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Pandemic nightmares: Effects on dream activity of the COVID-19 lockdown in Italy

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## 1           Pandemic nightmares: Effects on dream activity of the COVID-19 lockdown in Italy

2

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29

## 30 Abstract

31 COVID-19 has critically impacted the world. Recent works have found  
32 substantial changes in sleep and mental health during the COVID-19  
33 pandemic. Dreams could give us crucial information about people's well-  
34 being, so here we have directly investigated the consequences of  
35 lockdown on the oneiric activity in a large Italian sample: 5,988  
36 adults completed a web-survey during lockdown. We investigated  
37 sociodemographic and COVID-19-related information, sleep quality (by the Medical  
38 Outcomes Study-Sleep Scale), mental health (by the Depression, Anxiety, and  
39 Stress Scales), dream and nightmare frequency, and related emotional aspects (by the  
40 Mannheim Dream Questionnaire). Comparisons between our sample and a  
41 population-based sample revealed that Italians are having more frequent nightmares and dreams  
42 during the pandemic. A multiple logistic regression model showed the  
43 predictors of high dream recall (young age, female gender, not having children, sleep  
44 duration) and high nightmare frequency (young age, female gender, modification of napping, sleep  
45 duration, intrasleep wakefulness, sleep problem index, anxiety, depression).  
46 Moreover, we found higher emotional features of dream activity in  
47 workers who have stopped working, in people who have  
48 relatives/friends infected by or who have died from COVID-19 and  
49 in subjects who have changed their sleep habits. Our findings point to  
50 the fact that the predictors of high dream recall and nightmares are consistent with the  
51 continuity between sleep mentation and daily experiences. According to  
52 the arousal-retrieval model, we found that poor sleep predicts a high  
53 nightmare frequency. We suggest monitoring dream changes during the

54 epidemic, and also considering the implications for clinical treatment and prevention of  
55 mental and sleep disorders.

56

57 **K E Y W O R D:** Adverse events, continuity hypothesis, health, mental sleep activity, sleep

58

## 59 1 Introduction

60 Since December 2019, the new coronavirus (COVID-19) has criti- cally impacted the world. The  
61 virus has shown a rapid spread and many countries have adopted extremely restrictive measures  
62 (e.g., home confinement and social distancing) to contain diffusion of the virus. The Italian  
63 government imposed a lockdown from 9 March to 4 May, and people's lifestyles underwent  
64 remarkable changes (Altena et al., 2020). Modifications of sleep habits, feelings of fear and mood  
65 alterations were reported during lockdown by recent studies both in Italy (Casagrande et al., 2020;  
66 Cellini et al., 2020) and other countries (Blume et al., 2020; Wright et al., 2020; Xiao et al., 2020).

67 Since the beginning of the COVID-19 lockdown, many peo- ple worldwide have spontaneously  
68 reported recalling more vivid dreams and complained of nightmares on social media platforms and  
69 websites. However, to date very few studies have directly assessed the pandemic's impact on dream  
70 activity. Some authors have suggested that the pandemic experience could be con- sidered a  
71 traumatic event, as evidenced by a high proportion of post-traumatic stress disorder (PTSD)-like  
72 symptoms in Italy (Forte et al., 2020), as well as in China (Sun et al., 2020) during this pe- riod.  
73 Accordingly, nightmares could be considered consequences of PTSD (Germain, 2013). In this vein,  
74 previous investigations have shown modifications in dream patterns and increased nightmares in  
75 association with adverse events, such as wars and infectious dis- eases (Hartmann & Brezler, 2008;  
76 Nielsen et al., 2006; Sandman et al., 2013; Tempesta et al., 2013). Pesonen et al. (2020) explored

77 dream contents during the lockdown in Finland. By using network analysis, they revealed that many  
78 pandemic-related factors were linked to distressing events.

79 Furthermore, a survey completed by 3,031 US subjects revealed that people most affected by the  
80 pandemic had higher dream recall, more negative content in their dreams and pandemic-related con-  
81 tent (Schredl & Bulkeley, 2020). The authors also observed a large negative effect on those of  
82 female gender and people with a higher education level (Schredl & Bulkeley, 2020). Dream  
83 imagery during the early phase of the COVID-19 pandemic was investigated among Canadian  
84 university students (MacKay & DeCicco, 2020). The stu- dents reported higher dream experiences  
85 characterized by location changes, animals and virus-related contents. In keeping with pre- vious  
86 studies (Miller et al., 2017), the authors suggested that this type of mental sleep activity is related to  
87 anxiety experienced during wakefulness (MacKay & DeCicco, 2020).

88 To our knowledge, only one study assessed dream activity in an Italian sample (Iorio et al., 2020).  
89 A relatively small sample of partici- pants (N = 796) completed a dream questionnaire and reported  
90 their most recent dream. The results revealed that women's dreams are characterized by higher  
91 dream recall frequency, higher emotion and negative emotional tone as compared with men (Iorio et  
92 al., 2020). Also, subjects with COVID-19-infected/dead relatives or friends re- ported dreams with  
93 high emotional intensity and sensory impressions (Iorio et al., 2020).

94 Because dreaming and emotional processing are tightly linked, and dreams can reflect emotional  
95 waking experiences (Scarpelli et al., 2019), we would expect that frightening dreams may increase  
96 during a pandemic.

97 Here, we investigated the impact of the pandemic on dreaming in a very large Italian sample.

98 Specifically, we aimed to:

- 99 a) assess whether Italian people actually had higher dream and nightmare frequencies during the  
100 pandemic, as compared with a population-based sample (Settineri et al., 2019);

- 101 b) identify the sociodemographic and COVID-related aspects and psychological and sleep  
102 measures that predict the frequency of dreams and nightmares during the lockdown;  
103 c) evaluate the qualitative-emotional features of dreams and nightmares in the different groups,  
104 divided according to COVID-related aspects.

