

# Comparison of sleep characteristics during the first and second period of restrictive measures due to COVID-19 pandemic in Greece

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**Abstract.** – **OBJECTIVE:** The first wave of coronavirus pandemic and concomitant restrictive measures affected sleep. We slept more than usual, but the quality was worse. As the pandemic continues, a second period of restrictive measures was initiated, and no data exist about their impact on sleep. The aim of this study was to compare quantity and quality of sleep between the two periods of restrictive measures, due to the Coronavirus Disease-19 (COVID-19) pandemic in Greece.

**MATERIALS AND METHODS:** A web-based survey using a short 13-item questionnaire was created and was distributed online. This included information about demographic and professional data, quantitative and qualitative characteristics of sleep, degree of abidance in lockdown measures, and data about COVID-19 infection or close contact with active confirmed cases.

**RESULTS:** A total of 1,078 questionnaires were evaluated (first period, n=963; second period, n=115). Sleep duration was shorter during the second lockdown (mean difference -0.51h; 95% confidence interval, (CI), -0.82, -0.19,  $p=0.002$ ). Compared to usual habits, sleep increased in first wave (mean difference +0.37h; 95% CI, 0.26, 0.47;  $p<0.001$ ) and decreased in second wave (mean difference -0.35h; 95% CI, -0.60, -0.09;  $p=0.009$ ). Regarding quality of sleep, less participants reported good quality of sleep during the second wave compared to the first ( $p=0.006$ ). Finally, compliance to restriction measures was lower and the prevalence of confirmed illness or close contact with COVID-19 cases among participants was higher during the second period than during the first one ( $p<0.001$  and  $p=0.028$ , respectively).

**CONCLUSIONS:** Our data showed that sleep duration increased during the first lockdown and decreased in the second one, when compared to usual habits. Moreover, sleep quality progressively deteriorated, as the restrictive measures due to coronavirus pandemic continued.

*Key Words:*

COVID-19, Sleep, Sleep quality.

## Introduction

Acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection leading to Coronavirus disease (COVID-19) had spread rapidly worldwide and the first confirmed case in Greece was reported on 26 February 2020, two months after the first report in Wuhan, China, (31 December 2019)<sup>1-3</sup>. As new confirmed cases continued to increase, authorities responded to COVID-19 by applying measures like public commuting and travelling restrictions educational institutes' closure and enforcement of tele-working practices. On 22 March 2020, the Greek government announced the first national lockdown, with restrictions to all, non-essential movement throughout the country, that was extended until 4 May 2020 (42-days)<sup>3</sup>. Eventually, restrictions were withdrawn, and usual daytime activity was restored during summer 2020. Due to increased incidence of COVID-19 cases and deaths, on 7 November 2020, the

Greek government initiated the second national lockdown period that continues until now (end of March 2021 – 143 days).

Data from the first period showed that prolonged home confinement, in the context of a stressful situation of unknown duration, can affect sleep in different ways, depending on age, level of education, occupation, and country of residence<sup>4</sup>. We have previously reported a “gain” in self-reported sleep duration during the first lockdown period. However, in terms of quality, half of the population described their sleep as bad or average and one third of the participants reported worse sleep during the first lockdown week than in any other previous, “usual” week<sup>4</sup>. Several other studies<sup>5,6</sup> during the first peak of the SARS-CoV-2 pandemic confirmed that sleep quality was worse than before. Moreover, in a survey<sup>7</sup> from the United Kingdom, half of the population reported that their sleep was more disturbed and three up to ten said that although they slept longer, they felt less rested during lockdown. Sleep duration was longer probably due to the reduced mismatch between external (social) and internal (biological) sleep-wake timing<sup>8</sup>. On the other hand, worse sleep quality was reported due to the circadian rhythm’s disturbance and the higher prevalence of depression and anxiety<sup>9,10</sup>.

The aim of our study was to determine the characteristics of sleep during the second restriction period in Greece and to examine possible differences in terms of quantity and quality of sleep between the two periods (first vs. second).

