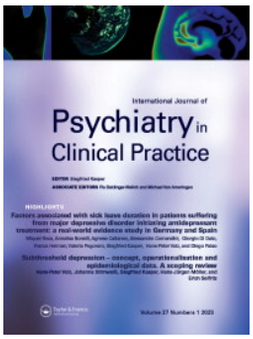

International Journal of Psychiatry in Clinical Practice

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/ijpc20

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To cite this article: Estefanía Mónaco, Mar Zaragozá & Inmaculada Montoya-Castilla (2023) ‘Sleep and emotions: How much are they affected by confinement due to COVID-19? A longitudinal study’, International Journal of Psychiatry in Clinical Practice, 27:1, 8-17, DOI: 10.1080/13651501.2022.2060838

To link to this article: https://doi.org/10.1080/13651501.2022.2060838

INTERNATIONAL JOURNAL OF PSYCHIATRY IN CLINICAL PRACTICE
2023, VOL. 27, NO. 1, 8–17
https://doi.org/10.1080/13651501.2022.2060838

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ORIGINAL ARTICLE

'Sleep and emotions: How much are they affected by confinement due to COVID-19? A longitudinal study'

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ABSTRACT

Objective: Our aim is to study changes in sleep and emotions in Spanish population during the confinement period due to first wave of COVID-19.

Methods: A total of 363 adults (69.4% women) aged between 18 and 65 (M_{age} = 32.59; SD = 12.57) participated in the study. Socio-demographics, sleep quality and emotional experience were evaluated. The study was longitudinal: a first data collection was developed after 15 d of confinement (asking for a subjective comparison with the pre-confined period), and a second collection after 30 d.

Results: Results suggest differences in sleep quality depending on the time confined. Difficulty falling asleep increases and daytime activity decreases with longer confined periods. Morning fatigue, sleepiness and nightmares are reduced significantly after 15 d of confinement when compared with the subjective data from pre-confinement. After 15 d of confinement participants felt higher levels of apathy, sadness, irritability and lower levels of euphoria and joy than they remember feeling before confinement. Anxiety, concern and fear seem to increase at 15 d of confinement and decrease at 30 d. Sleep quality and emotional experiences in confinement are closely correlated.

Conclusions: The confinement in Spain worsened the emotional state and changed sleep habits, although it did not necessarily worsen the quality of sleep.

KEY POINTS

- There are differences in sleep quality depending on the time spent in confinement.
- Confinement situation is related with higher levels of apathy, sadness, and irritability and lower levels of euphoria and joy.
- Anxiety, concern and fear seem to increase at 15 d of confinement and then decrease at 30 d.
- Sleep quality and emotional experiences in confinement are closely correlated.
- After COVID-19, there is a remarkable need of attend the disturbances emerged in sleep habits and daily moods of general popunlation.

ARTICLE HISTORY
Received 7 June 2021
Revised 14 February 2022
Accepted 27 March 2022

KEYWORDS
Sleep; emotions; COVID-19; confinement; longitudinal study

Introduction

The impact of the coronavirus disease in Spain

COVID-19 disease emerged in central China from the end of December 2019 and then began to spread worldwide. Particularly in Spain, the first case detected was on 31 January 2020. Since then, there have been 219 thousand confirmed cases and 25.600 deaths due to COVID-19 at the end of April 2020, being one of the most affected countries in the world by the *first wave* of the virus (National Epidemiological Surveillance Network and National Epidemiological Surveillance Network 2020). Alert state was declared on 14 March and with it, home confinement was the main health measure (see Official State Bulletin 2020, Royal Decree 463/2020, for accurate information about the implemented public health policies). Spanish citizens must remain indoors at their homes, only leaving the household to fulfil basic needs (Official State Bulletin 2020). In Figures 1 and 2, we can see the daily evolution of the number of infected and the number of deaths from the beginning of the confinement until 30 d after its implementation.

Infectious disease epidemics not only affect the physical health of patients but also affect the psychological health and well-being of the non-infected population (Brooks et al. 2020). So even if the individuals in confinement do not develop an infection and remain physically healthy, they often suffer from negative psychological effects related to emotional distress, which can lead to post-traumatic disorders for a certain part of the population with a prior disposition (Yoon et al. 2016). Being forced to stay at home, telework, do homeschooling with their children, minimise outings drastically, reduce social interaction, while dealing with the possible health risks, can have a major impact on daily functioning (DiGiovanni et al. 2004; Brooks et al. 2020).

Emotions and sleep quality during confinement

Sleep plays a critical role in mental health and psychosocial adjustment across the lifespan (Palmer & Alfano 2017). Sleep disturbances are highly prevalent (Altena et al. 2016). Generally, sleep loss has been shown to increase the experience of negative emotions, reduce the presence of positive emotions and alter the

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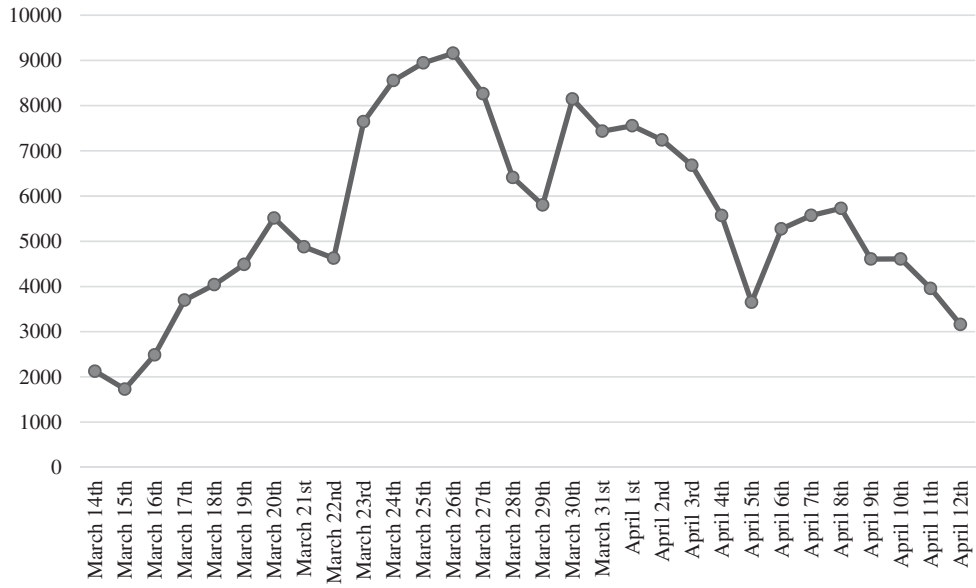

Figure 1. Number of daily infected in Spain since confinement started up to 30 d of confinement. Data extracted from the Ministry of Health (Government of Spain). X-Axis: days of year 2020; Y-Axis: number of people.