105 We hypothesized that psychological symptoms during wake might impact dream activity, especially  
106 by increasing the frequency of nightmares. Moreover, we hypothesized that lower sleep quality was  
107 related to higher dream activity. Finally, we expected that subjects whose daytime life is more  
108 affected by the COVID-19 pandemic and who have experienced COVID-19-related traumatic  
109 events (e.g., infected/dead relatives or friends) have more emotional dreams with a more negative  
110 tone.

111

## 112 2 Methods

### 113 2.1 Participants and protocol

114 Subjects completed a cross-sectional online survey on the Microsoft Azure platform specifically  
115 developed for the COVID-19 pandemic health emergency. The survey took approximately 30 min  
116 and was available for a limited period: from 10 March to 4 May (end of lockdown). Only adults  
117 (aged  $\geq 18$  years) living in Italy were included in the study.

118 The survey study was publicized via university communication systems as well as online forums.  
119 For instance, virtual learning environments, Facebook accounts or WeChat groups were used to  
120 promote the online survey. The general aim of the project was explained to the participants in the  
121 online advertisement (see the Supporting information).

122 Participants were requested to fill out a short self-administered questionnaire on sociodemographic  
123 and COVID-19 related information, along with self-administered questionnaires to assess

124 psychological and sleep variables in the web form. All individuals signed an electronic informed  
125 consent before filling out the survey. The subjects also explicitly agreed to provide an email contact  
126 and created an identification code to anonymize it. Participants could withdraw from the study at  
127 any moment, and no data were saved. The study was conducted in compliance with the Declaration  
128 of Helsinki and was approved by the Research Ethics Committee for Psychological Research of the  
129 University of Messina, Italy (no. 37442).

130 A total of 6,519 subjects completed the survey, and 531 subjects were excluded for several reasons  
131 (43 non-Italian; 48 infected by COVID-19; 440 missing data). The final sample consisted of 5,988  
132 subjects (91.85% of respondents).

133 Data reported in the current study were part of a wider project, 'Resilience and the COVID-19:  
134 how to react to perceived stress. Effects on sleep quality and diurnal behavior/thoughts', with differ-  
135 ent purposes regarding the impact of lockdown on the Italian pop- ulation. Other data with different  
136 objectives have been presented elsewhere (Franceschini et al., 2020).

137

## 138 2.2 Outcomes

139 The webform was composed of four sections:

### 140 2.2.1 Sociodemographic and COVID-related information

141 The variables collected in this section included: age, gender, marital status, presence/absence of  
142 children, education level, occupation, Italian area, cohabitants during lockdown, still working  
143 during lock- down, COVID-19-infected relatives or friends, relatives or friends who died from  
144 COVID-19, forced quarantine period, COVID-19 posi- tivity, and modification of sleep habits (i.e.,  
145 changes in the timing of sleep onset and morning awaking; changes in daytime napping compared  
146 to the pre-lockdown period).

147

## 148 2.2.2 Psychological symptoms: The Depression Anxiety Stress Scale-21

149 The Italian version of the Depression Anxiety Stress Scale-21 (DASS-21; short form; Bottesi et al.,  
150 2015) is a self-report questionnaire in which participants rate the frequency and severity of  
151 depression, anxiety and stress symptoms. A detailed description of the questionnaire has been  
152 reported in the Supporting information.

153 All three subscales (depression, anxiety and stress symptoms) were considered for further analysis.

154

## 155 2.2.3 Sleep measures: The Medical Outcomes Study—Sleep Scale

156 The Medical Outcomes Study—Sleep Scale (MOS-SS, Italian adaptation; Palagini & Manni,  
157 2016) is a self-administered questionnaire with 12 items to assess sleep quality and quantity within  
158 4 weeks (details in the online Supporting information). Here, three variables were extracted from  
159 the MOS-SS for further analyses: (a) the Sleep Index II or sleep problem index, an aggregate  
160 measure of responses concerning four sleep domains (sleep disturbance, awakening with shortness  
161 of breath or with headache, sleep adequacy and somnolence), as a synthetic measure of sleep  
162 quality; (b) a sleep duration (item 2); and (c) self-reported evaluation of intrasleep wakefulness  
163 (item 8), dichotomized as follows: “high intrasleep wakefulness” (answer 3, 4 or 5) and “low  
164 intrasleep wakefulness” (answer 1 or 2).

165

## 166 2.2.4 Dream variables: The Mannheim Dream Questionnaire

167 The Mannheim Dream Questionnaire (MADRE, Italian adaptation; Settineri et al., 2019) is a  
168 questionnaire with 20 self-reported items about dreams and related phenomena (details in the  
169 Supporting information).



170 In the current study, we focused on items examining state vari- ables of mental sleep activity (i.e.,  
171 items 1, 2, 3, 4 and 5). In light of the previous literature, item 1 was dichotomized to discriminate  
172 high and low dream recall (Eichenlaub et al., 2014) as follows: “low recall” (answer from 0  
173 [never] to 4 [about once a week]) and “high recall” (answer from 5 [several times a week] to 6  
174 [almost every morning]). Similarly, considering previous studies, item 4 was dichotomized to  
175 distinguish frequent from non-frequent nightmares (Schredl & Göritz, 2018), as follows: “non-  
176 frequent nightmares” (answer from 0 [never] to 5 [about two/three times a month]) and “frequent  
177 night- mares” (answer from 6 [about once a week] to 7 [several times a week]).