## Materials and Methods

### Study Design

This study was conducted during the two lockdown periods in Greece, namely 25<sup>th</sup> March and 6<sup>th</sup> April 2020 (for the first), and 8<sup>th</sup> and 19<sup>th</sup> November 2021 (for the second). The Local Institutional Review Board (“Alexandra” University Hospital, Athens) approved the study protocol (Number of approval: 232/2020). A web-based, cross-sectional survey was developed, in order to avoid close contact between researchers and participants. A convenience sampling technique was selected, and the survey was promoted through social media, giving the potential to everyone speaking Greek and living in Greece to participate after accessing the relevant link<sup>11</sup>.

### Questionnaire

An anonymous 13-item questionnaire was developed by our research group<sup>4</sup> and was completed by interested and willing participants. Basic demographic data such as sex (male, female), age, place of residence, level of education (basic, upper secondary, higher-degree), professional status in current situation (work outside home, limited work outside home, work at home, health professional, retirement), compliance with lockdown measures (yes, sometimes, no) were recorded. In addition, the questionnaire included items on sleep duration during lockdown period and under usual conditions (mean hours of sleep per night), quality of sleep in current situation (good, moderate, bad), change of quality of sleep in lockdown compared to normal conditions (same, better, worst), naps, use of sleep-related drugs, and disease or close contact with confirmed cases of COVID-19.

### Statistical Analysis

GraphPad Prism v. 7.0 (GraphPad Software, San Diego, CA, USA) and IBM SPSS v.26.0 (IBM SPSS Statistics for Windows, NY, USA) were used for statistical analyses. Descriptive statistics procedures for complex survey data were used to examine demographic and sleep duration and quality. The association among variables was examined by chi-square. A between-within analysis of variance examined the main effects of variables and their interaction on sleep duration and eta square tested the magnitude of these relationships. A *p*-value less than 0.05 was regarded as statistically significant.

## Results

A total number of 1539 subjects participated in either survey. We excluded those who did not answer all the questions, resulting in a final sample of 1078 participants; 963 (28.8% males) during the first period, and 115 (42.6% males) during the second period. The two groups did not differ in mean age (46.3±8.3 vs. 47.2±11.2 years, *p*=0.272). Less subjects were completely obedient in lockdown measures during the second period when compared with the first (85.2% vs. 95% answered yes, *p*<0.001). More subjects reported COVID-19 infection or close contact with a confirmed case in the second period than in the first (4.3% vs. 1.3%, *p*=0.028).

Sleep duration was shorter in the second period ( $7.07 \pm 1.33$ h) than in first ( $7.57 \pm 1.64$ h) (mean difference  $-0.51$ h; 95% confidence intervals, CI,  $-0.82, -0.19$ ,  $p=0.002$ ) (Figure 1). Compared to usual habits, sleep duration increased in lockdown 1 (mean difference  $+0.37$ h; 95% confidence intervals, CI,  $0.26, 0.47$ ;  $p<0.001$ ) and decreased in lockdown 2 (mean difference  $-0.35$ h; 95% confidence intervals, CI,  $-0.60, -0.09$ ;  $p=0.009$ ). A small lockdown (second vs. first lockdown)\*week (lockdown vs. usual) interaction on sleep duration was found ( $p=0.001$ ,  $\eta^2=0.012$ ). Finally, percentage of participants reporting  $< 7$  h of sleep (insomnia) rose from 27.1% during the first period to 36.3% in the second ( $p=0.041$ ).

Regarding sleep quality, more than half of the study population described it as bad or average; 52.96% during the first period and 58.28% during the first. Moreover, less participants reported better than usual quality of sleep in the second than in the first lockdown period (8.6% vs. 20.7%, respectively,  $p=0.006$ ). No statistically significant difference was observed in daytime napping or use of sleep-promoting drugs between the two periods. The data are presented in Table I.

