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# Sleep/wake rhythm modifications in the Italian population during SARS-CoV2 pandemic: a web-based cross-sectional survey

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**Abstract. – OBJECTIVE:** The study aims to investigate in a representative sample of the Italian population whether the SARS-CoV2 pandemic and the subsequent home isolation had repercussion on the daily sleep/wake cycling and habits.

**MATERIALS AND METHODS:** A web-based cross-sectional survey consisted of various multiple-choice questions concerning demographic characteristics, sleep habits, and sleep-related problems was broadcast through mainstream social-media. Individuals were randomly allowed to participate from April 29th to May 17th, namely 50 days after the lockdown imposition and the day before its abrogation.

**RESULTS:** 58.84% of respondents experienced a change in their sleep habits. 71% of those whose sleep changed showed a delayed sleep pattern. Overall, a two-fold risk of delayed sleep pattern without any change in total sleep time emerged during the investigation period. Females emerged almost 2 times more likely to modify their sleep habits than males. Youths were also more likely to experience modifications than old people, who conversely appeared protected. A significant improvement in daytime sleepiness occurred during the home isolation which additionally correlated with delayed bedtime and less sleep time.

**CONCLUSIONS:** A high rate of change in sleep habits, especially among youths and females, occurred in Italian population during the home isolation to limit the SARS-CoV2 pandemic. Moreover, self-reported daytime sleepiness decreased in severity.

*Key Words:*
COVID-19, Sleep behavior, Daytime sleepiness, Italian population.

## Introduction

In the late 2019 in Wuhan, China, emerged a novel human infecting coronavirus, SARS-CoV2, responsible for the pandemic disease COVID19[1,2]. The emergency was declared by the World Health Organization on January 30, 2020[3]. To date, epidemiological data report more than 170 million diagnosis and more than 3.5 million deaths due to COVID-19 worldwide[4]. On March 10$^{th}$, 2020, following the spread of the SARS-CoV2 pandemic, the Italian government imposed the lockdown of all activities on the entire national territory[5]. These measures consisted of physical distancing and self-isolation for more than 2 months and in particular cases were accompanied by a formal mandatory quarantine. People could leave home only if strictly necessary, such as for working activities or to buy food and medicine. Universities and schools were all closed, and students had to get familiar with in-home distance learning programs. Therefore, unexpected and radical changes occurred in habits and lifestyles of the population. These rigid rules, together with the fear of being infected, generated profound levels of anxiety, depression e suicidal thoughts in the general population[6-8]. A web-based cross-sectional survey reported severe psychological effects of COVID-19 in Italian population during the lockdown[9]. Reportedly, 32.1% of respondents experienced generalized anxiety symptoms, 41.8% psychological distress and 7.6% Post Traumatic Stress Disorder. Additionally, individuals were more likely to develop sleep problems[9]. Indeed, forced isolation represented per se an additional

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source of stress and could further alter the balance between circadian rhythm (CR) and sleep homeostasis *via* decreasing the exposition to zeitgebers.

The day/night cycle of wakefulness and sleep is regulated by a physiological clock in the anterior hypothalamus. This is the suprachiasmatic nucleus (SN)[10] and pushes sleepiness and alertness at about predictable times every day. The SN is the endogenous, self-sustained master clock that synchronize living systems to the outside environment[11]. It is highly conserved among animals, plants and insects, and allows individuals to entrain over a close to 24 hours behavioral states' pattern. However, healthy individuals not exposed to environmental zeitgebers run slightly longer than 24 hours, as they go to bed and wake up a little bit later every day. This type of circadian pattern has been named free running phenotype, which is typical of experimental designs in which external stimuli are abolished[12,13]. Similarly, the ability of individuals to cope with inadequate sleep will depend in part on whether the sleep regulatory system can acclimate to the stress of chronic sleep restriction[13]. In the last centuries, the conversion of human-being into a working 24 hours/day society has altered people normal pattern of sleep and wakefulness; in some cases, individuals work at night and rest during the day. Nowadays, around 17% of working population might be classified as shift workers. Societies have witnessed the deterioration in the quality of sleep and the corresponding rise in Daytime Sleepiness (DS). According to the U.S. Centers for Disease Control and Prevention, more than 1 out of 3 adult Americans lives with a chronic sleep debt[14]. Therefore, growing interest is arising about the impact of society impositions on the pathophysiology of CR in humans.

