</u>	<u>z</u>	<u>95% CI</u>	<u>p</u>	<u>p_adj</u>
WORSENE SLEEP										
Confinement	1.97	3.54	(1.35, 2.86)	<0.0005	<0.0005	1.80	2.95	(1.22, 2.67)	0.003	0.033
Claustrophobia	1.66	1.73	(0.93, 2.96)	0.084	0.168	1.63	1.59	(0.89, 2.96)	0.111	0.444
Suffocation	1.50	1.68	(0.94, 2.41)	0.092	0.092	1.29	0.99	(0.78, 2.12)	0.321	0.642
Oppression	3.16	4.82	(1.98, 5.03)	<0.0005	<0.0005	2.99	4.34	(1.82, 4.90)	<0.0005	<0.0005
Drowning	1.67	1.89	(0.98, 2.85)	0.059	0.236	1.28	0.81	(0.71, 2.29)	0.417	0.417
Failure	2.35	5.38	(1.72, 3.20)	<0.0005	<0.0005	2.12	4.58	(1.54, 2.93)	<0.0005	<0.0005
Helplessness	1.89	4.56	(1.44, 2.48)	<0.0005	<0.0005	1.67	3.53	(1.26, 2.22)	<0.0005	<0.0005
Natural disasters	2.06	3.40	(1.36, 3.13)	0.001	0.008	1.86	2.82	(1.21, 2.86)	0.005	0.045
Anxiety	2.20	5.51	(1.66, 2.92)	<0.0005	<0.0005	1.97	4.57	(1.47, 2.64)	<0.0005	<0.0005
Evil forces	1.74	3.14	(1.23, 2.47)	0.002	0.012	1.56	2.39	(1.08, 2.25)	0.017	0.102
War	2.30	3.68	(1.48, 3.59)	<0.0005	<0.0005	2.08	3.05	(1.30, 3.32)	0.002	0.024
Domestic abuse	2.60	3.41	(1.50, 4.49)	0.001	0.008	2.22	2.60	(1.22, 4.04)	0.009	0.063
Separation from loved ones	2.25	5.19	(1.66, 3.05)	<0.0005	<0.0005	2.01	4.29	(1.46, 2.76)	<0.0005	<0.0005

Totalitarian regimes	3.60	4.07	(1.94, 6.67)	<0.0005	<0.0005	3.39	3.51	(1.71, 6.70)	<0.0005	<0.0005
Being chased	1.44	2.40	(1.07, 1.94)	0.016	0.080	1.30	1.64	(0.95, 1.76)	0.101	0.505
Dangerous animals	1.58	1.80	(0.96, 2.59)	0.072	0.216	1.50	1.50	(0.88, 2.54)	0.134	0.402
Sickness	1.99	3.94	(1.41, 2.81)	<0.0005	<0.0005	1.74	2.97	(1.21, 2.52)	0.003	0.033
Death	2.27	4.89	(1.64, 3.16)	<0.0005	<0.0005	2.03	4.04	(1.44, 2.87)	<0.0005	<0.0005
COVID-19	2.36	3.98	(1.55, 3.60)	<0.0005	<0.0005	2.15	3.46	(1.39, 3.32)	0.001	0.013
Apocalypse	2.15	3.61	(1.42, 3.26)	<0.0005	<0.0005	1.86	2.77	(1.20, 2.88)	0.006	0.048
ONSET INSOMNIA										
Confinement	2.19	4.41	(1.55, 3.10)	<0.0005	<0.0005	2.03	3.85	(1.42, 2.92)	<0.0005	<0.0005
Claustrophobia	2.67	3.49	(1.54, 4.64)	<0.0005	<0.0005	2.76	3.44	(1.55, 4.93)	0.001	0.011
Suffocation	1.97	3.01	(1.27, 3.06)	0.003	0.015	1.75	2.40	(1.11, 2.76)	0.016	0.080
Oppression	2.66	4.69	(1.77, 4.01)	<0.0005	<0.0005	2.39	4.02	(1.56, 3.65)	<0.0005	<0.0005
Drowning	1.82	2.40	(1.12, 2.96)	0.016	0.048	1.44	1.42	(0.87, 2.40)	0.155	0.310
Failure	1.89	4.54	(1.44, 2.49)	<0.0005	<0.0005	1.70	3.66	(1.28, 2.26)	<0.0005	<0.0005
Helplessness	1.61	3.78	(1.26, 2.07)	<0.0005	<0.0005	1.44	2.75	(1.11, 1.87)	0.006	0.048
Natural disasters	1.98	3.56	(1.36, 2.89)	<0.0005	<0.0005	1.79	2.96	(1.22, 2.63)	0.003	0.027
Anxiety	2.00	5.27	(1.55, 2.60)	<0.0005	<0.0005	1.83	4.40	(1.40, 2.39)	<0.0005	<0.0005
Evil forces	1.52	2.61	(1.11, 2.08)	0.009	0.036	1.36	1.87	(0.98, 1.89)	0.062	0.248