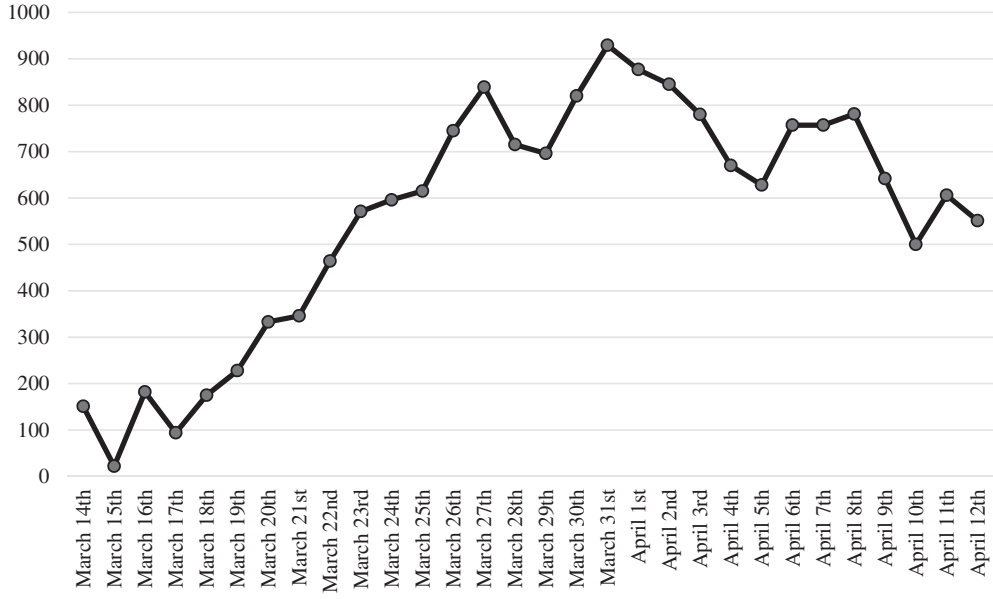

Figure 2. Number of daily deaths in Spain since confinement started up to 30 d of confinement. Data extracted from the Ministry of Health (Government of Spain). X-Axis: days of year 2020; Y-Axis: number of people.

ways in which individuals understand, express and modify these emotions (Kahn et al. 2013; Palmer & Alfano 2017). Furthermore, it has a crucial impact on modulation of emotional reactivity, emotional memory formation, empathic behaviour, fear conditioning, threat generalisation and extinction memory (Tempesta et al. 2018). Therefore, sleep problems have the potential to exacerbate mental health conditions, creating a vicious cycle that affects health and well-being (Weinberg et al. 2016; Wakefield et al. 2020).

Previous studies have shown that highly stressful situations, such as global pandemics, could have a significant impact on the sleep and emotional experience of the population (Akerstedt et al. 2007; Jeong et al. 2016; Franceschini et al. 2020; Xiao et al. 2020a). As occurred with previous pandemics like SARS, confinement due to COVID-19 may cause a significant reduction in sleep quality, as well as an increase in anxiety, depression stress, and posttraumatic symptoms (Wu et al. 2005; Xiao et al. 2020a).

Existing evidence suggests that the associations between emotion and sleep are complex and bidirectional: poor sleep may adversely affect emotional well-being, while certain emotions may lead to compromised sleep (Kahn et al. 2013; Shen et al. 2018). The duration and sleep quality influences cognitive performance (e.g., memory loss, attention and concentration difficulties) and emotional experience (restlessness, irritability and anxiety). Sleep disturbances can lead to deterioration in social, occupational and educational areas (Medrano-Martínez and Ramos-Platón 2016). Furthermore, previous research demonstrates the influence of sleep quality and emotional experience on health, well-being, and psychological functioning (both cognitive and behavioural) (Weinberg et al. 2016; Rogers 2020).

Sleep quality is closely related to sleep habits, such as bedtime and waking-up time (Altena et al. 2020). Furthermore, sleep quality is affected by both psychological and biological factors (Gamaldo et al. 2012). In confinement, there is less exposure to sunlight, changes in diet and a partial or total reduction in physical activity, which negatively affects the natural course of sleep (Richards 2017). Besides, a state of physiological, cognitive and emotional hyperactivation related to stress and the internalisation of negative emotions are factors related to sleep problems (Medrano-Martínez and Ramos-Platón 2016).

Importantly, the effects of mental health and good quality sleep on immunity to viral infection have been shown by previous studies (Gamaldo et al. 2012). Good sleep quality is a protective factor against the potential development of post-traumatic stress in situations arising from the pandemic, such as the loss of a loved one or the infection itself (Bo et al. 2021). Therefore, studying changes in sleep patterns and the emotional experiences of confined people could be one way to strengthen the health (both physical and mental) of the general population (Brooks et al. 2020).

This study

The aim of the present work is to study changes in sleep and emotions in the general adult Spanish population during confinement due to the first wave of COVID-19, comparing two moments: the first moment after 15 d of confinement and the second one after 30 d of confinement. Also, an additional measure was taken at the first moment, asking about the state of the sample before the confinement. However, it is important to note that this is not a measure of the actual state prior to confinement, but a retrospective memory.

The hypotheses are as follows: (1) sleep quality will decrease through the course of confinement days; (2) sleep quality and positive emotional experience in confinement will be negatively related to socio-demographic factors such as age and low socioeconomic status, and positively related to healthy habits such as physical exercise at home; (3) sleep habits will change and sleep quality will decrease during confinement; (4) emotional experience will get significantly worse during confinement, increasing level of negative emotions; and (5) sleep quality during confinement will be positively related to pleasant emotions and negatively related to unpleasant emotions.