The purpose of this study is to investigate, in a random representative sample of the Italian population, whether and how the SARS-CoV2 pandemic and the subsequent home isolation affected the daily sleep/wake cycling. To accomplish the aim, the authors provided an online questionnaire named "University of Cagliari-Sleep/Wake Rhythm Modifications in Italian Population during SARS-CoV2 Pandemic".

## Materials and Methods

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Review Boards at the University of Cagliari with the referent code PROT. PG/2020/13742.

### Study Population

Data were collected from a large community sample in Italy in 2020, during the SARS-CoV2 pandemic, and precisely between April 29th and May 17th. The survey was performed in agreement with the progress of the lockdown due to SARS-CoV2 in Italy, starting from the 50th day after its imposition and ending the day before its abrogation. As the biological clocks in humans tends to adjust rather slowly to shift in time, 50 days were supposed to be accurate to analyze the modified behavioral states' pattern. The target population consisted of Italian noninstitutionalized adults aged 18 years or older.

### Procedure

The setting of this study is a web-based cross-sectional survey. Google Forms was used as operating system as it consists in a free and publicly accessible online portal of Google Inc that allows users to interact easily with interviewers[15]. The survey was supplied through different platforms and mainstream social media. The study was conducted completely in blind as the authors received only nameless answers. In every part of the study personal data were no attributable to the own participants thanks to the operating system used. However, individuals were asked to provide an anonymous informed consent prior to submission. The questionnaire was accompanied by an introductory letter. The assessment took approximately 5 minutes to complete in all its parts. A translated version of the aforementioned questionnaire is available as supplementary material. Only data from questionnaires that had a complete set of participants' responses were analyzed.

### Structure of Questionnaire

The questionnaire consisted of 13 multiple-choice questions concerning demographic characteristics and sleep habits of participants. Questionnaire items were closed ended and the format was based on statements with tick box categories, easy to understood and quick to complete with meaningful answers. All questions were provided through a qualitative design to obtain categorical, nominal or ordinal data based on each specific variable. The questionnaire consisted of 3 parts: demographic characteristics, baseline sleep behaviors and sleep behaviors during the lockdown. In order to define the demographic characteristics, sex, age and occupation were assessed. Age and occupation were investigated as ordinal categorical data. In particular, age was arranged into 6 major categories, 18-29, 30-39, 40-49,50,59,60-69 and >70, and occupation was defined in terms of full-time occupation, part-time occupation and no occupation.

Sleep habits were ascertained as ordinal categorical data through the following multiple-choice questions: "Which sleep cycle do you usually belong to?" (Normal, sleeping from 11.00 pm to 8.00 am; Advanced, sleeping from 9.00 pm to 6.00 am; Delayed, sleeping from 1.00 am to 10.00 am); "How many hours do you usually sleep?" (>8; 5-8; <5). Drugs' use on regular basis was assessed as binary data: "Do you usually take medications to sleep?" (Yes; No). (Difficulties in initiating and maintaining sleep were recorded: "If you used to sleep less than 5 hours, causes were:" Difficulties in sleep onset; Early awakening in the morning; Multiple awakenings during the night; 2 or more of the above options; I used to sleep more than 5 hours/night). DS, fatigue, tiredness and lack of energy were assessed: "Do you usually suffer from daytime sleepiness and/or fatigue and/or tiredness and/or lack of energy?" (Never; Mild, sometimes; Moderate, often; Severe, always).

Any occurred change after 50 days of home isolation was ascertained with the following questions: "Since the imposition of the lockdown, has your sleep changed" (Yes; No); "If yes, what has changed in your sleep?" (Sleep duration; Sleep cycle; Both; Nothing has changed); "If sleep duration has changed, you are sleeping:" (More; Less; Sleep duration has not changed); "If sleep cycle has changed, you are going to bed:" (Earlier; Later; Sleep cycle has not changed); "Are you suffering from daytime sleepiness and/or fatigue and/or tiredness and/or lack of energy?"(Never; Mild, sometimes; Moderate, often; Severe, always).

### *Statistical Analysis*

The first step was an exploratory analysis to understand what kinds of data were collected and how they were distributed. The second step was an analysis of correlations that led to the change in sleep cycle and duration and in DS. Distribution of absolute and relative frequencies and Odds Ratio (OR) with the relative two-sided Wald 95% Confidence Interval (CI)[16] were used.

Python language was used for statistical analysis through the following packages: Pandas and Scipy for exploratory analysis and correlation study, Zepid for OR and 95% CI.

## Results

A total of 967 survey respondents participated to the study.

