

RESEARCH ARTICLE

Nightmare content during the COVID-19 pandemic: Influence of COVID-related stress and sleep disruption in the United States

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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 about 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 an 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 an 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 an 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

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

1 | 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 well-being 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 post-traumatic (following a traumatic event) and typically takes place during rapid eye movement (REM) sleep (Fisher et al., 1970; Spoomaker 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 (Spoomaker et al., 2006). This prevalence in females is thought to decline with age (Spoomaker et al., 2006). Nightmares are significantly associated with psychiatric disorders and anxiety, with persistence of nightmares linked to irregular sleep schedules, avoidance of addressing them, and fear of going to sleep (Hublin et al., 1999; Spoomaker et al., 2006). This can result in sleep deprivation, which increases anxiety levels and thus perpetuates 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 a key function of dreams is to play out threatening scenarios while asleep and thus help prepare for and avoid or confront a threat in waking life (Revonsuo, 2000).

A general increase in dream and nightmare frequency during the COVID-19 pandemic has been reported around the world. Scarpelli and colleagues (2021) and Gorgoni and colleagues (2021) both noted an increase in dreams with strong emotional content in Italy. In a sample of Canadian university students, an increase in nightmares was reported, with females disproportionately affected (Kilius et al., 2021). Another Canadian study noted an increase in dream imagery related to pandemic themes among participants (MacKay & DeCicco, 2020).

In the survey during the first lockdown in France, an increase in nightmare frequency was also observed (Ruby, 2021). Themes related to the health crisis were the most frequently reported. This was also seen in a Brazilian study that analyzed dream themes and found a higher proportion of themes around contamination and cleanliness (Mota et al., 2020), and in a Finnish study where participants reported more night-time awakenings and nightmares as compared to pre-pandemic times, with over 50% of these nightmares about pandemic-specific themes, including sickness, physical distancing and family concerns (Pesonen et al., 2020). Among adolescents living in Italy, Croatia and Romania, an increase in nightmares and dreams with pandemic-related themes were also reported (Guerrero-Gomez et al., 2021).

General sleep disturbances during the pandemic have been particularly prevalent among healthcare workers (Wang et al., 2020),

whereas other studies have found females in general to be at higher risk (Dal Santo et al., 2021; Kilius et al., 2021; Pinto et al., 2020; Scarpelli et al., 2021). A large study using Fitbit data from approximately 160,000 users across six major US cities found that compared to 2019, sleep duration had increased during the 2020 pandemic (Rezaei & Grandner, 2021). Bedtime also shifted to later and variability in sleep duration decreased. Increased sleep time was also observed in France during the first lockdown, as seen in a survey that covered all regions of the country ($N = 3337$) (Ruby, 2021).

In another study comparing pandemic-related sleep to pre-pandemic norms, a team from the Netherlands recruited a population consisting of both good and bad sleepers (for which previous data existed) and assessed subjective sleep quality changes during the pandemic. Kocavska and colleagues (2020) found no uniform effect on sleep, with some individuals experiencing improvements as compared to pre-pandemic times, whereas others noted worse sleep that was often associated with pandemic anxiety. This was also seen in Italy, France and Spain, where worse sleep quality was more frequently reported than improved sleep quality (Alfonsi et al., 2021; Dal Santo et al., 2021; Ruby, 2021).

More time than usual spent indoors could be responsible for some of the sleep disturbances that have been seen. Morin and colleagues (2020) postulated that not only could stress be responsible, but also disturbed circadian rhythms as a result of confinement. The usual light and social cues used for circadian entrainment are no longer present when individuals are restricted to extended periods of social distancing, at home, indoors. With this lifestyle change has also come increased reliance on the use of screens for work and social connections (Majumdar et al., 2020). Blue-light-emitting devices are known to suppress melatonin production and thus disturb sleep (Cajochen et al., 2011). These factors may have contributed to the increase in sleep medication use seen during confinement by Alfonsi and colleagues (2021).

Given the known implications of stress and sleep loss on health and well-being, and the need for further understanding of the pathology of nightmares, the aim of the present study was to determine whether COVID-related general, family or media stress, subjective perception of worsened sleep, increased onset insomnia or middle-of-the-night insomnia were associated with specific nightmare themes in a United States sample after seeing similar effects in other parts of the world. We hypothesized that pandemic-related worsening of sleep quality and pandemic-related increased stress would be associated with increased frequency of nightmares that would similarly reflect pandemic-related themes.