Method

Participants

A total of 363 adults (69.4% women) aged between 18 and 65 participated in the study (M_{age} =32.59 years; SD = 12.57). Most of the sample consists of young people in their early twenties, although each age range is represented. Regarding the educational level, 7.4% have a basic education, 19.3% have a bachelor's degree or training cycle, 48.8% have a university degree and 24.5% have a master's or doctorate degree. Regarding their socioeconomic level, 31.7% have an income between 0 and 500 euros/month (0–591.20 USD/month), 19.3% between 500 and 1.000 euros/month (591.20–1182,41 USD/month), 28.1% between 1.000 and 1.500 euros/month (1182,41–1773,62 USD/month) and 20.9% more than 1.500 euros/month (more than 1773,62 USD/month). 47 participants indicated that they suffer from a diagnosed sleep disorder, of which 24 take sleep medication. Regarding confinement days, they range from 0 to 23 d (M_{time} =10.03 d; SD = 2.64). From the sample, 261 participants answered the monitoring survey 15 d after (70.1% women; M_{age} =32.56 years; SD = 12.60). In this monitoring survey, days of confinement ranged from 0 to 70 d (M_{time} = 26.87d; SD = 7.61).

Instruments

Sociodemographic data

Age, gender, education, socioeconomic level, the existence of diagnosed sleep disorders (and medical treatment if applicable) and the existence of diagnosed psychopathology.

Data related to COVID-19

Days of quarantine, changes related to their work situation, cohabitation at home during confinement and physical activity.

Sleep habits before and during confinement

Bedtime, waking-up time, average hours of sleep, number of night-time awakenings and 'nap' duration.

Sleep satisfaction

Subjective perception of overall satisfaction with sleep quality on a scale of 0–10.

Sleep quality

Eight questions with a Likert scale of five response options (1: Never; 5: Always) that assesses difficulty in falling asleep, night-time awakenings, nightmares, early awakening, daytime activity, headaches, sleepiness and fatigue upon awakening.

Emotional experiences

Nine questions with a Likert scale of five response options (1: Never; 5: Always) that evaluate emotions of anxiety, apathy, sadness, relaxation, anger, worry, irritability, euphoria, fear, joy and hostility.

The variables were studied through a series of ad hoc questions adapted to the confinement period (see Appendix 1). In the first assessment, the sleep quality and emotional experience before confinement were asked retrospectively, and these variables were assessed during the last 15 d (coinciding with the first 15 d of confinement). The same ad hoc questions were repeated in the second assessment, asking about the last 30 d (30 d of confinement).

Procedure

First, the set of relevant ad-hoc questions was developed, ensuring that the fundamental principles set out in the Helsinki Declaration and the Council of Europe Convention on Human Rights were met. Second, the data were collected through the LimeSurvey computer platform, a software application for conducting online surveys.

A first data collection was carried out on 30 March 2020, 15 d after the alert state was declared in Spain due to the health emergency concerning COVID-19. In this first assessment, participants were asked about their perception of their state prior to confinement, as well as their current state during confinement. A second data collection was carried out after 15 d (12 April 2020), to evaluate longitudinally the evolution of participants in confinement.

The data collected was anonymous, complying with the requirements established by Spanish legislation in the field of biomedical research, personal data protection and bioethics. The project was approved by the Human Research Ethics Committee of the University of Valencia's Experimental Research Ethics Commission (UV-INV_ETICA-1296813). In addition, participants

gave their explicit consent to participate in the longitudinal research and were informed of their right to revoke their consent at any time during the study, as well as about the processing of their personal data. The selection of the sample was for proximity and convenience, using a snowball sampling technique. Regarding recruitment, the study began to spread through the social circles related to the authors and was later expanded using social networks and the dissemination of the study by the participants. Finally, a statistical analysis of the data was carried out.

Data analysis

Data were analysed with the SPSS statistical software version 24.0 ((SPSS Inc., Chicago, IL). Frequency analysis and descriptive statistics were performed to explore the data. *T*-tests were used to compare significant differences between average hours of sleep before and during confinement, along with sleep satisfaction before and after confinement. Repeated measures ANOVAs were performed to compare the sleep quality and emotional experiences informed retrospectively before confinement, with the sleep quality and emotional experiences after 15 d of confinement and after 30 d of confinement. Bivariate Pearson correlations were used to study the relationship between sleep quality and emotional experiences.

Results

Changes related to COVID-19 in the work situation, cohabitation and physical exercise: its relationship with sleep and emotions

Regarding the employment situation of the participants, before the alert state was declared, 36.6% of the participants were studying, 50.7% were working, 5.5% were unemployed and 7.2% were in other professional situations (e.g., sick leave, retirement or unpaid internships, among others). After declaring the alert state and the confinement, 24.3% of the people who were working have continued working face-to-face, 31.8% are teleworking, 30.4% are in a situation of temporary suspension of their job, 3.7% have suffered a dismissal and 9.8% are in another work situation (e.g., partial reduction, delay in incorporation or resignation, among others). Those who were studying have continued their studies online.

Considering the age of the participants in relation to sleep quality after 15 d of confinement, we observed a significant negative correlation between age and the subjective perception of sleep satisfaction during confinement ($r=-0.11$; $p<.000$). Furthermore, age shows a significant negative correlation with sleepiness ($r=-0.10$; $p<.000$), and a positive ones with daytime activity ($r=0.18$; $p<.000$) and early awakening ($r=0.18$; $p<.000$). In terms of emotions, age shows a significant negative correlation with apathy ($r=-0.21$; $p<.000$), irritability ($r=-0.14$; $p<.000$) and hostility ($r=-0.19$; $p<.000$) and a positive one with fear ($r=0.11$; $p<.05$).

Regarding the employment situation, higher socioeconomic status correlates positively with sleep quality during confinement ($r=0.13$; $p<.05$) and with early awakening ($r=0.15$; $p<.05$) and negatively with difficulty in falling asleep ($r=-0.23$; $p<.01$) and morning fatigue ($r=-0.17$; $p<.01$). It also correlates positively with relaxation ($r=0.13$; $p<.05$) and negatively with anxiety ($r=-0.14$; $p<.05$), apathy ($r=-0.14$; $p<.05$) and irritability ($r=-0.18$; $p<.01$).

Regarding the situation of cohabitation at home, before the alert state was declared, 53.44% of the participants lived with their family, 20.7% with roommates or friends, 18.73% with their couple and 6.9% lived alone. After declaring the alert state and confinement, 63.09% lived with their family, 9.6% with roommates or friends, 19.28% with their couple and 8% lived alone. Living with other people in confinement correlates positively with irritability ($r=0.16$; $p<.01$).