### *Baseline Characteristics*

Figures 1 and 2 display the baseline characteristics of the sample. The demographic distribution of participants showed that mostly were female (58.84%), younger than 50 years old (66.48%) and full-time workers (61.84%). "Normal" was the most prevalent sleep cycle as 64.32% of respondents revealed to use to sleep between 11.00 pm and 8.00 am. 81.49% of participants reported to sleep usually from 5 up to 8 hours per night while only 4.24% of participants tended to sleep less than 5 hours/night. "Multiple awakenings during the night" were reported to be the most common cause of sleep restriction. When "Daytime sleepiness and/or fatigue and/or tiredness and/or lack of energy" were investigated, "Mild, sometimes" was the most prevalent answer, 55.43%. Conversely, only 0.93% of respondents reported "Severe, always" suffering. 94.21% of the whole sample declared not to take sleep medications.

### *Sleep Changes*

569 respondents, namely 58.84% of the whole sample, reported modifications in their sleep habits during the lockdown. Table I depicts the proportions of the sample whose sleep changed. Going to sleep later contains 71.18% of subjects whose sleep changed, which means 41.88% of the total. Analyzing data in terms of sleep duration only among those who selected a delayed sleep cycle, 43.95% declared to sleep more, 37.04% to sleep less and 19.01% no changes. When the whole group of participants reporting changes in sleep duration is taken into account, "More" was the most common answer, 45.34%, followed by "Less", 37.78%, and "Sleep duration has not changed", 16.87%. The only significant correlation between modifications in sleep cycle and sleep duration emerged for delayed sleep without any changes in total sleep time [OR 1.80, 95%CI (1.05-3.07)].

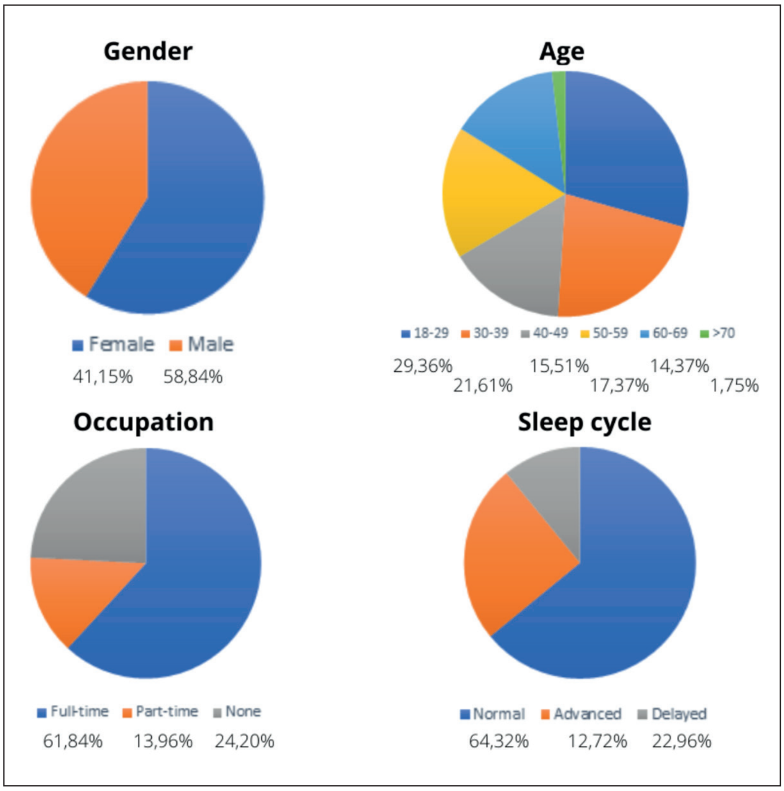


**Figure 1.** Distribution of respondents' baseline characteristics.

When any sleep change was adjusted for demographic factors (Figure 3), gender and age emerged to be risk factors. About 64.50% of women experienced changes in their sleep habits, nearly 15% more than men [OR 1.76, 95%CI (1.36-2.29)]. Furthermore, the 18-29 age group underwent the greatest change as 69.01% experienced a modification in their sleep habits [OR 1.85, 95%CI (1.38-2.48)]. By contrast, older age revealed to protect from changes in sleep: 60-69 group OR 0.48, 95%CI (0.33-0.69), and >70 group OR 0.15, 95%CI (0.04-0.51).