2 | METHODS

2.1 | 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

TABLE 1 Characteristics of the sample

Variable	Category/units	Value
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%

(Continues)

TABLE 1 (Continued)

Variable	Category/units	Value
Sleep onset insomnia	Strongly disagree	10.95%
	Disagree	45.48%
	Agree	33.33%
	Strongly agree	10.24%
Middle-of-the-night insomnia	Strongly disagree	5.95%
	Disagree	38.81%
	Agree	40.00%
	Strongly agree	15.24%

Abbreviation: SD, standard deviation.

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 in order to proceed. Analyses were conducted on all completed surveys ($N = 419$).

2.2 | 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 from loved ones," "totalitarian regime," "being chased," "dangerous animals," "sickness," "death," "covid-19 virus" and "end of the world."

Participants completed the Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001), which screened for depression, and the Generalized Anxiety Disorder 7-item instrument (GAD-7) (Spitzer et al., 2006). Participants also completed the Mannheim Dreams questionnaire (MADRE) (Shredl et al., 2014), which asked about dream and nightmare experiences, including frequency of nightmares.

TABLE 2 Associations between COVID-related stress and nightmare content, unadjusted and adjusted, with standard and Holm-Bonferroni-adjusted *p* values

	Unadjusted				Adjusted for age, sex and race/ethnicity				
	OR	<i>z</i>	95% CI	<i>p</i>	OR	<i>z</i>	95% CI	<i>p</i>	<i>p</i> _{adj}
General stress									
Confinement	1.78	2.65	(1.16, 2.72)	0.008	1.66	2.21	(1.06, 2.59)	0.027	0.270
Claustrophobia	1.30	0.80	(0.69, 2.43)	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	1.82	1.92	(0.99, 3.34)	0.055	0.495
Oppression	1.66	2.04	(1.02, 2.69)	0.041	1.55	1.68	(0.93, 2.60)	0.093	0.744
Drowning	1.86	1.91	(0.98, 3.52)	0.056	1.45	1.07	(0.74, 2.84)	0.284	0.852
Failure	1.85	3.63	(1.33, 2.58)	<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	2.89	5.93	(2.04, 4.11)	<0.0005	<0.0005
Natural disasters	1.61	2.01	(1.01, 2.55)	0.044	1.46	1.55	(0.90, 2.37)	0.121	0.726
Anxiety	2.57	5.79	(1.87, 3.54)	<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	1.11	0.51	(0.75, 1.63)	0.612	0.612
War	3.63	4.21	(1.99, 6.61)	<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	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	2.23	4.22	(1.54, 3.24)	<0.0005	<0.0005
Totalitarian regimes	4.55	3.55	(1.97, 10.50)	<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	1.31	1.55	(0.93, 1.84)	0.121	0.726
Dangerous animals	1.59	1.59	(0.90, 2.82)	0.113	1.44	1.21	(0.80, 2.59)	0.227	0.908
Sickness	2.26	3.91	(1.50, 3.40)	<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	1.66	2.58	(1.13, 2.43)	0.010	0.120
COVID-19	2.10	2.98	(1.29, 3.43)	0.003	1.96	2.59	(1.18, 3.26)	0.010	0.120
Apocalypse	3.18	4.17	(1.85, 5.48)	<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	2.01	2.99	(1.27, 3.16)	0.003	0.039
Claustrophobia	2.29	2.31	(1.13, 4.64)	0.021	2.20	2.12	(1.06, 4.55)	0.034	0.170
Suffocation	2.58	3.10	(1.42, 4.68)	0.002	2.36	2.70	(1.26, 4.41)	0.007	0.070
Oppression	2.79	3.76	(1.63, 4.75)	<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	1.30	0.79	(0.68, 2.49)	0.429	0.429
Failure	1.98	4.04	(1.42, 2.77)	<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	1.80	3.67	(1.32, 2.47)	<0.0005	<0.0005
Natural disasters	1.73	2.33	(1.09, 2.73)	0.020	1.54	1.76	(0.95, 2.48)	0.079	0.237