Concerning physical exercise, before quarantine 23.4% did not exercise, 35.8% did 1–2 times/week, 36.1% between 3 and 5 times/week and 4.7% more than 6 times/week. During confinement, 26.7% did not exercise, 23.7% exercised 1–2 times/week, 35% between 3 and 5 times/week and 14.6% more than 6 times/week. The frequency of physical exercise in confinement correlates negatively with the feeling of sleepiness during the day ($r=-0.12$; $p<.05$). It also correlates negatively with apathy ($r=-0.17$; $p<.01$), worry ($r=-0.16$; $p<.01$) and fear ($r=-0.15$; $p<.05$) and positively with euphoria ($r=0.14$; $p<.05$).

Furthermore, it is observed that the number of confinement days correlates negatively with the feeling of activity during the day ($r=-0.12$; $p<.05$) and positively with the existence of nightmares ($r=0.16$; $p<.01$).

Differences in sleeping habits before and during confinement

In Table 1, we can see changes in the pattern of sleep before and during confinement. A large number of people in confinement delay both their bedtime and their wake-up time. The frequency of people suffering from night-time awakening also increases. In addition, long naps in confinement became more frequent.

Participants inform that their sleep time in pre-confinement ranged from 4 to 10 h, with an average of 7.23 h of sleep (SD = 0.91). After 15 d of confinement, sleep hours ranged from 4 to 12, with an average of 7.90 h of sleep (SD = 1.20). After 30 d of confinement, sleep hours ranged from 5 to 11, with an average of 7.85 h slept (SD = 1.08). Thus, average sleep hours increased significantly during confinement ($t=-11.40$; $p<.001$).

Satisfaction and sleep quality before and during confinement

For the subjective satisfaction with sleep quality (from 0 to 10), participants manifest a mean of 7.37 (SD = 1.80) before confinement, reducing to 7.11 (SD = 2.05) after 15 d of confinement and 6.83 (SD = 1.98) after four weeks. So, satisfaction with sleep quality decreased significantly during confinement ($t=3.53$; $p<.001$).

In Table 2, we observe that after 15 d of confinement, participants have a significantly higher difficulty of falling asleep and are less active during the day compared to what they recall before confinement. However, they also woke up significantly more rested, have less daytime sleepiness and suffer fewer nightmares. After a full month of confinement, some results changed significantly: difficulty falling asleep increased even more, also morning fatigue and nightmares increased. In Figure 3, we can see the temporal progression of sleep quality variables in the three measured periods.

Emotional experience before and during confinement

In Table 3, we observe that before confinement the most predominant emotions participants remember feeling were joy and calm. At 15 d of confinement, participants felt a significant increase in anxiety, apathy, sadness, worry, irritability and fear, as well as less joy and euphoria than they informed feeling before confinement. After 30 d of confinement, worry and fear are significantly reduced compared to the 2-week confinement. In Figure 4, we

can see the temporal progression of the emotional variables in the three times measured.

The relationship between sleep quality and emotional experience in confinement

When studying the correlation between sleep quality variables and emotional experiences at 15 d of confinement (Table 4), we observed a large number of correlations, of which we will focus on the strongest. Morning fatigue correlates with anxiety, apathy, sadness, anger and irritability in a positive way, and in a negative way with calmness. Waking-up headache correlates positively with anxiety and negatively with calmness. Sleepiness correlates positively with anxiety, apathy, anger, irritability and hostility. Daytime activity correlates positively with joy and negatively with apathy. Besides, anxiety correlates positively with night-time awakenings and nightmares, and negatively with perceived sleep quality.

Table 1. Sleep pattern frequencies before and during confinement.

	Time 1 ($N = 363$) *n* (%)		Time 2 ($N = 261$) *n* (%)
	Pre-confinement (retrospective measure)	15 d of confinement	30 d of confinement
Bedtime			
9–10:30 pm	24 (6.6%)	13 (3.6%)	6 (2.3%)
10:30–12:30 pm	241 (66.4%)	148 (40.8%)	102 (39.1%)
12:30 pm–2:30 am	95 (26.2%)	164 (45.2%)	132 (50.6%)
Later than 2:30 am	3 (0.8%)	38 (10.5%)	21 (8%)
Waking-up time			
Before 6 am	11 (3%)	2 (0.6%)	1 (0.4%)
6–7:30 am	137 (37.7%)	43 (11.8%)	15 (5.7%)
7:30–9 am	159 (43.8%)	126 (34.7%)	94 (36%)
9–10:30 am	50 (13.8%)	114 (31.4%)	104 (39.8%)
10:30–12 am	5 (1.4%)	60 (16.5%)	35 (13.4%)
Later than 12 am	1 (0.3%)	18 (5%)	12 (4.6%)
Night-time awakenings			
No awakenings	191 (52.6%)	143 (39.4%)	101 (38.7%)
1–2 times/night	141 (38.8%)	175 (48.2%)	124 (47.5%)
3–4 times/night	27 (7.4%)	38 (10.5%)	29 (11.1%)
+4 times/night	4 (1.1%)	7 (1.9%)	7 (2.7%)
Nap			
No nap	257 (70.80%)	245 (67.49%)	199 (76.25%)
10–20 min	39 (10.74%)	44 (12.12%)	19 (7.28%)
30 min − 1 h	56 (15.43%)	50 (13.77%)	33 (12.64%)
More than 1 h	11 (3.03%)	24 (6.61%)	10 (3.83%)

Discussion

Even though a large part of the population is in good physical health, some people may suffer from negative psychological effects due to confinement because of COVID-19 (Brooks et al. 2020). Some of the areas that are most quickly affected by confinement and stress are sleep and emotional experience (Xiao et al. 2020a). However, no longitudinal studies in this area have been found about people confined in Spain, one of the most severely affected countries (Altena et al. 2020).

The present work aimed to study changes in routines, sleep and emotions in the adult Spanish population confined due to COVID-19, comparing two different moments: the first moment after 15 d of confinement and a second moment after 30 d of confinement. An additional measure was taken at the first moment, asking about the memory of the state before the confinement. Results suggest that confinement has led to a change in sleep habits, although this does not necessarily mean a poorer sleep quality, which is consistent with previous literature (Alfonsi et al. 2021). Emotional experience is negatively affected due to confinement, increasing apathy, sadness, irritability, anxiety, concern and fear. Data show differences according to the time of confinement, as some variables worsen after 15 d of confinement, but seem to re-stabilise after 30 d. These findings provide information on how to intervene on sleep and emotions of confined people, considering that good sleep quality and positive emotional experience is a protective factor against the potential development of post-traumatic stress related with the pandemic (Bo et al. 2021).