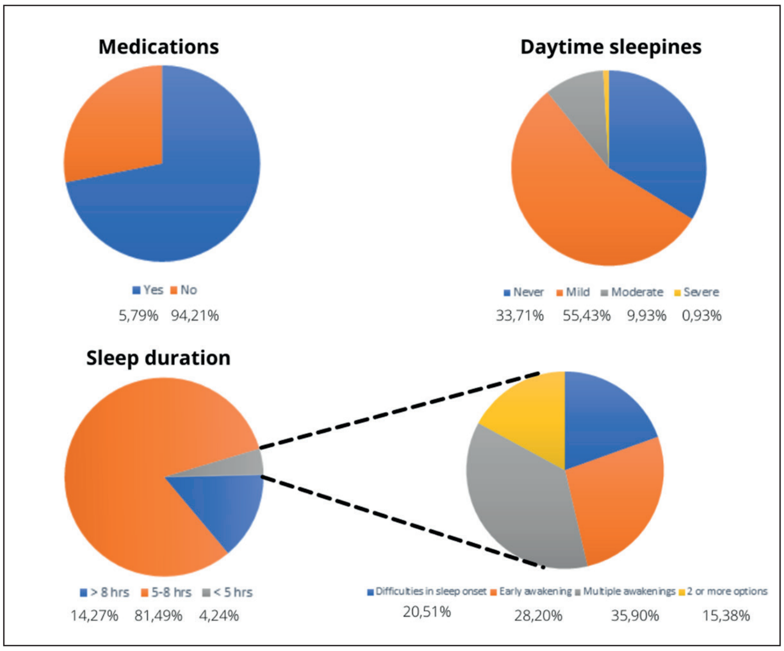


**Figure 2.** Distribution of respondents' baseline characteristics.

**Table I.** Contingency sleep change causes.

| | Not changed (%) [OR (95% CI)] | Delayed bedtime (%) [OR (95% CI)] | Earlier bedtime (%) [OR (95% CI)] | Total |
|---|---|---|---|---|
| Sleep less (%) | 43 (7.56%) | 150 (26.36%) | 22 (3.96%) | 215 (37.78%) |
| [OR (95% CI)] | [1.30 (0.84-2.02)] | [0.87 (0.61-1.30)] | [0.85 (0.49-1.46)] | |
| Sleep more (%) | 46 (8.08%) | **178 (31.28%)** | 34 (5.97%) | **258 (45.34%)** |
| [OR (95% CI)] | [1.03 (0.67-1.59)] | [0.83 (0.57-1.18] | [1.42 (0.84-2.40)] | |
| Not changed (%) | 11 (1.93%) | 77 (13.53%) | 8 (1.41%) | 96 (16.87%) |
| [OR (95% CI)] | [0.56 (0.29-1.09)] | [1.80 (1.05-3.07)] | [0.68 (0.31-1.47)] | |
| Total | 100 (17.57%%) | **405 (71.18%)** | 64 (11.25%) | 569 (100%) |

Duration (rows), Cycles (column). The mode is in bold type.

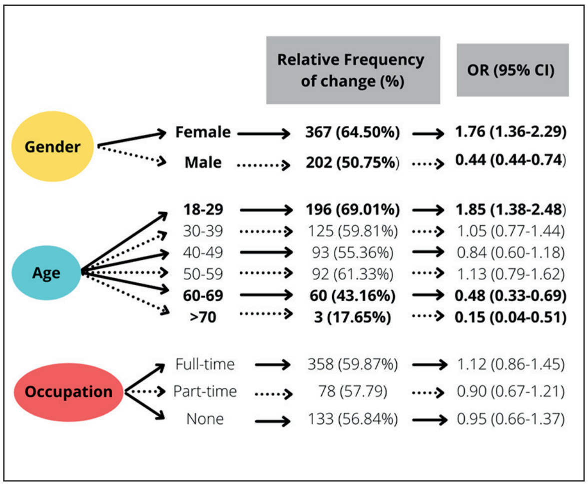


**Figure 3.** Sleep changes and demographic variables. Relative frequency.

### *Daytime Sleepiness*

DS, described additionally as fatigue and/or tiredness and/or lack of energy, was firstly analyzed in terms of percentage differences (%) (Figure 4). The answer "Never" peaked during the lockdown, increasing from 33.71% to 40.43%, since 19.94% more patients reported that they no longer suffer from DS. By contrast, "Mild, sometimes", "Moderate, often" and "Severe, always" showed a slight resolution of 10.26%, 9.37% and 11.11%, respectively.