178

### 179 2.3 Statistical analysis

180 All the data were analysed using the Statistical Package for Social Sciences (spss) version 20.0.

181 Descriptive analyses were conducted to outline the sociodemo- graphic characteristics of the  
182 sample, as well as COVID-19 related aspects, considering the following features: age, gender,  
183 marital sta- tus, education level, occupation, Italian area, cohabitants, still work- ing during the  
184 lockdown, COVID-19-infected relatives or friends, relatives or friends who died from COVID-19,  
185 forced quarantine period, and modification of sleep habits (sleep onset, morning awakenings,  
186 daytime napping).

187 The chi-squared test was used to compare the two distributions (pandemic Italian sample versus  
188 population-based sample) of the answers to item 1 (dream recall frequency [DRF]) and item 4  
189 (nightmare frequency [NF]) in order to assess whether dream and nightmare frequency during the  
190 lockdown period differ from that re- ported in the population-based Italian sample (Settineri et al.,  
191 2019). The population-based group in the Settineri et al. (2019) dataset included 623 subjects (57%  
192 female; mean age  $\pm$  standard deviation,  $38.26 \pm 14.71$ ). This sample was recruited from two degree  
193 courses at the University of Messina.

194 Two binary multivariable logistic regression models were per- formed to explore the role of  
195 sociodemographic variables, COVID- related aspects, and psychological and sleep measures on the  
196 DRF (item 1) and NF (item 4). We entered the variables simultaneously and calculated the adjusted  
197 odds ratio (aOR) to control for other predictor variables in the model.

198 The following variables were tested as potential predictors of dream and nightmare frequency: age;  
199 gender (male; female); Italian area (north; centre-south); cohabitants (alone; no); having children  
200 (yes; no); days of lockdown; still working (yes; no); COVID- 19-infected relatives or friends (yes;  
201 no); relatives or friends who have died from COVID-19 (yes; no); forced quarantine period (yes;  
202 no); modification of sleep habits at sleep onset (yes; no); modifications of sleep habits at mornings  
203 awakening (yes; no); modifications of daytime napping (yes; no); total sleep duration; intrasleep  
204 wakefulness; sleep problem index; anxiety, depression and stress scores.

205 Before running logistic analyses, we checked for multicollinearity among the independent variables.  
206 The false discovery rate (FDR) correction (Benjamini & Hochberg, 1995) was applied to adjust the  
207  $\alpha$ -value (adjusted critical  $p = 0.0005$  for the regression model predicting DR; adjusted critical  $p =$   
208  $0.010$  for the regression model predicting NR).

209 Finally, unpaired  $t$  tests were computed to assess the qualitative-emotional dream and nightmare  
210 features among groups obtained on the basis of the COVID-related aspects (still working; COVID-  
211 19-infected relatives or friends; relatives or friends who have died from COVID-19; forced  
212 quarantine period; modifications of sleep habits at sleep onset; modifications of sleep habits at  
213 morning awakening; modifications of daytime napping). We considered emotional intensity and  
214 tone (items 2 and 3) and nightmare distress (item 5) as dependent variables. Before applying the  
215 above tests, the assumptions of normality or variances were checked. FDR correction (Benjamini &  
216 Hochberg, 1995) was applied to adjust the  $\alpha$ -value for multiple comparisons (adjusted critical  $p =$   
217  $0.018$ ).

218

## 219 3 Results

## 220 3.1 Demographic and COVID-related characteristics

221 The characteristics of participants are shown in Table 1. In short, data from 5,988 subjects revealed  
222 that the most represented age range was 18–25 years (40.8%; mean age  $\pm$  standard deviation [SD],  
223  $33.54 \pm 13.53$ ) and most of the participants were female (73.3%). Among all respondents, 35%  
224 were single, 25.2% were married, 26.3% were engaged, and a small percentage were cohabiting  
225 (9.1%) or divorced/separated/widower (4.5%); most of the individuals received a high school  
226 education (47.5%) and were employed (51.5%); 4,009 individuals (67%) came from north Italy;  
227 28.6% of the sample had children; most of the participants had at least one cohabitant during  
228 lockdown (92.8%); concerning job changes, 52.6% had stopped working during the lockdown;  
229 among respondents, 13.7% had COVID-19-infected relatives or friends and 6.4% had relatives or  
230 friends who had died from COVID-19; a forced quarantine period was prescribed to 444 individuals  
231 (7.4%); and finally, most participants reported modifications in their sleep habits (60.9% at sleep  
232 onset, 63.5% at morning awakening and 60.8% in daytime napping).

233 Insert Table 1

234

## 235 3.2 Comparison between Italian population-based and pandemic sample

236 The distributions of dream recall and nightmare frequency for population-based and pandemic  
237 samples are depicted in Figure 1a,b. Statistical comparisons by chi-squared test showed that the  
238 distribution of DRF of the pandemic sample differs significantly from that of the population-based  
239 Italian sample (chi-squared = 745.06;  $p < 0.001$ ). Similarly, the distributions of NF in population-  
240 based and pandemic sample are significantly different (chi-squared = 713.81;  $p < 0.001$ ). Figure 1

241 illustrates that the answers indicating low dream recall (Figure 1a) and low nightmare (Figure 1b)  
242 frequency show higher percentages in the population-based sample than in the pandemic one.

243 Inversely, the answers indicating high dream recall (Figure 1a) and high nightmare (Figure 1b)  
244 frequency show lower percentages in the population-based than the pandemic sample.

245 Insert Figure 1

246

### 247 3.3 Predictors of pandemic dream activity

248 Multiple binary logistic regression analyses on DRF as the outcome provided a significant model  
249 (likelihood ratio: chi-squared = 397.312,  $p < .001$ ; Nagelkerke's  $R^2 = 0.086$ ). The results (see  
250 Figure 2 and Table S1) showed that age ( $p < 0.0001$ ; odds ratios [aOR], 0.985; 95% confidence  
251 intervals [CI], 0.979–0.991), gender ( $p < 0.0001$ ; aOR, 2.035; CI, 1.790–2.312), having children ( $p$   
252 = 0.0005; aOR, 0.728; CI, 0.609–0.870) and sleep duration ( $p < 0.0001$ ; aOR, 1.107; CI, 1.059–  
253 1.158) were significant predictors of DRF. Specifically, younger age, female gender, not having  
254 children and higher sleep duration were associated with higher DRF. No other variable predicted  
255 DRF.