Table 2. ANOVA repeated measures of sleep quality.

	T1-A M (SD)	T1-B M (SD)	T2 M (SD)	*F*	Wilks Lambda	ηp^2	Pairwise comparisons					
							Time		(I-J)	Error	LLCI 95%	ULCI 95%
Difficulty falling asleep	2.08 (0.87)	2.26 (1.03)	2.58 (1.07)	2098.82**	0.81	0.19	*T0*	*T1*	−0.17**	0.06	−0.31	−0.03
							T0	*T2*	−0.50**	0.07	−0.65	−0.34
							T1	*T2*	−0.33**	0.06	−0.47	−0.18
Morning fatigue	2.54 (0.89)	2.22 (0.98)	2.50 (1.05)	2309.22**	0.87	0.13	*T0*	*T1*	0.32**	0.06	0.18	0.47
							T0	*T2*	0.05	0.06	−0.10	0.19
							T1	*T2*	−0.28**	0.05	−0.41	−0.15
Headache	1.66 (0.72)	1.72 (0.90)	1.77 (0.88)	1521.02**	0.98	0.02	*T0*	*T1*	−0.06	0.04	−0.16	0.04
							T0	*T2*	−0.11	0.05	−0.22	0.00
							T1	*T2*	−0.05	0.05	−0.17	0.08
Sleepiness	2.21 (0.79)	2.01 (0.88)	2.13 (0.91)	2365.29**	0.95	0.05	*T0*	*T1*	0.20**	0.06	0.06	0.33
							T0	*T2*	0.08	0.06	−0.05	0.21
							T1	*T2*	−0.12	0.05	−0.23	0.00
Daytime activity	3.45 (0.82)	2.94 (0.97)	2.98 (.92)	49357.49**	0.75	0.25	*T0*	*T1*	0.51**	0.06	0.36	0.66
							T0	*T2*	0.47**	0.06	0.33	0.61
							T1	*T2*	−0.04	0.06	−0.18	0.10
Awakenings	1.51 (0.61)	1.51 (0.71)	1.57 (0.74)	2006.95**	0.99	0.01	*T0*	*T1*	0.00	0.04	−0.09	0.100
							T0	*T2*	−0.06	0.05	−0.18	0.05
							T1	*T2*	−0.07	0.04	−0.17	0.04
Early awakening	2.28 (1.08)	2.25 (1.17)	2.18 (1.11)	1493.26**	0.99	0.01	*T0*	*T1*	0.03	0.07	−0.12	0.19
							T0	*T2*	0.10	0.07	−0.06	0.27
							T1	*T2*	0.07	0.07	−0.09	0.23
Nightmares				1796.91**	0.92		*T0*	*T1*	0.14**	0.04	0.05	0.24
	1.83 (0.71)	1.69 (0.81)	1.87 (0.89)			0.08	*T0*	*T2*	−0.03	0.05	−0.16	0.09
							T1	*T2*	−0.18**	0.05	−0.29	−0.07

*$p < .05$; **$p < .01$.
ηp^2: partial Eta Square; T1-A: Retrospective measure of pre-confinement; T1-B: 15 d of confinement; T2: 30 d of confinement; LLCIL: lower limit confidence interval; ULCI: upper limit confidence interval.

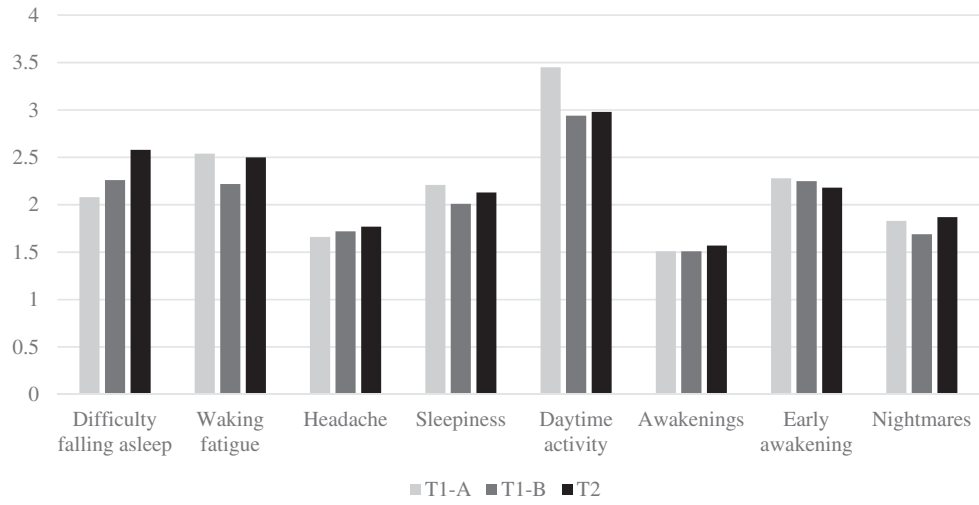

Figure 3. Progression of sleep quality over time. Y-Axis ranges between 1 and 5; T1-A: etrospective measure of pre-confinement; T1-B: 15 d of confinement; T2: 30 d of confinement.

Table 3. ANOVA repeated measures of emotional experience.

