Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Original Article

Changes in sleep patterns and disturbances in children and adolescents in Italy during the Covid-19 outbreak

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ABSTRACT

Objective: To examine the impact of home confinement during the COVID-19 pandemic on the sleep patterns and sleep disturbances in Italian children and adolescents.
Methods: Participants completed an anonymous online survey, shared via social media and targeting children and adolescents aged 1–18 years, subdivided into age groups: 1–3, 4–5, 6–12, and 13–18 years. Caregivers completed a modified version of the Sleep Disturbance Scale for Children (SDSC), along with demographic information.
Results: The final sample consisted of 4314 subjects: 2217 males (50.4%) and 2097 females (49.6%). Age group distribution was: 1–3 years 1263 (29.3%), 4–5 years 893 (20.7%), 6–12 years 1848 (42.8%) and 13–18 years 310 (7.2%). We found a significant delay in bedtime and risetime in all age groups. School-age children and adolescents experienced the most significant delay: weekday bedtime ≥23 was reported by 28.4% of 6- to 12-year-old children during lockdown vs. 0.9% before and by 63.5% vs. 12.3% of 13- to 18-year-old adolescents. Risetime was also delayed with most subjects waking up after 8 in all age groups and sleep duration increased in all groups but not in the younger group. The screen time (excluding online lessons) boosted during the lockdown, mainly in older children but also in younger children. Sleep disorders increased in all groups but not in adolescents. Younger groups had an increased prevalence of difficulty falling asleep, anxiety at bedtime, night awakenings, nightmares and sleep terrors.
Conclusion: Our study demonstrates that confinement due to COVID-19 determined a big delay in sleep/wake schedule of children in all age groups as well as an increase of sleep disturbances in all groups but adolescents.

1. Introduction

The World Health Organization has deemed the coronavirus disease 2019 (COVID-19) outbreak a global pandemic. In Italy, one of the major COVID-19 hotspots, to prevent the disease spread, a total lockdown started on March 10th, 2020 and continued until the end of phase 2 on May 3rd, forcing people into home confinement and imposing restrictions on travels over the entire national territory. People were only allowed to leave their homes for limited and documented purposes (eg, shopping for basic necessities and to go to work, if this could not be done from home). Phase 3 should have started on May 4th, but the restrictions continued until June 15th, 2020.

The lockdown involved also schools, children and adolescents were confined to their homes for an extended period of time, with schools remaining closed and students only allowed to follow online lessons.

Although these measures and efforts were necessary to reduce contagion and pressure on the Italian healthcare system, there were concerns because prolonged home confinement during a disease outbreak may affect physical and mental health [1,2] (Wang et al., 2020a; World Health Organization, 2020). The lockdown

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restriction can affect health and wellbeing through the reduction of physical activity and of exposure to daylight, and social isolation might increase the level of stress. These changes can impact daily activities as well as the sleep/wake pattern and circadian rhythmicity [3].

It is known that sleep is crucial for child and adolescent health and wellbeing and the potential for sleep problems to emerge or worsen during home confinement is high. The probability of emerging of sleep disturbances might be related to isolation and shielding that could result in sedentary behaviors, increased food consumption and weight gain. Moreover, sleep disturbances might also be associated to increased levels of stress, due to possible changes in family financial conditions, health concerns, and uncertainty about the future [4]. We should also consider that social distancing, advice to stay indoors, and remote learning can reduce exposure to sunlight, allow more flexibility in wake and sleep time, increase the opportunity to have prolonged daytime naps and favor the use of technology for long time during the day.

In addition, home confinement can lead to substantial changes of the lifestyle of children, adolescents and their families with loss of the principal zeitgebers that help maintaining a regular routine and sleep/wake schedule. The restrictions led to unconstrained sleep schedules, prolonged screen exposure, limited access to outdoor activities and reduced peer interactions, as well as heightened stress and anxiety that can contribute to unhealthy sleep patterns and sleep disturbances in children and adolescents [5,6].