256 Insert Figure 2

257

258 Multiple binary logistic regression analyses on NF as the outcome provided a significant model  
259 (likelihood ratio: chi-squared = 819.012,  $p < 0.001$ ; Nagelkerke's  $R^2 = 0.207$ ). The results (see  
260 Figure 3 and Table S2) showed that age ( $p < 0.0001$ ; aOR, 0.972; CI, 0.963–0.982), gender ( $p <$   
261  $0.0001$ ; aOR, 1.825; CI, 1.504–2.213), daytime napping ( $p = 0.001$ ; aOR, 1.351; CI, 1.133–1.612),  
262 intrasleep wakefulness ( $p = 0.010$ ; aOR, 1.282; CI, 1.062–1.546); sleep duration ( $p = 0.001$ ; aOR,  
263 1.096; CI, 1.038–1.158), the sleep problem index ( $p < 0.0001$ ; aOR, 1.023; CI, 1.017–1.029),

264 anxiety score ( $p = 0.001$ ; aOR, 1.021; CI, 1.009–1.034) and depression score ( $p = 0.001$ ; aOR,  
265 1.019; CI, 1.008–1.030) are significant predictors of NF. Specifically, younger age, female gender,  
266 modification of daytime napping, high intrasleep wakefulness, higher sleep duration, higher sleep  
267 problem index score, higher anxiety and depressive symptoms are associated with higher NF. No  
268 other variable predicted NF.

269 Insert Figure 3

270

### 271 3.4 Emotional features of pandemic dream activity

272 Table 2 reports the group differences in emotional features of dream activity during the lockdown.  
273 People who had stopped working showed higher emotional intensity ( $t = 2.36$ ;  $p = 0.018$ ), higher  
274 negative emotional tone ( $t = -2.60$ ;  $p = 0.009$ ) and nightmare distress ( $t = 3.81$ ;  $p < 0.001$ ),  
275 compared to individuals who kept working. People having COVID-19-infected relatives or friends  
276 and relatives or friends who had died from COVID-19 reported more nightmare distress than  
277 individuals not having these traumatic experiences ( $t = -3.59$ ;  $p < 0.001$  and  $t = -2.61$ ;  $p = 0.009$ ,  
278 respectively).

279 Insert Table 2

280

281 Table 2. Mean and standard deviation (SD) of emotional intensity, emotional tone and nightmare  
282 distress for each group divided according COVID-related aspects and results of statistical  
283 comparisons by unpaired t test. Significant effects are marked with asterisks (adjusted critical  $p =$   
284 0.018)

285

286

## 287 4 Discussion

288 This is the first study investigating quantitative and qualitative aspects of dream activity during the  
289 spring 2020 lockdown in a large Italian sample. The current results show increased dream recall and  
290 nightmare frequency, as compared with a population-based sample. Furthermore, we showed that  
291 specific sociodemographic characteristics along with COVID-19-related changes in psychological  
292 symptoms and sleep quality were able to impact dream and nightmare frequency during the  
293 lockdown. In line with our expectations, our results suggest a higher predictive power for nightmare  
294 frequency.

295 Consistently, many studies have highlighted that, after experiencing traumatic or stressful events,  
296 dreams underwent significant changes in their occurrence. Investigations on dream recall  
297 immediately after the 9/11 attacks revealed that people reported more intense dreams in that period  
298 (Hartmann & Brezler, 2008). More directly, a study in the Italian population showed that PTSD  
299 survivors of the L'Aquila earthquake living near the epicentre had more sleep disorders and  
300 nightmares (Tempesta et al., 2013). In line with our hypothesis, we found that both anxiety and  
301 depressive symptoms are positively associated with nightmares. During the day, a high level of  
302 anxiety could lead to more unpleasant dreams (Sikka et al., 2018). Accordingly, several aspects  
303 related to COVID-19 are shrouded by fear and uncertainty. The scarce knowledge about this new  
304 virus, the absence of definitive treatment or vaccines, the fear of death and the economic collapse,  
305 are turning the pandemic into a sort of “collective trauma” (Forte et al., 2020). Moreover, home  
306 confinement and isolation may increase depressive feelings (Brooks et al., 2020), which may affect  
307 sleep and oneiric activity (Skancke et al., 2014).

308 Dreaming can reflect our inner suffering and is linked to memory mechanisms that could help us  
309 cope with the negative affects related to daytime life experiences. More directly, we explored the  
310 qualitative-emotional features of dream activity, showing that people having COVID-related  
311 traumatic experiences (death or illness of relatives or friends) reported increased distress associated

312 with their oneiric contents. Similarly, groups with higher lifestyle modifications (in sleep habits or  
313 stopping working) showed greater emotion in their dreams. These findings are consistent with  
314 previous studies on pandemic dreams that highlighted the presence of high emotional intensity in  
315 people most affected by the pandemic (Schredl & Bulkeley, 2020) and individuals with death or  
316 illness of relatives or friends due to COVID-19 (Iorio et al., 2020).

317 As a whole, in keeping with these findings and the well-established hypothesis of continuity  
318 between cognitive processes during wakefulness and sleep (Schredl & Hofmann, 2003), we suggest  
319 that negative emotions during the lockdown could be incorporated in sleep mentation. In this vein,  
320 some authors have supposed that nightmares in the early aftermath of exposure to trauma could rep-  
321 resent an attempt to metabolize and contextualize life changes and stressful events (Scarpelli et al.,  
322 2019b).