Table II shows the comparison of DS before and during the lockdown. Percentage frequency on the total sample and percentage frequency by category were calculated. The former defines the magnitude of any changes in DS before and during the lockdown. More accurately, percentage frequency by category refers to how many

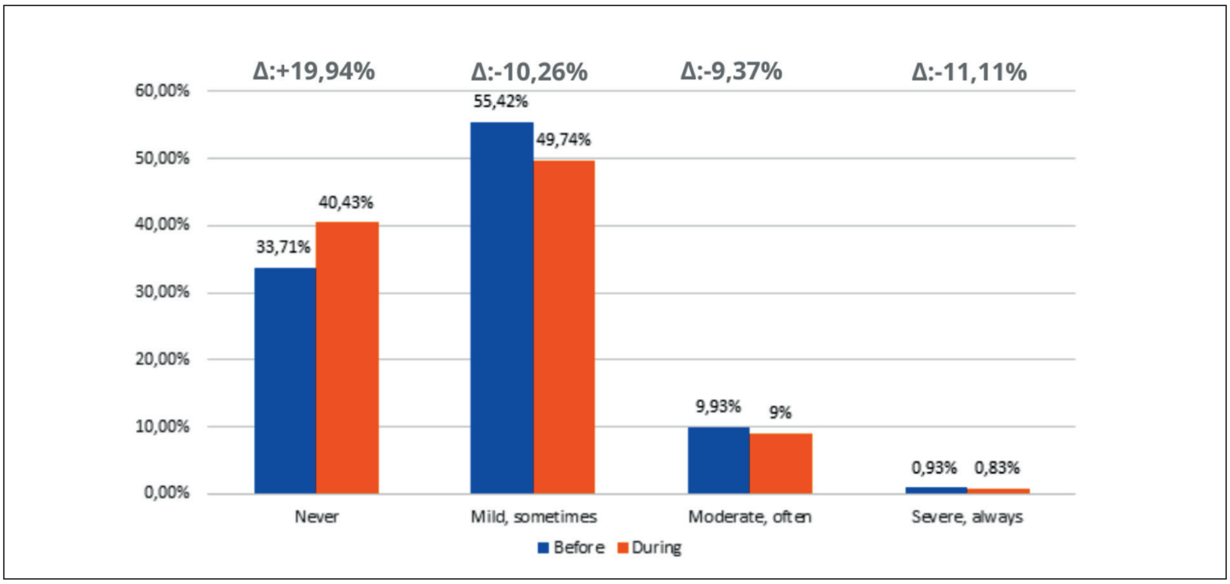


**Figure 4.** Comparison of daytime sleepiness and/or fatigue and/or tiredness and/or lack of energy before and during the lockdown.

**Table II.** Comparison of daytime sleepiness and/or fatigue and/or tiredness and/or lack of energy before and during the lockdown.

| Before | During | N | Percentage frequency on the total sample | Percentage frequency by category | OR (95% CI) |
|---|---|---|---|---|---|
| Never | Mild, sometimes | 57 | 5.89% | 17.48% | 2.43 (0.83-7.09) |
| | Moderate, often | 5 | 0.52% | 1.53% | **0.32 (0.12-0.86)** |
| | Severe, always | 1 | 0.10% | 0.31% | 0.80 (0.09-7.31) |
| Mild, sometimes | Never | 120 | 12.41% | 22.39% | **19.71 (8.51-45.66)** |
| | Moderate, often | 32 | 3.31% | 5.97% | 2.30 (0.96-5.52) |
| | Severe, always | 3 | 0.31% | 0.56% | 1.08 (0.18-6.55) |
| Moderate, often | Never | 6 | 0.62% | 6.25% | **0.05 (0.02-0.15)** |
| | Mild, sometimes | 41 | 4.24% | 42.71% | 0.99 (0.35-2.82) |
| | Severe, always | 1 | 0.10% | 1.04% | 1.14 (0.12-10.42) |
| Severe, always | Never | 2 | 0.21% | 22.22% | 0.31 (0.06-1.81) |
| | Mild, sometimes | 2 | 0.21% | 22.22% | **0.07 (0.01-0.40)** |
| | Moderate, often | 2 | 0.21% | 22.22% | 2.45 (0.43-13.85) |

Percentage frequency on the total sample and by category. Never (*green*), mild, sometimes (*yellow*), Moderate, often (*orange*), severe, always (*red*).