## Discussion

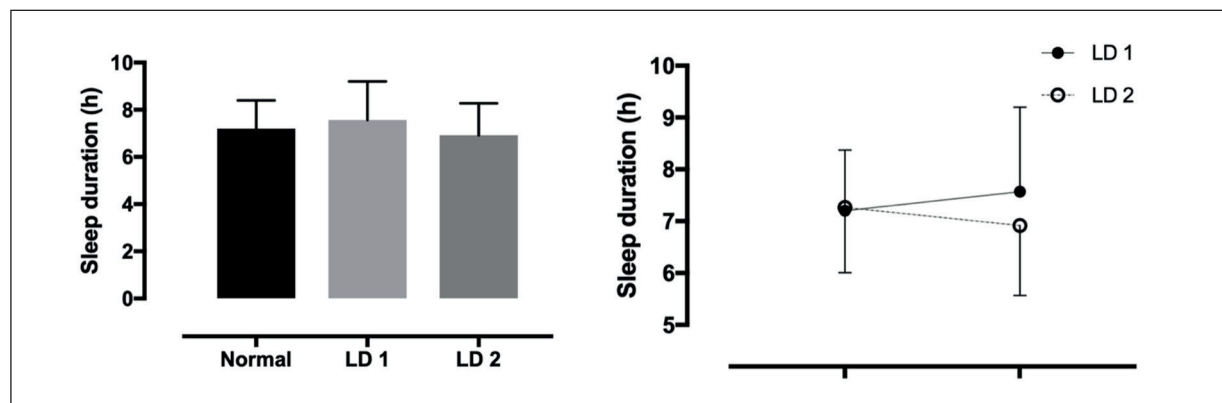
The main finding of the present study was that the reintroduction and extension of several restrictions due to increased incidence of SARS-CoV-2 infections in November 2020 led to a significant deterioration of sleep quality and quantity in the general population, compared to that reported in the first period. To our knowledge, this is the first study comparing sleep characteristics in a sample from the general population of

Greece, between these two consecutive periods of restrictions as a state response to the COVID-19 increased incidence.

In the initial stages of the pandemic, several studies<sup>4-8</sup> have been conducted globally to assess lifestyle changes and the impact on sleep in populations subjected to restrictions. We have previously described an increase in self-reported sleep duration during this first period when compared to usual conditions, depending on age, level of education, occupation, and country of residence; however, sleep quality was poorer<sup>4</sup>. Sleep quality represents one's satisfaction of the sleep experience, in terms of sleep initiation, sleep maintenance, sleep quantity, and refreshment upon awakening<sup>12</sup>. It is associated with mental and physical health and functioning and, therefore, it could be an issue of a public health concern. In accordance with our findings, increased sleep duration of poor quality was also reported in studies from other European countries like Italy<sup>5,6</sup>, Spain<sup>13</sup>, Austria, Germany, and Switzerland<sup>8</sup>, and United Kingdom<sup>7</sup>.

During the first wave of the pandemic, although people slept more, they felt less refreshed upon awakening. Reduced "social jetlag" and improved individual sleep-wake schedules led to an increase in sleep duration, especially in delayed chronotypes<sup>8,14</sup>. On the other hand, decreased mental and physical wellbeing due to fear, uncertainty and imposed restrictions led to higher levels of stress, anxiety, and depression and aggravated sleep quality<sup>15</sup>. As the pandemic continues into the second year, a good night's sleep is getting harder. The informal term 'coronasomnia' has become rapidly popular to describe sleep problems related to the pandemic.

According to our data, during the second lockdown period in Greece, self-reported duration of sleep decreased compared to normal conditions and the number of people experiencing insomnia