323 We also confirmed that sleep quality impacted dream activity. In particular, nightmares are  
324 associated with more significant sleep problems and intra-sleep wakefulness. In this respect,  
325 Koulack and Goodenough (1976) claimed that sleep fragmentation and awakenings promote oneiric  
326 trace storage and recall (i.e., arousal-retrieval model). In apparent contradiction with this result, we  
327 found that higher sleep duration predicts high dream activity (i.e., both DR and NR). Sleep-wake  
328 schedules were strongly affected by home confinement (Bottary et al., 2020), and multiple studies  
329 have found both increased sleep duration (Blume et al., 2020; Wright et al., 2020) and time spent in  
330 bed (Cellini et al., 2020; Wright et al., 2020) and a decrease in self-reported sleep quality (Blume et  
331 al., 2020; Cellini et al., 2020). In line with electrophysiological evidence, we hypothesize that we  
332 are dealing with light and unstable sleep, probably characterized by cortical arousal and reduced  
333 slow-wave activity (i.e., activation hypothesis; Scarpelli et al., 2017; van Wyk et al., 2019).  
334 Moreover, modifications to daytime napping predict higher NF. On the one hand, we could interpret  
335 this result as an expression of the multiple daily routine changes that may strongly affect dream

336 activity. On the other, we could speculate that modifications to napping may be the consequence of  
337 changes in general sleep habits and quality (i.e., sleep extension and/or sleep fragmentation).

338 Quite surprisingly, our results show that having children predicts high DR. Considering that recent  
339 studies have suggested that COVID-19-related stressors can negatively impact parents' sleep (Peltz  
340 et al., 2020), the direction of our finding on DR and the lack of any effect for NR may appear  
341 counterintuitive. However, we did not have any information about the ages or numbers of children,  
342 which are crucial data for unravelling the issue of the impact of childcare at home on sleep and,  
343 consequently, dreaming.

344 In line with previous COVID-19 dream studies (Barrett, 2020; Iorio et al., 2020; Schredl &  
345 Bulkeley, 2020), we showed that female gender and younger age are predictors of high DRF and  
346 NF. Indeed, sex differences in dream activity had been previously reported, evidencing that  
347 women have higher recall frequencies than men (Nielsen, 2012). Moreover, ageing is recognized as  
348 one of the key factors responsible for the drop in DR, and the frequency seems to be already  
349 reduced in early and middle adulthood (Scarpelli et al., 2019a). The decline was also observed for  
350 nightmares (Scarpelli et al., 2019a). The replication of these findings informs us about the goodness  
351 of our sample.

352 Nevertheless, it should be considered that the majority of the participants in the current study are  
353 women, so our sample cannot be considered as fully representative of the entire Italian population.  
354 However, this huge gender difference in the response rate to the web survey is similarly present in  
355 many COVID-19 studies on sleep and dreaming (i.e., females make up around 70% of the sample;  
356 Casagrande et al., 2020; Cellini et al., 2020; McKay & DeCicco, 2020). The current investigation  
357 has the great advantage of including a large sample. However, we must underline some  
358 methodological constraints. Firstly, we did not collect dream contents but only self-reported  
359 emotional features. This represents a limitation because we cannot directly assess the continuity  
360 between waking experiences and actual dream contents. Also, the information about sleep quality is



361 not supported by any systematic sleep measures, neither daily sleep diaries nor objective measures.  
362 Moreover, our survey did not require information on any possible pharmacological treatment that  
363 can affect sleep and dreaming (Nicolas & Ruby, 2020).

364 Lastly, although we compared the actual distribution of DRF and NF with that of a population-  
365 based Italian population, we are aware that the lack of a pre–post study design does not allow us to  
366 control potential confounding and stable factors unrelated to the epidemic (Nielsen, 2012; Scarpelli  
367 et al., 2019a). We should also mention that the comparison with the convenience sample by  
368 Settineri et al. (2019) should be made with caution as the recruitment strategy is very different and  
369 it is significantly smaller than our sample.

370 In conclusion, oneiric activity, such as sleep, can give us crucial information about people's well-  
371 being (Scarpelli et al., 2019b; Sikka et al., 2018). Indeed, disturbing dreams and nightmares have  
372 been found to be signs of reactivation of PTSD symptoms in patients whose disorder was in  
373 remission during the lockdown period (Gupta, 2020). Bearing in mind that the epidemic produced a  
374 real “psychiatric emergency”, we suggest looking at oneiric activity from a clinical perspective.  
375 That is, future investigations should monitor the changes in dreams and nightmares across the  
376 pandemic, also consid- ering the implications for clinical treatment and prevention of mental and  
377 sleep disorders.

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508   Table 1

	N (overall sample: 5,988)	%
<b>Age, years</b>		
>60	228	3.8
18-25	2,442	40.8
26-30	964	16.1
31-40	855	14.3
41-50	741	12.4
51-60	758	12.7
<b>Gender</b>		
Male	1,596	26.7
<b>Marital status</b>		
Single	2,095	35.0
Married	1,506	25.2
Cohabiting	546	9.1
Engaged	1,573	26.3
Divorced/separated/widower	268	4.5
<b>Education level</b>		
Until middle school	207	3.5
High school	2,846	47.5
Bachelor's degree	1,125	18.8
Master's degree	1,344	22.4
PhD/postgraduate school	466	7.8
<b>Occupation</b>		
Student	2,521	42.1
Employed	3,085	51.5
Retired	108	1.8
Unemployed	274	4.6
<b>Italian area</b>		
North Italy	4,009	67.0
<b>Having children</b>		
Yes	1,713	28.6
<b>Cohabitants during lockdown</b>		
Yes	5,557	92.8
<b>Still working during lockdown</b>		
Yes	3,152	47.4
<b>COVID-19-infected relatives or friends</b>		
Yes	821	13.7
<b>COVID-19-died relatives or friends</b>		
Yes	385	6.4
<b>Forced quarantine period</b>		
Yes	444	7.4
<b>Modification of sleep habits (sleep onset)</b>		
Yes	3,645	60.9
<b>Modification of sleep habits (morning awakenings)</b>		
Yes	3,803	63.5
<b>Modification of sleep habits (daytime nap)</b>		
Yes	3,640	60.8