people out of the total number of subjects who suffered from a certain level of DS before the pandemic changed into a different level during the pandemic. 22.39% of participants who used to suffer from "Mild, sometimes" DS reported an improvement to "Never" during the lockdown [OR 19.71, 95%CI (8.51-45.66)]. Despite the proportion, those who habitually were affected from "Moderate, often" DS and passed to "Mild, sometimes" failed in reaching a statistical significance [OR 0.99,95%CI (0.35-2.82)]. Having suffered from "Moderate, often" DS before the pandemic negatively affected the answer "Never" during the lockdown [OR 0.05, 95%CI (0.02-0.15)]. Habitual "Severe, always" DS similarly influenced the transition to "Mild, sometimes" [OR 0.07, 95%CI (0.01-0.40)]. Never having suffered from DS significantly reduced the risk of developing "Moderate, often" DS during the lockdown [OR 0.32, 95%CI (0.12-0.86)].

Among the 569 subjects who experienced sleep modifications, only 192 reported a change in DS while 337 did not declare any change. Specifically, DS decreased in 117 subjects and increased in 75 subjects. The correlation between the non-variation, the decrease and the increase of DS and changes in the duration and cycle of sleep was separately analyzed and the Odds Ratio was subsequently obtained (Table III, IV and V).

**Table III.** DS and changes in sleep cycle and sleep duration; data referred to those who didn't experience any change in DS during the lockdown.

| = DS | Not changed (%) [OR (95% CI)] | Delayed bedtime (%) [OR (95% CI)] | Earlier bedtime (%) [OR (95% CI)] | Total |
|---|---|---|---|---|
| Sleep less (%) | 36 (9.55%) | 93 (24.67%) | 14 (3.71%) | 143 (37.93%) |
| [OR (95% CI)] | [1.79 (1.07-3.00)] | [0.55 (0.34-0.86)] | [1.48 (0.70-3.13)] | |
| Sleep more (%) | 28 (7.43%) | **122 (32.36%)** | 13 (3.45%) | 163 (43.24%) |
| [OR (95% CI)] | [0.78 (0.46-1.31)] | [1.21 (0.77-1.92] | [1.00 (0.47-2.13)] | |
| Not changed (%) | 9 (2.39%) | 59 (15.65%) | 3 (0.79%) | 71 (18.83%) |
| [OR (95% CI)] | [0.55 (0.26-1.16)] | [2.08 (1.07-4.06)] | [0.46 (0.13-1.55)] | |
| Total | 73 (19.37%) | 274 (72.68%) | 30 (7.95%) | 377 (100%) |

The mode is in bold type.

**Table IV.** DS and changes in sleep cycle and sleep duration; data referred to those who experienced a reduction in DS during the lockdown.

| ↓ DS | Not changed (%) [OR (95% CI)] | Delayed bedtime (%) [OR (95% CI)] | Earlier bedtime (%) [OR (95% CI)] | Total |
|---|---|---|---|---|
| Sleep less (%) | 2 (1.71%) | 26 (22.22%) | 4 (3.42%) | 32 (27.35%) |
| [OR (95% CI)] | [0.338 (0.07-1.58)] | [2.75 (1.02-7.39)] | [0.50 (0.16-1.59)] | |
| Sleep more (%) | 13 (11.11%) | **40 (34.19%)** | 14 (11.97%) | **67 (57.27%)** |
| [OR (95% CI)] | [3.77 (1.01-14.05)] | [0.47 (0.21-1.05] | [1.20 (0.47-3.05)] | |
| Not changed (%) | 1 (0.85%) | 12 (10.26%) | 5 (4.27%) | 18 (15.38%) |
| [OR (95% CI)] | [0.33 (0.04-2.66)] | [1.00 (0.35-2.90)] | [1.73 (0.55-5.47)] | |
| Total | 16 (13.68%) | **78 (66.67%)** | 23 (19.65%) | 117 (100%) |

The mode is in bold type.

Table III shows the distribution of changes in sleep duration and cycle among participants who did not report any changes in DS. Those who answered to go to bed later represent the 72.68% of the group. Differences in proportion about self-reported total sleep time were less dramatic as 43.24% of subjects reported to sleep more and 37.93% to sleep less. Participants who slept less during the lockdown emerged at reduced risk to go to bed later [OR 0.55, 95%CI (0.34-0.86)] which was in turn positively associated with no changes in total sleep time [OR 2.08, 95%CI (1.07-4.06)].

57.27% of subjects who reported a decrease in the DS during the lockdown emerged to have increased their sleep time. Additionally, most of them experienced a delayed in their bedtime. When the whole group is considered, two out of three participants having experienced a reduction in DS reported to go to bed later than normal habits. Significantly, subjects who reduced their sleep time were at 2.75 times greater risk to go to bed later. By contrast, those whose sleep time did not change had almost 4 times the probability to not change the sleep cycle.