	T1-A M (SD)	T1-B M (SD)	T2 M (SD)	Wilks Lambda	ηp^2	Pairwise comparisons					
						Time		(I-J)	Error	LLCI 95%	ULCI 95%
Anxiety	2.33 (0.75)	2.50 (0.96)	2.46 (0.84)	0.97	0.03	*T0*	*T1*	−0.18*	0.06	−0.32	−0.03
						T0	*T2*	−0.13	0.06	−0.27	0.00
						T1	*T2*	0.05	0.06	−0.07	0.16
Apathy	1.99 (0.80)	2.37 (0.97)	2.41 (0.96)	0.81	0.19	*T0*	*T1*	−0.38**	0.06	−0.52	−0.23
						T0	*T2*	−0.42**	0.06	−0.57	−0.28
						T1	*T2*	−0.05	0.06	−0.18	0.09
Sadness	2.10 (0.66)	2.32 (0.82)	2.25 (0.81)	0.92	0.08	*T0*	*T1*	−0.22**	0.05	−0.33	−0.10
						T0	*T2*	−0.15**	0.05	−0.26	−0.04
						T1	*T2*	0.07	0.05	−0.04	0.18
Calm	2.77 (0.89)	2.77 (0.96)	2.78 (0.90)	1.00	0.00	*T0*	*T1*	−0.00	0.07	−0.17	0.17
						T0	*T2*	−0.00	0.06	−0.16	0.14
						T1	*T2*	0.00	0.05	−0.13	0.12
Anger	1.98 (0.52)	2.01 (0.72)	2.05 (0.71)	0.99	0.01	*T0*	*T1*	−0.03	0.04	−0.13	0.08
						T0	*T2*	−0.07	0.04	−0.17	0.04
						T1	*T2*	−0.04	0.05	−0.15	0.08
Worry	2.52 (0.75)	2.90 (0.94)	2.67 (0.92)	0.87	0.13	*T0*	*T1*	−0.38**	0.06	−0.53	−0.23
						T0	*T2*	−0.15*	0.05	−0.28	−0.02
						T1	*T2*	0.23**	0.06	0.23	0.53
Irritability	2.08 (0.64)	2.23 (0.90)	2.30 (0.87)	0.93	0.07	*T0*	*T1*	−0.15**	0.05	−0.28	−0.03
						T0	*T2*	−0.22**	0.05	−0.35	−0.10
						T1	*T2*	−0.07	0.05	−0.19	0.06
Euphoria	2.24 (0.72)	1.91 (0.72)	1.94 (0.73)	0.80	0.21	*T0*	*T1*	0.33**	0.04	0.23	0.43
						T0	*T2*	0.30**	0.05	0.19	0.41
						T1	*T2*	−0.03	0.04	−0.13	0.07
Fear	1.82 (0.77)	2.24 (1.03)	2.00 (0.93)	0.84	0.17	*T0*	*T1*	−0.42**	0.06	−0.56	−0.27
						T0	*T2*	−0.18**	0.05	−0.30	−0.05
						T1	*T2*	0.24**	0.05	0.13	0.35
Joy	3.33 (0.82)	2.80 (0.87)	2.85 (0.81)	0.69	0.31	*T0*	*T1*	0.53**	0.05	0.40	0.65
						T0	*T2*	0.48**	0.05	0.35	0.60
						T1	*T2*	−0.05	0.04	−0.65	−0.40
Hostility	1.72 (0.66)	1.81 (0.85)	1.82 (0.81)	0.97	0.03	*T0*	*T1*	−0.10	0.04	−0.19	0.00
						T0	*T2*	−0.11	0.05	−0.22	0.00
						T1	*T2*	−0.01	0.05	−0.12	0.10

*$p < .05$; **$p < .01$.
ηp^2: partial Eta square; T1-A: Retrospective measure of pre-confinement; T1-B: 15 d of confinement; T2: 30 d of confinement; LLCI: lower limit confidence interval; ULCI: upper limit confidence interval.

As for the hypotheses raised, the first hypothesis said that sleep quality will be poorer after a longer confinement period. This hypothesis is partially confirmed in the results: more days of confinement are related to less activity during the day and more nightmares, but it is not related to the other variables of sleep quality. This suggests that sleep quality does not get worse proportionately to lockdown time, so the relationship between these two variables may not be linear.

The second hypothesis suggested that sleep quality and positive emotional experience during confinement will be negatively related to socio-demographic factors such as age and low socioeconomic status, and positively related to healthy habits such as physical exercise at home. This hypothesis is confirmed: age and

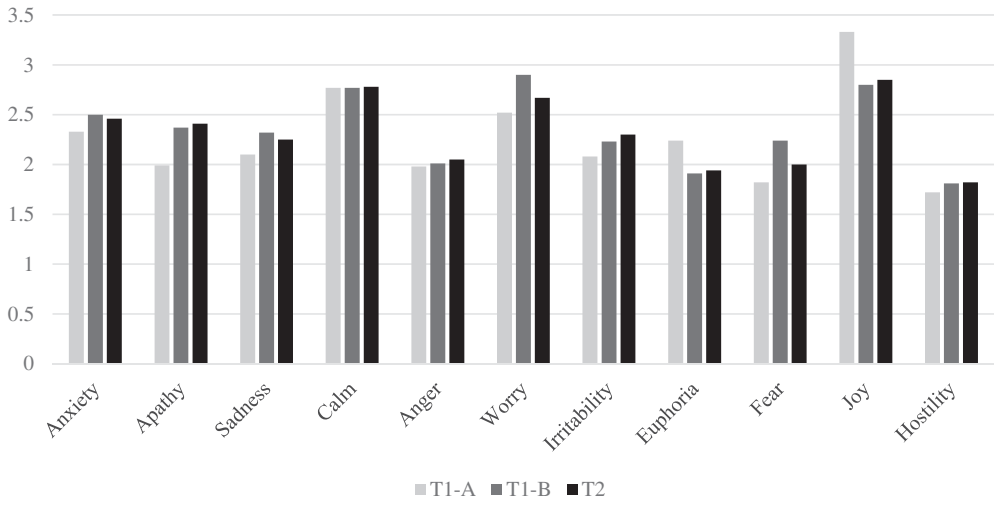

Figure 4. Progression of emotional variables over time. Y-Axis ranges between 1 and 5; T1-A: Retrospective measure of pre-confinement; T1-B: 15 d of confinement; T2: 30 d of confinement.

higher socioeconomic status are related to sleep quality during confinement. Higher age is associated with poor sleep satisfaction during confinement and with the emotion of fear, even though young people feel more apathy, irritability and hostility. Lower socioeconomic status is associated with more difficulty in falling asleep and, possibly in consequence, more difficulty to wake up early. Regarding emotional experience, economic difficulties are related to higher anxiety, apathy and irritability, in conjunction with lower relaxation. These results are in line with the literature (Xiao et al. 2020a 2020b), which suggests that increased social capital improves sleep quality by reducing anxiety and stress during a period of self-isolation. Physical activity at home may be a practical way to reduce those negative emotions, as it is related to lower apathy, concern, and fear, and with a greater euphoria. Also, people who did an exercise routine at home during confinement felt lower sleepiness during the day.