(Continues)

TABLE 2 (Continued)

	Unadjusted				Adjusted for age, sex and race/ethnicity					
	OR	z	95% CI	p	p_adj	OR	z	95% CI	p	p_adj
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

(Continues)

TABLE 2 (Continued)

	Unadjusted				Adjusted for age, sex and race/ethnicity				
	OR	z	95% CI	p	OR	z	95% CI	p	p_adj
Sickness	1.43	2.13	(1.03, 1.98)	0.033	1.26	1.30	(0.89, 1.78)	0.195	>0.999
Death	1.10	0.64	(0.82, 1.49)	0.524	0.98	-0.13	(0.71, 1.35)	0.895	0.895
COVID-19	1.29	1.26	(0.87, 1.90)	0.207	1.21	0.94	(0.81, 1.82)	0.349	>0.999
Apocalypse	1.58	2.23	(1.06, 2.36)	0.026	1.42	1.61	(0.93, 2.17)	0.107	>0.999

Abbreviation: CI, confidence interval; OR, odds ratio.

Additional variables included age, sex and self-reported race/ethnicity (non-Hispanic white, Hispanic/Latino, black/African-American, Indian/Subcontinent, Asian or multiracial/other).

2.3 | Statistical analyses

Logistic regression analyses examined the likelihood of each nightmare as a binary variable, predicted by each of the stress and sleep variables, treated as pseudo-linear independent variables. All logistic regression analyses were adjusted for age, sex and race/ethnicity. Results are displayed as adjusted odds ratios (ORs) and 95% confidence intervals (CIs), along with z score of the OR and p-value. Because there were 20 different outcomes, all p-values were subject to Holm-Bonferonni adjustment (Holm, 1979). Adjusted p-values were computed by weighting the observed p-value by the Holm-Bonferonni cut-offs, relative to 0.05. All analyses were performed in STATA 14.2 (STATA CORP, College Station, TX), except for Holm-Bonferonni adjustments, which were computed in Microsoft Excel 365.

3 | RESULTS

3.1 | Characteristics of the sample

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

3.2 | Associations between COVID-related stress and nightmare content

Results of logistic regression analyses investigating relationships between COVID-related stress and nightmare content are reported in Table 2. In unadjusted analyses, following p-value adjustment for multiple comparisons, a greater increase in general stress was associated with an increased likelihood of nightmares about failure, helplessness, anxiety, war, separation from loved ones, totalitarian regimes, sickness, death, COVID-19 and an apocalypse. After adjustment for demographic covariates, the

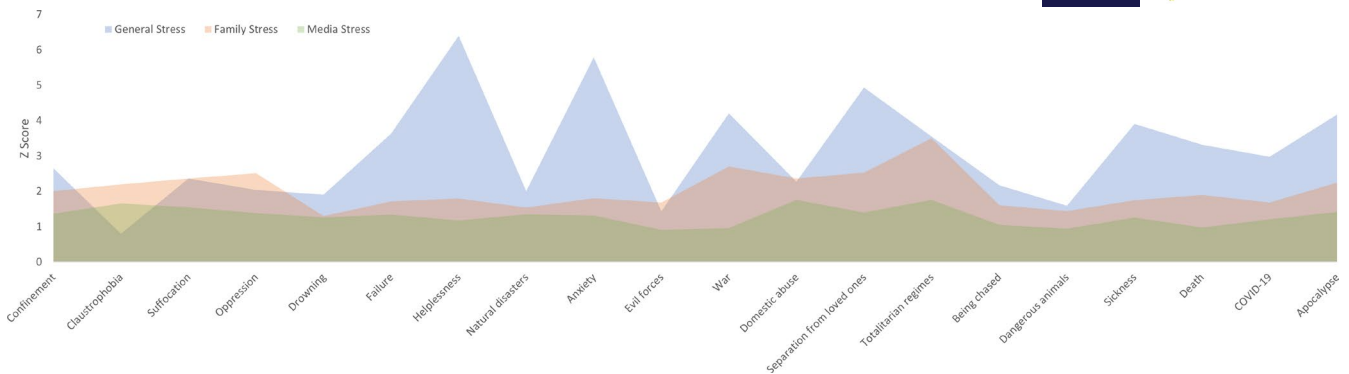


FIGURE 1 Associations between general, family and media-related stress and nightmare content [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

relationships with failure, death and COVID-19 were no longer statistically significant in Holm-Bonferroni-adjusted analyses. Z-score plots for each stress and nightmare theme are presented in Figure 1.