War	2.33	4.11	(1.56, 3.49)	<0.0005	<0.0005	2.17	3.55	(1.41, 3.32)	<0.0005	<0.0005
Domestic abuse	3.27	4.51	(1.95, 5.49)	<0.0005	<0.0005	2.90	3.81	(1.68, 5.01)	<0.0005	<0.0005
Separation from loved ones	1.86	4.47	(1.42, 2.45)	<0.0005	<0.0005	1.66	3.48	(1.25, 2.20)	<0.0005	<0.0005
Totalitarian regimes	3.09	4.13	(1.81, 5.28)	<0.0005	<0.0005	2.80	3.50	(1.57, 4.97)	<0.0005	<0.0005
Being chased	1.37	2.25	(1.04, 1.80)	0.024	0.048	1.23	1.44	(0.93, 1.63)	0.149	0.447
Dangerous animals	1.46	1.64	(0.93, 2.29)	0.100	0.100	1.38	1.32	(0.86, 2.21)	0.188	0.188
Sickness	1.78	3.64	(1.30, 2.42)	<0.0005	<0.0005	1.53	2.56	(1.10, 2.11)	0.011	0.066
Death	1.84	4.10	(1.38, 2.47)	<0.0005	<0.0005	1.62	3.14	(1.20, 2.19)	0.002	0.020
COVID-19	1.86	3.29	(1.28, 2.70)	0.001	0.006	1.66	2.64	(1.14, 2.42)	0.008	0.056
Apocalypse	2.61	4.81	(1.77, 3.86)	<0.0005	<0.0005	2.23	3.91	(1.49, 3.34)	<0.0005	<0.0005
MIDDLE INSOMNIA										
Confinement	1.75	3.15	(1.24, 2.48)	0.002	0.022	1.60	2.57	(1.12, 2.29)	0.010	0.110
Claustrophobia	1.43	1.30	(0.83, 2.44)	0.195	0.195	1.37	1.09	(0.78, 2.40)	0.276	0.552
Suffocation	1.56	1.94	(1.00, 2.44)	0.053	0.159	1.36	1.33	(0.86, 2.16)	0.182	0.546
Oppression	2.03	3.40	(1.35, 3.05)	0.001	0.013	1.97	3.08	(1.28, 3.04)	0.002	0.026
Drowning	1.48	1.55	(0.90, 2.44)	0.121	0.242	1.17	0.59	(0.69, 1.96)	0.558	0.558
Failure	2.12	5.10	(1.59, 2.83)	<0.0005	<0.0005	2.00	4.53	(1.48, 2.71)	<0.0005	<0.0005
Helplessness	1.73	4.23	(1.34, 3.34)	<0.0005	<0.0005	1.60	3.44	(1.22, 2.08)	0.001	0.016