509

510 Table 1 Demographic characteristics and COVID-related features

511

512

513 Table 2

514

	Emotional intensity			Emotional tone			Nightmare distress		
	Mean (SD)	t-values (p-values)	Cohen's d	Mean (SD)	t-values (p-values)	Cohen's d	Mean (SD)	t-values (p-values)	Cohen's d
Still working during lockdown									
Yes	2.27 (1.088)	2.361 (0.018*)	0.064	-0.04 (0.811)	-2.600 (0.009*)	0.061	1.65 (1.064)	3.806 (0.000*)	0.103
No	2.34 (1.078)			-0.09 (0.807)			1.76 (1.068)		
Forced quarantine period									
Yes	2.32 (1.090)	-0.257 (0.797)	0.018	-0.09 (0.822)	0.700 (0.484)	0.036	1.71 (1.016)	-0.107 (0.915)	0.009
No	2.30 (1.083)			-0.06 (0.809)			1.70 (1.071)		
COVID-19-infected relatives or friends									
Yes	2.33 (1.079)	-0.921 (0.357)	0.027	-0.06 (0.827)	-0.226 (0.821)	0	1.83 (1.084)	-3.587 (0.000*)	0.139
No	2.30 (1.084)			-0.06 (0.807)			1.68 (1.064)		
COVID-19-died relatives or friends									
Yes	2.38 (1.071)	-1.434 (0.152)	0.074	-0.05 (0.854)	-0.316 (0.752)	0.012	1.84 (1.103)	-2.611 (0.009*)	0.138
No	2.30 (1.084)			-0.06 (0.807)			1.69 (1.064)		
Modification of sleep onset									
Yes	2.36 (1.079)	-4.897 (0.000*)	0.129	-0.10 (0.817)	4.231 (0.000*)	0.111	1.79 (1.073)	-7.452 (0.000*)	0.198
No	2.22 (1.085)			-0.01 (0.795)			1.58 (1.046)		
Modification of morning awakenings									
Yes	2.34 (1.075)	-3.253 (0.001*)	0.092	-0.08 (0.816)	2.633 (0.008*)	0.061	1.74 (1.057)	-3.771 (0.000*)	0.093
No	2.24 (1.096)			-0.03 (0.797)			1.64 (1.081)		
Modification of daytime nap									
Yes	2.31 (1.091)	-1.039 (0.299)	0.027	-0.08 (0.825)	2.043 (0.041)	0.049	1.74 (1.081)	-3.464 (0.001*)	0.094
No	2.28 (1.073)			-0.04 (0.784)			1.64 (1.044)		

515

516 Table 2 Mean and standard deviation ( SD) of emotional intensity, emotional tone and nightmare  
 517 distress for each group divided according COVID-related aspects and results of statistical  
 518 comparisons by unpaired t test. Significant effects are marked with asterisks (adjusted critical p =  
 519 0.018)

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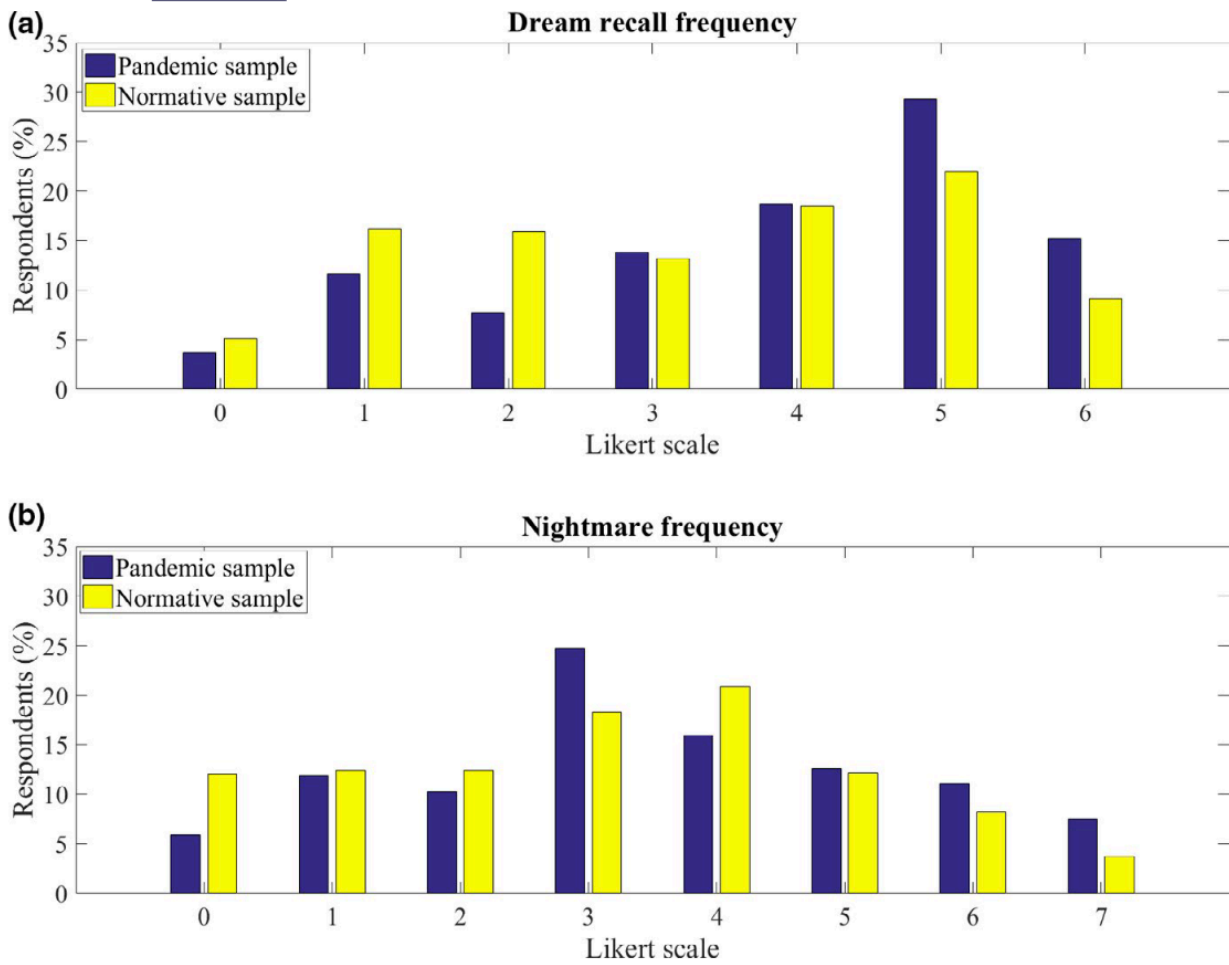
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527 Figure 1