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

Media stress was not associated with an increased likelihood of any specific nightmare content.

3.3 | 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 an 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-of-the-night 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 an apocalypse. After adjustment for demographic covariates, the relationships with confinement, COVID-19 and an apocalypse were no longer statistically significant in Holm-Bonferroni-adjusted analyses.

3.4 | 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 all nightmare themes. This persisted following adjustment for demographic covariates, with the exception of what are presumed to be two spurious results (natural disasters and COVID-19).

3.5 | Association between nightmare frequency and content

Nightmare frequency was assessed using the Mannheim Dream questionnaire (MADRE), with the question: "How often have you experienced nightmares recently (in the past several months)?" The answer options included: several times a week, about once a week, two to three times a month, once a month, two to four times a year, once a year, less than once a year, and never. Data were grouped into: more than once a week, more than one a month, more than one a year, and less than one a year, and assessed as an additional covariate in the models. In almost all cases, the relationship between stressor and nightmare content, or sleep complaint and nightmare content was maintained, indicating there was no influence of nightmare frequency on specific nightmare themes (unreported data).

TABLE 3 Associations between COVID-related sleep disturbance and nightmare content, unadjusted and adjusted, with standard and Holm-Bonferroni-adjusted *p* values

	Unadjusted				Adjusted for age, sex and race/ethnicity				
	OR	<i>z</i>	95% CI	<i>p</i>	OR	<i>z</i>	95% CI	<i>p</i>	<i>p</i> _{adj}
Worsened sleep									
Confinement	1.97	3.54	(1.35, 2.86)	<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	1.63	1.59	(0.89, 2.96)	0.111	0.444
Suffocation	1.50	1.68	(0.94, 2.41)	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	2.99	4.34	(1.82, 4.90)	<0.0005	<0.0005
Drowning	1.67	1.89	(0.98, 2.85)	0.059	1.28	0.81	(0.71, 2.29)	0.417	0.417
Failure	2.35	5.38	(1.72, 3.20)	<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	1.67	3.53	(1.26, 2.22)	<0.0005	<0.0005
Natural disasters	2.06	3.40	(1.36, 3.13)	0.001	1.86	2.82	(1.21, 2.86)	0.005	0.045
Anxiety	2.20	5.51	(1.66, 2.92)	<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	1.56	2.39	(1.08, 2.25)	0.017	0.102
War	2.30	3.68	(1.48, 3.59)	<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	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	2.01	4.29	(1.46, 2.76)	<0.0005	<0.0005
Totalitarian regimes	3.60	4.07	(1.94, 6.67)	<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	1.30	1.64	(0.95, 1.76)	0.101	0.505
Dangerous animals	1.58	1.80	(0.96, 2.59)	0.072	1.50	1.50	(0.88, 2.54)	0.134	0.402
Sickness	1.99	3.94	(1.41, 2.81)	<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	2.03	4.04	(1.44, 2.87)	<0.0005	<0.0005
COVID-19	2.36	3.98	(1.55, 3.60)	<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	1.86	2.77	(1.20, 2.88)	0.006	0.048
Sleep onset insomnia									
Confinement	2.19	4.41	(1.55, 3.10)	<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	2.76	3.44	(1.55, 4.93)	0.001	0.011
Suffocation	1.97	3.01	(1.27, 3.06)	0.003	1.75	2.40	(1.11, 2.76)	0.016	0.080
Oppression	2.66	4.69	(1.77, 4.01)	<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	1.44	1.42	(0.87, 2.40)	0.155	0.310
Failure	1.89	4.54	(1.44, 2.49)	<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	1.44	2.75	(1.11, 1.87)	0.006	0.048
Natural disasters	1.98	3.56	(1.36, 2.89)	<0.0005	1.79	2.96	(1.22, 2.63)	0.003	0.027

(Continues)

TABLE 3 (Continued)

	Unadjusted					Adjusted for age, sex and race/ethnicity				
	OR	z	95% CI	p	p_adj	OR	z	95% CI	p	p_adj
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-of-the-night 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

(Continues)

TABLE 3 (Continued)

	Unadjusted					Adjusted for age, sex and race/ethnicity				
	OR	z	95% CI	p	p _{adj}	OR	z	95% CI	p	p _{adj}
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

Abbreviation: CI, confidence interval; OR, odds ratio.