Natural disasters	1.67	2.63	(1.14, 2.45)	0.008	0.056	1.52	2.10	(1.03, 2.24)	0.036	0.288
Anxiety	2.45	6.38	(1.86, 3.22)	<0.0005	<0.0005	2.27	5.68	(1.71, 3.01)	<0.0005	<0.0005
Evil forces	1.53	2.59	(1.11, 2.11)	0.010	0.060	1.38	1.85	(0.98, 1.93)	0.064	0.384
War	2.32	3.92	(1.52, 3.54)	<0.0005	<0.0005	2.10	3.29	(1.35, 3.26)	0.001	0.016
Domestic abuse	2.06	2.83	(1.25, 3.39)	0.005	0.045	1.74	2.07	(1.03, 2.94)	0.039	0.273
Separation from loved ones	2.01	4.83	(1.51, 2.67)	<0.0005	<0.0005	1.86	4.10	(1.38, 2.50)	<0.0005	<0.0005
Totalitarian regimes	2.07	2.71	(1.22, 3.51)	0.007	0.056	1.87	2.16	(1.06, 3.29)	0.031	0.279
Being chased	1.41	2.41	(1.07, 1.87)	0.016	0.080	1.31	1.84	(0.98, 1.75)	0.065	0.325
Dangerous animals	1.62	2.01	(1.01, 2.58)	0.045	0.180	1.53	1.69	(0.93, 2.49)	0.091	0.364
Sickness	2.00	4.17	(1.44, 2.76)	<0.0005	<0.0005	1.80	3.36	(1.28, 2.53)	0.001	0.016
Death	2.13	4.81	(1.56, 2.90)	<0.0005	<0.0005	2.00	4.20	(1.45, 2.76)	<0.0005	<0.0005
COVID-19	1.81	3.03	(1.23, 2.65)	0.003	0.030	1.68	2.61	(1.14, 2.49)	0.009	0.108
Apocalypse	1.88	3.21	(1.28, 2.76)	0.001	0.013	1.65	2.45	(1.11, 2.46)	0.014	0.140

TABLE 4. Associations between Depression, Anxiety, and Nightmare Content, Unadjusted and Adjusted, with Standard and Holm-Bonferroni Adjusted p Values

	Unadjusted				Adjusted for Age, Sex, and Race/Ethnicity			
	OR	95% CI	p	p_adj	OR	95% CI	p	p_adj
PHQ9 DEPRESSION								
Confinement	1.11	(1.07, 1.15)	<0.0005	<0.0005	1.10	(1.06, 1.15)	<0.0005	<0.0005
Claustrophobia	1.11	(1.05, 1.18)	<0.0005	<0.0005	1.12	(1.06, 1.20)	<0.0005	<0.0005
Suffocation	1.14	(1.09, 1.20)	<0.0005	<0.0005	1.13	(1.07, 1.19)	<0.0005	<0.0005
Oppression	1.14	(1.09, 1.19)	<0.0005	<0.0005	1.13	(1.07, 1.19)	<0.0005	<0.0005
Drowning	1.13	(1.07, 1.19)	<0.0005	<0.0005	1.10	(1.04, 1.17)	0.001	0.008
Failure	1.14	(1.09, 1.18)	<0.0005	<0.0005	1.12	(1.08, 1.16)	<0.0005	<0.0005
Helplessness	1.13	(1.09, 1.17)	<0.0005	<0.0005	1.11	(1.07, 1.15)	<0.0005	<0.0005
Natural disasters	1.06	(1.01, 1.11)	0.009	0.009	1.04	(0.99, 1.09)	0.141	0.141
Anxiety	1.11	(1.07, 1.15)	<0.0005	<0.0005	1.09	(1.05, 1.13)	<0.0005	<0.0005
Evil forces	1.09	(1.05, 1.13)	<0.0005	<0.0005	1.07	(1.02, 1.11)	0.002	0.012
War	1.09	(1.05, 1.14)	<0.0005	<0.0005	1.07	(1.02, 1.12)	0.009	0.036
Domestic abuse	1.14	(1.09, 1.21)	<0.0005	<0.0005	1.13	(1.06, 1.19)	<0.0005	<0.0005
Separation from loved ones	1.13	(1.09, 1.17)	<0.0005	<0.0005	1.11	(1.07, 1.15)	<0.0005	<0.0005
Totalitarian regimes	1.14	(1.08, 1.20)	<0.0005	<0.0005	1.13	(1.06, 1.20)	<0.0005	<0.0005
Being chased	1.09	(1.05, 1.12)	<0.0005	<0.0005	1.07	(1.03, 1.11)	<0.0005	<0.0005