In subjects where DS increased, almost one out of two reported both to sleep less and to go to bed later during the lockdown. Globally, 53.34% and 70.66% of participants declared to have reduced their sleep time and to have delayed their bedtime, respectively. None of the subjects having experienced an increase in DS showed an earlier bedtime without changes in the total sleep time (Table V).

## Discussion

The present study sought to report the occurrence of changes in human daily sleep/wake cycling during the home isolation imposed by the Italian government from March 10th to May 17th, 2020, in order to contain the SARS-CoV2 spreading. Web-based epidemiological survey data from a large Italian community-based sample were obtained. The study elicited values for changes in sleep duration and in sleep cycling separately. Changes in sleep duration, if any, were verified as total sleep time increased or decreased. Changes in sleep cycling, if any, were registered as bed-

**Table V.** DS and changes in sleep cycle and sleep duration; data referred to those who experienced an increase of DS during the lockdown.

| ↓ DS | Not changed (%) [OR (95% CI)] | Delayed bedtime (%) [OR (95% CI)] | Earlier bedtime (%) [OR (95% CI)] | Total |
|---|---|---|---|---|
| Sleep less (%) | 5 (6.67%) | **31 (41.34%)** | 4 (5.33%) | **40 (53.34%)** |
| [OR (95% CI)] | [0.69 (0.19-2.50)] | [2.04 (0.74-5.59)] | [0.45 (0.12-1.67)] | |
| Sleep more (%) | 5 (6.67%) | 16 (21.33%) | 7 (9.33%) | 28 (37.33%) |
| [OR (95% CI)] | [1.49 (0.41-5.41)] | [0.36 (0.13-1.00] | [3.58 (0.94-13.61)] | |
| Not changed (%) | 1 (1.33%) | 6 (8.00%) | 0 (0.00%) | 7 (9.33%) |
| [OR (95% CI)] | [0.97 (0.11-8.91)] | [2.68 (0.30-23.68)] | [0.00 (0.00-0.00)] | |
| Total | 11 (14.67%) | **53 (70.66%)** | 11 (14.67%) | 75 (100%) |

The mode is in bold type.

time shifted forward or backward than normal habits. Simultaneously, DS was further ascertained as diurnal consequence of sleep restriction. To the best of our knowledge, this is the first study investigating any change in self-reported DS in the Italian population before and during the COVID-19 lockdown so far.

The main finding of our study revealed that 58.84% of respondents experienced a change in their sleep habits. This evidence is in line with a previous study[9] showing that almost two out of three Italians experienced sleep modifications during the COVID-19 outbreak. Characteristics of the sample, i.e., age and gender, appeared to be related with sleep modifications. Females emerged almost 2 times more likely to modify their sleep habits than males [OR 1.76, 95%CI (1.36-2.29)]. Our results are consistent with other Italian studies[9,17,18] that reported an increased prevalence of sleep changes among women during the COVID-19 emergency. Along with evidence, sex differences in CR and sleep are clearly established in literature and tend to remain stable across the lifespan[19]. Despite small absolute differences when compared to men, women showed longer sleep latency, later morning time of awakening, increased total sleep time, more nighttime awakenings and poorer sleep quality[20]. Furthermore, sex-related dissimilarities amplify when the uncoupling between sleep and CR occurs, and desynchronization affects the sleep-wake rhythm especially in women[21]. Therefore, we showed that women set free to run according to their CR tended to modify their sleep habits more than men during the Italian lockdown. This may suggest that nowadays women worse tolerate the impact of the society on their sleep. However, the absence of investigations of any correlations between changes in sleep and stress or anxiety could also affect the strength of our results, and this represents a great limit of our study. In fact, psychologic diseases, as well as dysfunctional emotionality, increased during COVID19 outbreak, impair sleep quality and predispose and/or maintain sleep disorders[22]. There is also evidence that women are more vulnerable to anxiety disorders[23].