528



529

530 Figure 1: Distributions of dream recall and nightmare frequency for population-based and pandemic  
531 samples. (a) The percentage distribution of respondent scores on a Likert scale (0–6) about dream  
532 recall frequency, in population-based (yellow bars) and pandemic (blue bars) samples. (b) The  
533 percentage distribution of respondent scores on a Likert scale (0–7) about nightmare frequency, in  
534 population-based (yellow bars) and pandemic (blue bars) samples

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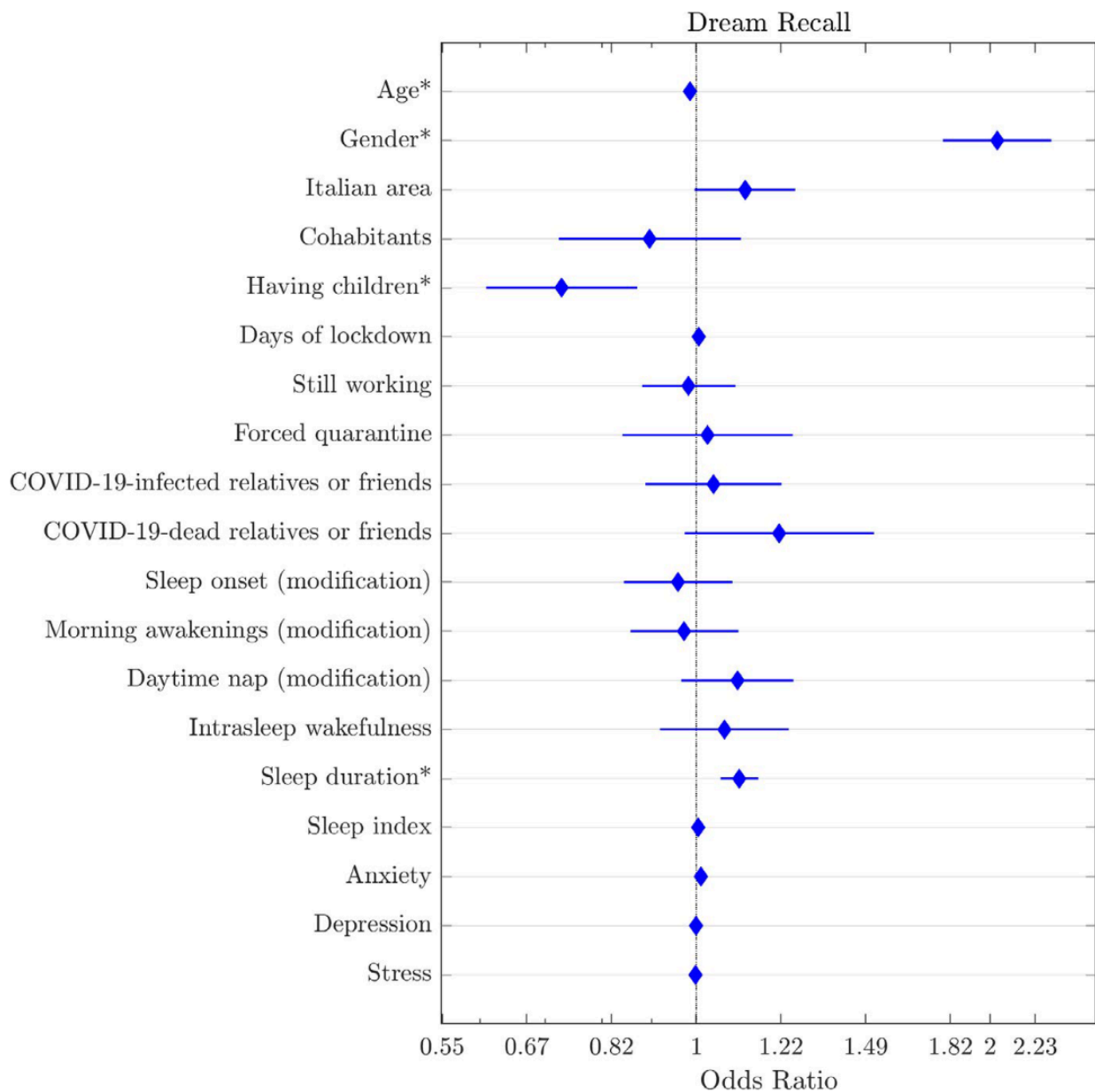
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543 Figure 2