The third hypothesis indicated that sleep habits will change, and sleep quality will decrease in confinement. Results confirm the first part of the hypothesis, since sleep habits seem to change during confinement, but are not as concise about sleep quality. Regarding changes in sleeping habits, it is observed that many confined people delay both their bedtime and wake-up time. The frequency of people informing from suffering night-time awakenings seems to increase and long naps become more frequent during confinement. The number of hours of nightly sleep increases during confinement, from 7 to nearly 8 h. It can be taken as a positive aspect, since these are the recommended hours of sleep for an adult, with beneficial consequences for health (Potter et al. 2016). However, more important than the number of sleep hours is the subjective perception of satisfaction with sleep quality (Richards 2017), which decreased during confinement according to the results.

Regarding the sleep quality, there seem to be differences in the results depending on the time of confinement in each specific variable. Some variables notably get worse as the confinement progresses, such as the difficulty falling asleep. Daytime activity is also reduced, a natural consequence of being forbidden to leave the household. However, other variables of quality sleep seem to get better after 15 d of confinement compared to what participants remembered from before being confined, but after 30 d of confinement, they returned to a similar state as they felt before lockdown. The perception of morning fatigue, sleepiness during the day and nightmares was significantly reduced when participants answered after 15 d of confinement. One possible explanation for this is that at the beginning of confinement people had a greater perception of time for themselves, both in terms of hours of sleep and rest in general (Rogers 2020). But, when participants answered a second time after 30 d of confinement, morning fatigue, sleepiness and nightmares increased again. This may be related to the chronification of stress due to the confinement and the COVID-19 pandemic, as well as changes in sleep habits, such as delayed bedtime and waking-up time.

The fourth hypothesis suggests that emotional experience will get significantly worse during confinement, increasing the level of negative emotions. This hypothesis is confirmed by the results, except for emotions of calm, anger, and hostility, which do not seem to change during confinement. After 15 d of confinement, participants feel more apathy, sadness, irritability and less euphoria and joy than before the lockdown. These emotional changes remain stable after 30 d of confinement. This is probably due to the psychological burden of having to work from home, facing family problems and not being able to go out for pleasant activities or social meetings, among other reasons (Altena et al. 2020). Anxiety, though, seemed to increase after 15 d of confinement but was reduced after 30 d of confinement, returning to a similar level than before the lockdown. Concern and fear significantly increased after 15 d of confinement. After 30 d, concern and fear were reduced, but both emotions remained significantly higher than before the confinement. This increased concern and fear after 15 d of confinement may be due to the peak of deaths observed during this date (Figure 2), which later began to decline. Also, we could think that the reduction in anxiety, concern and fear during the confinement period is due to the natural human tendency to habituate, even to difficult or stressful circumstances (Yoon et al. 2016) This result suggests that participants show flexibility in adapting to adverse circumstances as confinement due to COVID-19, as well as a tendency to regulate their emotional experience (Rogers 2020).

Finally, the last hypothesis said that variables of sleep quality during confinement will be positively related to pleasant emotions and negatively related to unpleasant emotions after 15 d of confinement. This hypothesis is confirmed by the results. Some of the most remarkable results are the relationship between morning fatigue and sleepiness with higher anxiety, apathy, and anger, and

Table 4. Pearson correlations between variables at 15 d of confinement.

	HS	QS	FA	WF	HE	SL	DA	AW	EA	NI	AXE	AP	SA	CA	AG	WO	IR	EU	FE	JO	HO
HS	1																				
QS	.030**	1																			
FA	−0.02	**−0.46****	1																		
WF	−0.08	**−0.49****	**0.41****	1																	
HE	−.01	−.36**	.33**	**.40****	1																
SL	−0.05	−0.38**	0.24**	**0.68****	0.39**	1															
DA	−0.03	0.28**	−0.23**	**−0.49****	−0.27**	**−0.50****	1														
AW	−0.04	−0.37**	0.34**	0.26**	0.33**	0.30**	−0.12**	1													
EA	−0.24**	−0.27**	0.12*	0.20**	0.16**	0.17**	−0.07	0.21**	1												
NI	0.05	−0.32**	0.34**	0.31**	0.32**	0.23**	−0.14**	**0.50****	0.20**	1											
AXE	0.02	−0.33**	0.32**	0.36**	0.34**	0.35**	−0.22**	0.36**	0.18**	**0.43****	1										
AP	0.16**	−0.26**	0.26**	**0.50****	0.31**	**0.50****	**−0.53****	0.19**	0.15**	0.27**	0.37**	1									
SA	0.02	−0.18**	0.22**	0.30**	0.29**	0.28**	−0.24**	0.27**	0.08	0.37**	**0.54****	**0.46****	1								
CA	0.06	0.29**	−0.24**	−0.30**	−0.34**	−0.25**	0.18**	−0.26**	−0.12*	−0.24**	**−.56****	−.21**	**−.42****	1							
AG	−0.04	−0.16**	0.22**	0.32**	0.22**	0.30**	−0.18**	0.23**	0.07	0.24**	**0.44****	0.33**	**0.52****	−0.32**	1						
WO	−0.07	−0.25**	0.16**	0.16**	0.27**	0.20**	−0.15**	0.25**	0.14**	0.29**	**0.55****	0.27**	**0.52****	**−0.41****	0.35**	1					
IR	0.01	−0.25**	0.25**	**0.40****	0.27**	0.37**	−0.23**	0.20**	0.12*	0.23**	**0.43****	0.33**	**0.49****	−0.35**	**0.69****	0.24**	1				
EU	−0.09	0.04	−0.10	−0.04	−0.02**	0.01	0.24**	0.02	0.03	0.01	−0.08	−0.12**	−0.06	0.15**	0.10	−0.14**	.08	1			
FE	−0.08	−0.13*	0.18**	0.13*	0.21**	0.15**	−0.16**	0.26**	0.13*	0.29**	**0.45****	0.18**	**0.47****	−0.28**	0.29**	**0.61****	.19**	−.08	1		
JO	−0.03	0.22**	−0.22**	−0.31**	−0.16**	−0.26**	**0.40****	−0.17**	−0.03	−0.17**	−0.33**	**−.41****	**−0.45****	**0.46****	−0.32**	−0.32**	−.27**	.31**	−.23**	1	
HO	0.11*	−0.22**	0.25**	0.28**	0.29**	0.30**	−20**	0.29**	0.10	0.32**	0.38**	0.39**	**0.45****	−0.30**	**0.56****	0.31**	**.66****	.12*	.29**	-.25**	1

$*p < .01$ $**p < .001$.