4 | DISCUSSION

This study shows that individuals who reported greater general COVID-related stress were more likely to have nightmares about confinement, helplessness, anxiety, war, separation, totalitarianism, sickness, death and apocalypse scenarios. 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 scenarios. Those who reported worsened middle-of-the-night insomnia were also more likely to have nightmares about confinement, oppression, failure, helplessness, disaster, anxiety, war, domestic abuse, separation, totalitarianism, sickness, death, COVID and apocalypse scenarios. The strongest associations included greater general COVID-related stress or worsened sleep and totalitarianism-themed nightmares, greater general COVID-related stress and war-themed nightmares, and greater general COVID-related stress and helplessness nightmares. Depression and anxiety scores were positively associated with all nightmare themes.

These findings suggest that increased stress or dysregulated emotions may result in more frequent nightmares and that the pandemic may have given rise to specific associated nightmare themes. Although this was also seen in locations outside the United States (Gorgoni et al., 2021; Mota et al., 2020; Ruby, 2021; Scarpelli et al., 2021), unique sociopolitical stressors specific to the United States occurring in parallel may have also influenced the themes of totalitarianism, war and helplessness.

Data from Germain and Nielsen (2003) indicating that post-traumatic nightmares were more closely associated with insomnia than idiopathic nightmares suggest that the findings seen in the present study are indicative of traumatic responses to pandemic-related events. Uncertainty about the future could have led to nightmares about helplessness, totalitarianism or war. Experiencing concerns regarding personal or familial sickness are also possible sources of anxiety that can manifest in negatively toned dreams. Interestingly, media stress was generally not associated with an increased likelihood of any specific nightmare themes. Rather, general and family stress seemed to evoke the strongest responses. This suggests that nightmares could be less influenced by societal issues portrayed in the media and more closely influenced by personal issues that pose imminent threats to an individual's health and well-being.

Negatively toned dreams are associated with higher stress levels (De Koninck & Brunette, 1991), and nightmares are accompanied by increased autonomic activity and sympathetic tone (Paul et al., 2019; Perogamvros et al., 2019). Although it's unclear which specific mechanisms are involved in the brain that experiences frequent nightmares, as outlined by Nielsen and Levin (2007), norepinephrine may be involved. The success of the drug Prazosin in reducing post-traumatic stress disorder (PTSD)-related nightmare frequency could be a result of decreased norepinephrine, although this remains to be determined (Spoormaker et al., 2006).

The hormone cortisol may also play a role in nightmares. One study found that frequent nightmares were associated with a