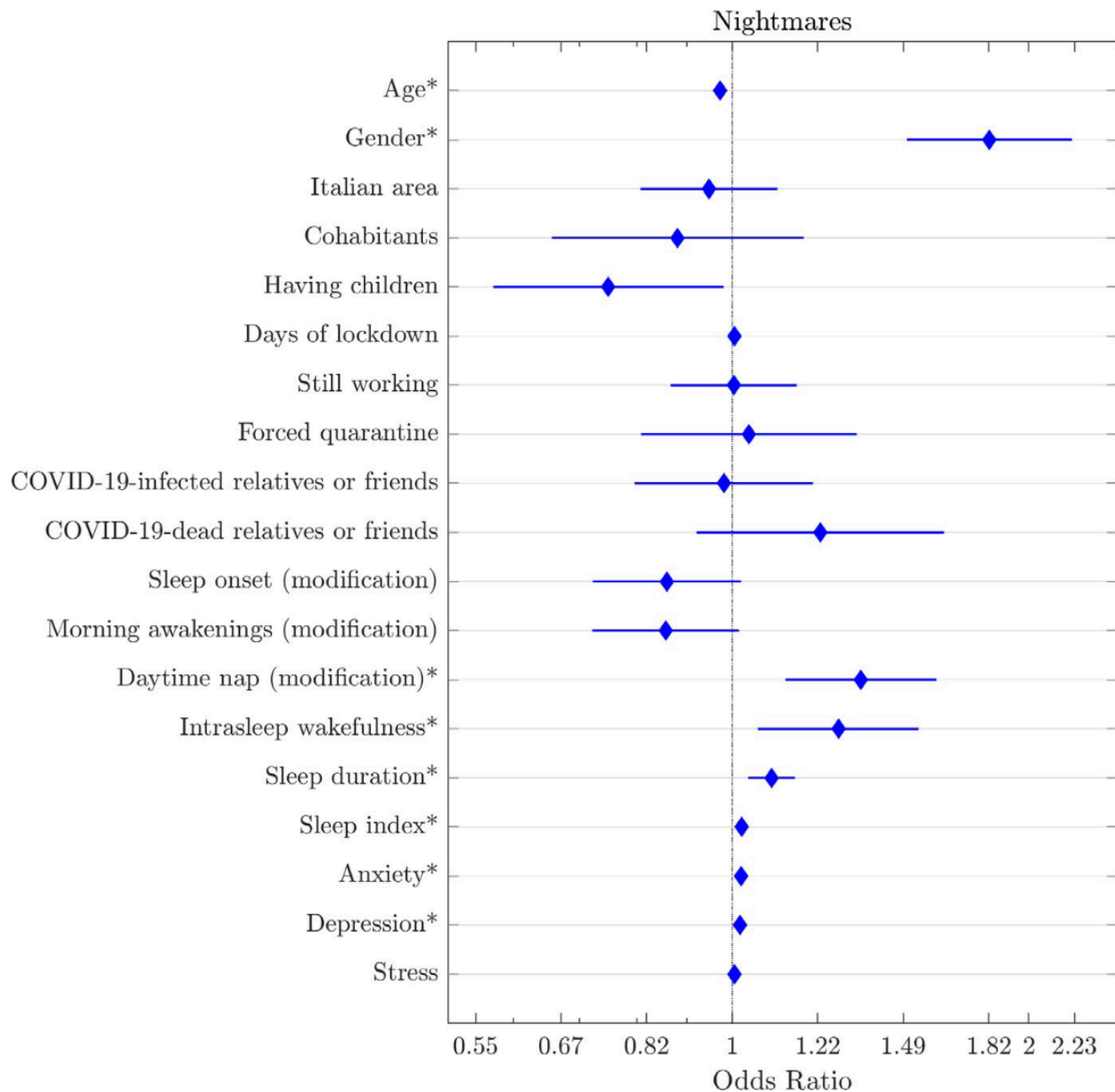
544

545 Figure 2: Multiple binary logisticregression model with dream recallfrequency (high and low dream  
 546 recallfrequency) as dependent variable.Graphic representation of odds ratio andrelative 95%  
 547 confidence intervals for eachpredictor: age, gender (reference: male),Italian area (reference: north),  
 548 cohabitants(reference: alone), having children(reference: no), days of lockdown, stillworking during  
 549 lockdown (reference: no),COVID-19-infected relatives or friends(reference: no), relatives or friends  
 550 whohave died from COVID-19 (reference: no),forced quarantine period (reference:  
 551 no),modification of sleep habits at sleep onset(reference: no), modification of sleep habits at  
 552 morning awakenings (reference:no), modifications in daytime napping(reference: no), intrasleep  
 553 wakefulness(reference: low), sleep duration, sleepproblem index, and anxiety, depressionand stress  
 554 scores. Independent significantpredictors for each outcome are markedwith asterisks

555

556 Figure 3

557



558

559 Figure 3: Multiple binary logistic regression model with nightmare frequency (high and low  
 560 nightmare frequency) as dependent variable. Graphic representation of odds ratio and relative 95%  
 561 confidence intervals for each predictor: age, gender (reference: male), Italian area (reference: north),  
 562 cohabitants (reference: alone), having children (reference: no), days of lockdown, still working during  
 563 lockdown (reference: no), COVID-19-infected relatives or friends (reference: no), relatives or friends  
 564 who have died from COVID-19 (reference: no), forced quarantine period (reference:  
 565 no), modification of sleep habits at sleep onset (reference: no), modification of sleep habits at  
 566 morning awakenings (reference: no), modifications in daytime napping (reference: no), intrasleep  
 567 wakefulness (reference: low), sleep duration, sleep problem index, and anxiety, depression and stress  
 568 scores. Independent significant predictors for each outcome are marked with asterisks