Dangerous animals	1.09	(1.04, 1.15)	<0.0005	<0.0005	1.10	(1.04, 1.17)	0.001	0.008
Sickness	1.09	(1.05, 1.14)	<0.0005	<0.0005	1.07	(1.03, 1.11)	0.002	0.012
Death	1.13	(1.09, 1.17)	<0.0005	<0.0005	1.10	(1.06, 1.14)	<0.0005	<0.0005
COVID-19	1.08	(1.03, 1.12)	0.001	0.002	1.06	(1.01, 1.11)	0.019	0.057
Apocalypse	1.09	(1.04, 1.13)	<0.0005	<0.0005	1.05	(1.00, 1.10)	0.031	0.062
GAD7 ANXIETY								
Confinement	1.14	(1.09, 1.20)	<0.0005	<0.0005	1.14	(1.08, 1.20)	<0.0005	<0.0005
Claustrophobia	1.11	(1.04, 1.20)	0.004	0.008	1.12	(1.04, 1.22)	0.003	0.018
Suffocation	1.18	(1.11, 1.26)	<0.0005	<0.0005	1.18	(1.10, 1.26)	<0.0005	<0.0005
Oppression	1.15	(1.09, 1.22)	<0.0005	<0.0005	1.15	(1.08, 1.22)	<0.0005	<0.0005
Drowning	1.12	(1.05, 1.20)	0.001	0.005	1.09	(1.01, 1.18)	0.026	0.078
Failure	1.16	(1.11, 1.21)	<0.0005	<0.0005	1.13	(1.08, 1.19)	<0.0005	<0.0005
Helplessness	1.18	(1.13, 1.24)	<0.0005	<0.0005	1.16	(1.10, 1.21)	<0.0005	<0.0005
Natural disasters	1.08	(1.02, 1.14)	0.004	0.008	1.06	(1.00, 1.12)	0.051	0.051
Anxiety	1.17	(1.12, 1.22)	<0.0005	<0.0005	1.16	(1.10, 1.21)	<0.0005	<0.0005
Evil forces	1.11	(1.05, 1.16)	<0.0005	<0.0005	1.09	(1.03, 1.14)	0.001	0.011
War	1.13	(1.06, 1.19)	<0.0005	<0.0005	1.10	(1.04, 1.18)	0.002	0.014
Domestic abuse	1.22	(1.14, 1.31)	<0.0005	<0.0005	1.21	(1.11, 1.31)	<0.0005	<0.0005
Separation from loved ones	1.15	(1.10, 1.20)	<0.0005	<0.0005	1.12	(1.07, 1.18)	<0.0005	<0.0005
Totalitarian regimes	1.14	(1.06, 1.22)	<0.0005	<0.0005	1.12	(1.04, 1.22)	0.005	0.025

Being chased	1.11	(1.06, 1.15)	<0.0005	<0.0005	1.09	(1.04, 1.14)	<0.0005	<0.0005
Dangerous animals	1.12	(1.05, 1.19)	0.001	0.005	1.13	(1.05, 1.21)	0.001	0.011
Sickness	1.12	(1.07, 1.17)	<0.0005	<0.0005	1.09	(1.04, 1.15)	0.001	0.011
Death	1.11	(1.06, 1.16)	<0.0005	<0.0005	1.07	(1.02, 1.12)	0.006	0.024
COVID-19	1.09	(1.03, 1.15)	0.003	0.009	1.06	(1.00, 1.13)	0.036	0.072
Apocalypse	1.13	(1.07, 1.19)	<0.0005	<0.0005	1.10	(1.04, 1.17)	0.001	0.011

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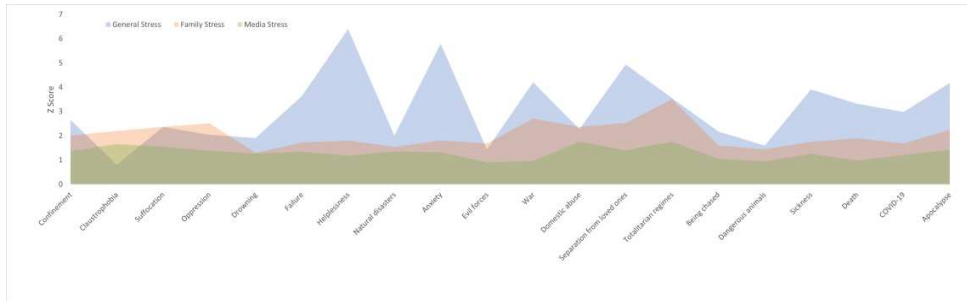


FIGURE 1. Associations between general, family, and media-related stress and nightmare content
373x114mm (330 x 330 DPI)