Similar to gender, age significantly contributed to sleep changes. Our results highlighted that youths were more likely to experience modifications in their sleep habits [OR 1.85, 95%CI (1.38-2.48)] in comparison with adults. By contrast, older age appeared to be a protective factor. People grouped into the 60-69 years old class showed a halved risk than all other categories [OR 0.48, 95%CI (0.33-0.69)]. The risk further reduced when people above 70 years old were considered [OR 0.15, 95%CI (0.04-0.51)], in spite of the small number of respondents. These findings agree with other studies[9,17,18] having reported that younger age is a predictor of sleep modifications in Italian population during SARS-CoV2 pandemic. The CR undergoes dramatic changes in the lifespan. The ability to synchronize the endogenous CR and the environment is impaired in old organism, as well as the stability of free-running rhythms. The result is the uncoupling from the environment in normal condition and the appearance of spontaneous, mostly phase-advanced, free-running rhythms. In the view of such evidence[24], it is plausible to postulate that the impact of the COVID19-related home isolation was lower on adults than youths, and further decreased on elderly.

Since the COVID-19 outbreak and the subsequent home confinement, sleep habits were challenged by several stressful factors. Work from home, reduced physical activity and face-to-face interactions and limited exposure to sunlight greatly influenced people CR[25]. Despite sleep disturbances increased among the worldwide population[6,7,9,17,18,26], for some individuals the social isolation was a good opportunity to schedule the sleep/wake cycle more closely to their endogenous CR. This strongly involved "evening-type" individuals and youths[18,27,28]. We observed that 41.88% of all respondents reported delayed sleep onset and offset during the lockdown. More notably, such people accounted for 71.18% of those whose sleep changed. Among subjects who experienced sleep modifications, we found a two-fold risk of delayed sleep pattern without any change in total sleep time [OR 1.80, 95%CI (1.05-3.07)]. For the first time we assessed changes in sleep habits during COVID19 lockdown in a cohort of participants reasonably mirroring Italian general population. These findings may further support that without imposed schedules, "evening types" individuals, who account for most of the general population, especially among youths[13], go to bed later following their biological rhythm.

In such scenario, we also found an improvement in DS during the home isolation. Among subjects in whom there was no change in DS, the proportion of those who declared to sleep more during the lockdown was similar to those who started to sleep less. By contrast, in subjects who experienced a decrease in DS, the duration of sleep was more likely to increase and to decrease instead in those where DS increased. Interestingly, while people who did not experienced any change in DS had a halved probability to go to bed early if sleeping less, the same risk appeared almost triplicated in those who reported a reduced DS. Again, it emerged that going to bed later is associated with a reduced sleep need.

Analyzing changes in DS more in depth, there was a +19.94% increased difference in the answer "Never" and correspondingly a decrease in all the other values in the order of -10%. People who habitually suffered from "Mild, sometimes" DS had the greatest chance to recover [OR 19.71, 95%CI (8.51-45.66)]. Conversely, we also observed that individuals self-reporting usual higher degrees of DS were less likely to ameliorate their status. This last result suggests the need of further interventions rather than the only disruption of social impositions in those who are chronically moderate-to-severe drowsy. Italian data about sleep propensity during wakefulness date back to 1983, when Lugaresi et al[29] found a prevalence of 8.7% in the general population. Regardless, DS has been reported by 5.3% up to 26.1% of the worldwide population[30]. Chronic sleep need has an adverse impact on vigilance, cognitive skills, behavior and mood, as well as metabolic and immune functions[13].

Therefore, in the light of such evidence, our data suggest that a change in social impositions and schedules would allow people to delay both the bedtime and the wake up. The natural consequence may be a more physiologic sleep and, subsequently, less DS propensity.

This study has some limitations. First, data were obtained from a cross sectional design limiting the causal interpretations. Whereas representing the only method to collect wide data during social confinement, the web-based survey limits the distribution of the results, and the response rate is unknown. Accordingly, selection bias emerged in our cohort, namely a high number of youths and young adults, and women. This aspect must be taken into consideration in the interpretation of the results. The questionnaire did not further clarify whether shift workers were present in the cohort. Similarly, whether participants received a diagnosis of SARS-CoV2 infection or suffered a loss during the social confinement is not known. A control group represented by individuals out from lockdown was not tested. In order to simplify the questionnaire DS and fatigue were not investigated separately. Another limitation is the fact that the survey was provided *via* self-reported not validated questionnaires rather than clinical and instrumental examinations.

## Conclusions

In summary, we observed an unexpected high rate of changes in sleep habits in Italian population during the home isolation due to the COVID19, especially among youths and women. Moreover, self-reported DS decreased in severity and the improvement correlated with delayed bedtime. Our findings may highlight the need to implement intervention programs with the aim to ameliorate people sleep and preserve well-being in the daily society.

### Conflict of Interest

All authors disclose no financial and personal relationships with people or organizations that could inappropriately influence this manuscript.

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