**Figure 1.** Sleep duration in lockdown 1 and 2 compared to a 'normal' week. LD 1 = lockdown 1; LD 2 = lockdown 2.

**Table I.** Comparison of characteristics of participants during the two periods of restrictions.

	Period 1 (n = 963)	Period 2 (n = 115)	Statistics
<b>Sex</b>			
Women	685 (71.2%)	66 (57.4%)	$\chi^2 = 9.3, p = 0.002$
Men	277 (28.8%)	49 (42.6%)	
Age (years)	46.3 ± 8.3	47.2 ± 11.2	$t = 1.1, p = 0.272$
<b>Compliance with restriction measures</b>			
Yes	908 (95.0%)	98 (85.2%)	$\chi^2 = 24.6, p < 0.001$
Sometimes	39 (4.1%)	17 (14.8%)	
No	9 (0.9%)	0	
<b>Change in sleep duration (compared to usual) (hours)</b>	+0.37 ± 1.62	-0.35 ± 1.01	$t = 3.4, p = 0.001$
<b>Quality of sleep</b>			
Good	452 (47.0%)	49 (42.2%)	$\chi^2 = 2.4, p = 0.305$
Average	353 (36.7%)	51 (44.0%)	
Bad	157 (16.3%)	16 (13.8%)	
<b>Change in quality of sleep (compared to usual)</b>			
Better	199 (20.7%)	10 (8.6%)	$\chi^2 = 10.1, p = 0.006$
Same	442 (45.9%)	65 (56.0%)	
Worst	321 (33.4%)	41 (35.3%)	
<b>Napping</b>			
Often	103 (10.7%)	15 (12.9%)	$\chi^2 = 1.1, p = 0.579$
Occasionally	374 (38.9%)	40 (34.5%)	
Never	484 (50.4%)	61 (52.6%)	
<b>Medication</b>			
Often	43 (4.5%)	6 (5.2%)	$\chi^2 = 0.4, p = 0.812$
Occasionally	72 (7.5%)	7 (6.0%)	
Never	846 (88.0%)	103 (88.8%)	
<b>COVID-19 infection or close contact to confirmed case</b>			
Yes	12 (1.3%)	5 (4.3%)	$\chi^2 = 6.3, p = 0.028$
No	942 (98.7%)	110 (95.7%)	

(< 7h of sleep) increased. Bad or average quality of sleep was reported by more than half of the participants. It was assumed that a prolonged lockdown destroyed daily routines due to social distancing, erased work-life boundaries and enhanced ongoing uncertainty about financial consequences. Moreover, it seemed that reduced physical activity, exposure to sun, and increased use of electronic devices led to a progressive and severe deterioration of sleep quantity and quality. A recent study<sup>16</sup> in Greece highlighted that increased levels of intolerance to uncertainty, COVID-19-related worry, loneliness, and more severe depressive symptoms, were all associated with bad sleep and insomnia.

Nonrestorative or poor quality and/or chronic loss of sleep can activate the hypothalamic-pituitary-adrenal (HPA) axis and stimulate a state of hyperarousal, sleeplessness and complaints about fatigue<sup>17-19</sup>. On the other hand, sleep has an inhibitory effect on HPA activation<sup>19</sup>. Short or poor sleep is strongly associated with anxiety, depression, obesity, cardiovascular diseases, cancer, and dementia<sup>20</sup>. Furthermore, sleep is crucial for daytime functioning and insomnia symptoms correlate

with increased accident risk and work disability<sup>20</sup>.

The major strength of our study is the originality and novelty of our data. This is the first study to examine and compare sleep characteristics of the general population between the two first periods of the COVID-19 pandemic. However, our study also has limitations. The short, self-reported questionnaire assessing sleep characteristics in participants was not previously validated; nonetheless, the items were already used in previously validated questionnaires<sup>4</sup>. Moreover, subjective reports could not be verified with objective measurements (actigraphy) due to pandemic measures. Finally, the study was based on a convenience sampling technique making it vulnerable to certain biases.

### Conclusions

The findings of the present study provide evidence that sleep deteriorates as COVID-19 pandemic and associated restrictive measures continue affecting all aspects of daily life.



### Conflict of Interest

The Authors declare that they have no conflict of interests.

### Funding

This research received no external funding.

### Authors' Contribution

Conceptualization, P.T.N., B.K. and G.T.; methodology, P.T.N., B.K. and G.T.; software, P.T.N., B.K. and G.T.; validation, P.T.N., B.K. and G.T.; formal analysis, P.T.N., B.K. and G.T.; investigation, P.T.N., B.K. and G.T.; resources, P.T.N., B.K. and G.T.; data curation, P.T.N., B.K. and G.T.; writing—original draft preparation, A.T., P.T.N., N.T.E., A.K., E.N., P.S., B.K. and G.T.; writing—review and editing, A.T., P.T.N., N.T.E., A.K., E.N., P.S., B.K. and G.T.; visualization, P.T.N., B.K. and G.T.; supervision, P.T.N., B.K. and G.T.; project administration, P.T.N., B.K. and G.T.; funding acquisition, P.T.N., B.K. and G.T. All authors have read and agreed to the published version of the manuscript.

### Institutional Review Board Statement

The study was conducted according to the guidelines of the Declaration of Helsinki, and the local institutional review board ("Alexandra" University Hospital, Athens) approved the study protocol (number of approval: 232/2020).

### Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

### Data Availability Statement

All data are available by the corresponding author upon reasonable request.

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