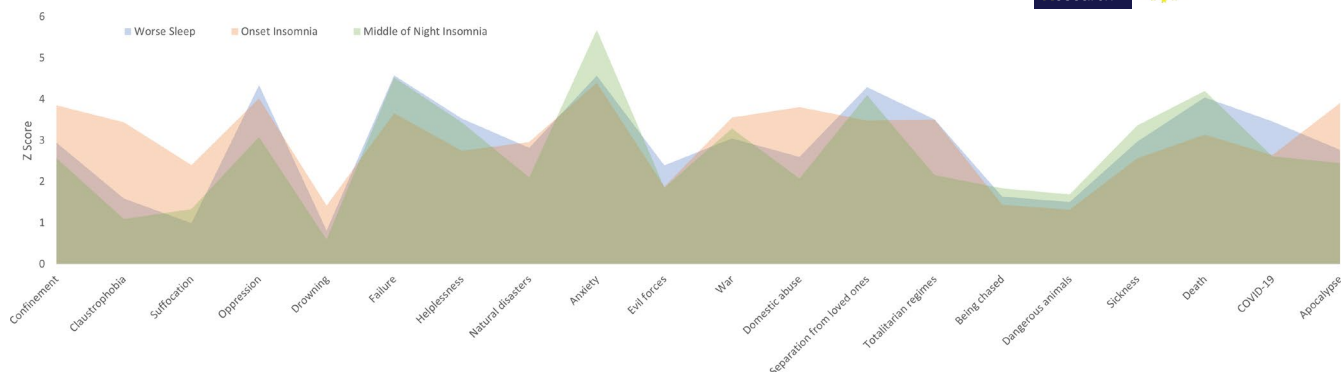


FIGURE 2 Associations between worse sleep, onset insomnia and middle-of-the-night insomnia and nightmare content [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.com)]

blunted cortisol awakening response in women, who comprised 74% of our sample (Nagy et al., 2015). Cortisol is known to act on the hypothalamic-pituitary-adrenal (HPA) axis, suggesting that the HPA may be involved in nightmare generation. The association between disrupted cortisol levels and sleep disturbances, including insomnia, has also been well documented (Drake et al., 2017; Grimaldi et al., 2020). If individuals have insufficient or poor-quality sleep, emotion processing in the brain can become impaired (Walker & van der Helm, 2009). This may then perpetuate the risk of an increased frequency of nightmares.

Although the COVID-19 pandemic experience has been unique for each individual in the United States, the sleep disturbances and nightmare themes reported in this study are similar to what has been observed in other countries. This provides further insight into the causes of negatively toned dreams during a global health crisis, as well as perhaps some of the most common fear responses, despite sociopolitical differences in various parts of the world. Further investigation is required to elucidate the mechanisms underpinning the relationship between stress, sleep disturbances and nightmares, and might look more closely at dimensions of emotion regulation and personality, as well as social support available to individuals experiencing stress and nightmares, along with other lifestyle factors.

4.1 | Limitations

Although this survey was open to all adults over the age of 18, the specific location of participants was unknown. However, although any location-specific variability in COVID-19 related circumstances could not be accounted for, this sample represents a general or collective effect of the pandemic on nightmares within the US. Similarly, the extent to which participants were affected by other potentially stressful sociopolitical circumstances that may have had an impact on nightmares that occurred during the study period remains unknown. Although survey questions included those about dreams and nightmares prior to the COVID-19 pandemic, previous data for these individuals does not exist, thus preventing accurate comparisons being made in the realms of sleep quality, nightmare content and frequency before and after the pandemic. Also, the difference between

a bad dream and a nightmare was not specified in the survey; therefore, it's unclear whether individuals were awoken by these reported nightmares, thus leading to sleep difficulties, or whether they remembered the dream content once they were awake and were thus unable to return to sleep. Regardless, there was a general increase in sleep difficulties that accompanied these negatively toned dreams. Measures of sleep were also limited to very few questions, thus limiting the extent to which disturbances and poor sleep could be determined. Lastly, this survey was advertised largely online and those without internet access or those without social media accounts will have been less likely to have participated. Although online survey distribution is now commonplace, it's important that future studies take this portion of the population into account, so as not to exclude any individuals.

5 | CONCLUSIONS

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

CONFLICT OF INTEREST

There are no conflicts of interest to disclose.

AUTHOR CONTRIBUTIONS

The study was conducted by Kathryn E.R. Kennedy, Chloe C.A. Wills and Michael A. Grandner. The manuscript was written by Kathryn E.R. Kennedy and Michael A. Grandner, with edits from Celyne H. Bastien, and a review by William D.S. Killgore. Perrine M. Ruby participated to the design of the study by sharing the questions of the survey launched on April 6th 2020 in France, reviewed and amended the manuscript.

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	<i>p</i>	<i>p</i> _{adj}	OR	95% CI	<i>p</i>	<i>p</i> _{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

Abbreviation: CI, confidence interval; OR, odds ratio.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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How to cite this article: Kennedy, K. E. R., Bastien, C. H., Ruby, P. M., Killgore, W. D. S., Wills, C. C. A., & Grandner, M. A. (2022). Nightmare content during the COVID-19 pandemic: Influence of COVID-related stress and sleep disruption in the United States. *Journal of Sleep Research*, 31, e13439. <https://doi.org/10.1111/jsr.13439>