HS: hours sleep; QS: sleep quality; FA: difficulty falling asleep; WF: morning fatigue; HE: headache; SL: sleepiness; DA: daytime activity; AW: awakenings; EA: early awakening; NI: nightmares; AXE: anxiety; AP: apathy; SA: sadness; CA: calm; AG: anger; WO: worry; IR: irritability; EU: euphoria; FE: fear; JO: joy; HO: hostility. Correlations higher than $r = 0.40$ (moderate correlation) are highlighted in bold.

lower calmness. Also, morning fatigue is associated with sadness while sleepiness associates with irritability. Wake-up headaches are related to high anxiety and lower calmness. Decreased daytime activity is associated with apathy and lower joy. Low satisfaction with sleep quality, as well as night-time awakenings and nightmares, are related to greater anxiety. These results are in line with what has been studied in the literature, which suggests a strong and bidirectional relationship between sleep quality and emotional experience (Kahn et al. 2013).

This study has its limitations, the most outstanding being the use of ad hoc measures. This decision was taken due to the particular and exceptional characteristics of the confinement situation, in which authors preferred to provide a different point of view using ad hoc questions adapted to the particular situation of the individuals, instead of general instruments that did not take into account the forced alteration of routines and the impediment to develop a normalised daily life. However, this decision implies a loss of validity in the results obtained, since the internal consistency of the questions asked was not evaluated. Thus, for future research, it would be necessary to carry out a validation of the measures used in order to study its characteristics and check convergent and discriminant validity by comparing them with other previously validated instruments.

Another limitation is the use of a convenience sample, which may make it difficult to generalise the results to the total population. It would be important to expand the sample to obtain higher representativeness of the older age ranges. Another issue to consider is that sleep quality and emotional experience before confinement was not measured before confinement, yet displays a subjective perception that subjects formed once they were on lockdown. Therefore, this measure could be influenced by alterations in memory or cognitive biases (Medrano-Martínez and Ramos-Platón 2016). Finally, it is difficult to know exactly how much of the emotional and sleep changes detected in this study are due to the fact of being confined, and how much is due to concern about the pandemic in general. Thus, we consider the importance of develop qualitative research for studying in more depth some issues related to the pandemics, such as worries about health, economic situation or social relationships, experiencing stressful life situations, perceived subjective changes in emotional state or sleep, among others.

Despite its limitations, this study helps to fill the gap in the scientific information that currently exists regarding the unexpected expansion of COVID-19. We consider it of vital importance to continue studying the impact of the pandemic not only on a physical level but also on a psychological level, both on those affected by the virus and the general population with and without previous sleep problems. This study provides specific information on the population living in Spain, a country that has been heavily affected by the virus. Considering the influence of cultural factors on the way people face adversity (Bernardi and Jobson 2019), the psychological effects of confinement should be further investigated in different countries. The results obtained in this study may help psychologists and sanitary professionals to design prevention and intervention plans on sleep and emotional experience of people in confinement. Healthy sleep habits and a positive emotional experience can be two protective factors that help people to effectively cope with the vital challenges arising from the pandemic (Altena et al. 2020; Gamaldo et al. 2012).

Acknowledgements

The authors thank the University of Valencia and the participants in this study.

Disclosure statement

The authors have no conflict of interest.

Funding

The author(s) reported there is no funding associated with the work featured in this article.

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Appendix 1. Evaluation questions at time 1*

Sociodemographic data

- Age
- Gender (1: Male; 2: Female; 3: Other).
- Education level (1: basic education; 2: bachelor's degree or training cycle; 3: university degree; 4: master's or doctorate degree).
- Socioeconomic level (1: 0–500 euros/month; 2: 500–1.000 euros/month; 3: 1.000–1.500 euros/month; 4: more than 1.500 euros/month).
- Do you suffer from a sleep disorder? (Yes/No). If yes, indicate which one(s).
- If you take any sleeping medication, indicate which one.
- If you have a diagnosed mental disorder, please indicate which.

Data relating to COVID-19

- How many days have you been in confinement?
- Before the quarantine, you lived with (1: family; 2: roommates or friends; 3: couple; 4: alone).
- During the quarantine, you live with (1: family; 2: roommates or friends; 3: couple; 4: alone).
- Employment/academic situation before quarantine (1: studying; 2: working; 3: unemployment).
- Employment/academic situation during quarantine (1: face-to-face working; 2: tele-working; 3: dismissal; 4: other work situation; 5: online studies).
- Physical activity routine before quarantine (1: I do not practice physical activity; 2: 1–2 times/week; 3: 3–5 times/week; 4: more than 6 times/week).
- Physical activity routine during quarantine (1: I do not practice physical activity; 2: 1–2 times/week; 3: 3–5 times/week; 4: more than 6 times/week).

First part: From here on, please answer as accurately as possible according to what you remember about your sleep habits during the month prior to being in confinement (February 2020).

Sleep habits

- Time of going to bed (1: 9–10:30pm; 2: 10:30pm to 12:30am; 3: 12:30am to 2:30am, 4: later than 2:30am).
- Time of getting up (1: before 6am; 2: 6–7:30am; 3: 7:30–9am; 4: 9–10:30am; 5: later than 12am).
- Indicate the average hours of sleep per night.
- Number of night-time awakenings (1: none; 2: 1–2 times/night; 3: 3–4 times/night; 4: more than 4 times/night).
- You used to take a nap? (Yes/No). If yes, indicate how long it usually lasts.

Sleep satisfaction

- How satisfied were you with your quality of sleep before quarantine? (Indicates a number from 1 to 10).

Sleep quality (1: Never; 2: Rarely; 3: Many times; 4: Almost always; 5: Always)

- I have trouble falling asleep
- I wake up tired
- I have a headache when I wake up
- I feel sleepy during the day
- I feel active during the day
- I wake up in the middle of the night startled
- I wake up earlier than I would like (with no alarm)
- I have nightmares

Emotional experiences (1: Never; 2: Rarely; 3: Many times; 4: Almost always; 5: Always)

- I feel anxiety
- I feel apathy
- I feel sadness
- I feel relaxation
- I feel anger
- I am concerned
- I feel irritability
- I feel euphoria
- I am afraid
- I feel joy
- I feel hostility

Second part: From here on, please answer as accurately as possible according to the present moment (in confinement).

- Same questions about sleep habits, sleep satisfaction, sleep quality and emotional experiences.

**Note.* At Time 2 of the research, only the "second part" of the evaluation was used.