The closure of kindergartens and schools as a measure to maintain social distancing during the COVID-19 crisis has a marked impact on the life of children and their parents [6,7], especially for families of young children.

All these restrictions might impact even more adolescents, increasing their loneliness, negative affect, lethargy and napping behaviors, screen time and social networking, impacting their sleep quality and schedule.

Beside these negative aspects, home confinement might decrease the need for attending social constrictions (work for parents and school for children) and could allow for better alignment with the children's sleep requirements and for enhanced parent–child interactions [1]. However, only few studies have focused on children and their parents' psychological responses during the COVID-19 pandemic.

Since Italy was the first European country to employ home confinement measures, it is particularly critical to understand its impact on sleep of children and adolescents, as well as the factors that may mitigate or enhance such an impact.

There are several studies on sleep changes during lockdown in Italy, but mainly in the adult population. A study on 1310 Italian adults showed that during the lockdown, people increased the usage of digital media near bedtime, sleep timing markedly changed, with people going to bed and waking up later, and also reporting a lower sleep quality [8]. In another Italian survey 57% of adult respondents reported, high levels of anxiety and distress as well as poor sleep quality that was associated to female sex, fear of contact with cases of COVID-19 and uncertainty about the COVID-19 infection [9]. Finally, another web survey involving 1035 adults (82.9% women) reported an increase of disordered sleep associated with the COVID-19 pandemic home confinement and characterized by a sleep phase delay (1–2 h), increase in nighttime or early awakenings, perception of decreased sleep quality, increased frequency of bad dreams, and increased use of sleeping pills [10].

We carried out this new study with the aim to examine the sleep patterns and sleep disturbances in Italian children and adolescents confined at home during the COVID-19 pandemic, in comparison to their sleep habits before confinement. In order to collect data on the whole Italian territory, a specific online questionnaire was arranged and advertised through the Italian Federation of Pediatricians (FIMP).

2. Methods

2.1. Participants

Participants completed an anonymous online survey, after reading the written consent form and explicitly agreeing to participate in the survey. The survey was shared via social media for a limited time window (from May 7th to June 15th, 2020), targeting children and adolescents aged 1–18 years, in order to obtain a homogenous sample of responders. Data were organized per age groups: 1–3 years; 4–5 years, 6–12 years and 13–18 years.

The survey was developed and conducted following the guidelines set by the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) [11].

There was no monetary or credit compensation for participating in the study. The study protocol was approved by the Ethics Committee of the Department of Developmental and Social Psychology of the Sapienza University of Rome and was conducted in accordance with the Declaration of Helsinki.

Electronic informed consent was obtained from each participant.

2.2. Measures

A specific questionnaire was arranged for the survey. The first section of the survey was devoted to the collection of demographic data (age, gender, caregiver education, region of Italy). A second section was organized to gather information on sleep arrangement and schedule during weekdays and during weekend (bedtime, risetime, sleep latency, sleep duration, napping, co-sleeping). All these questions were asked in order to evaluate differences between before and during the lockdown period. A third section of the survey was related to family composition, work of parents during the lockdown, online lessons for children and adolescents, screen time excluding the hours for lessons, respiratory infections, use of over the counter or drugs for sleep.

Caregivers completed a modified version of the Sleep Disturbance Scale for Children (SDSC) [12]. All the questions were asked in order to evaluate differences before and during the lockdown.

Retrospective questions were used to estimate perceived changes across two-time periods: from "before the lockdown" (ie, in the last month before the outbreak) to "during the lockdown " (ie, in the seven days prior to filling out the survey).

The SDSC was originally validated on a sample of 6- to 16-year-old healthy children from the general population but was also used for younger children. We grouped questions related to sleep disordered breathing into one question and selected, in total, 13 items in order to facilitate the compilation by parents.

A final specific question was related to factors that influenced the child's sleep changes (ie, more time at home with the family, not waking up too early in the morning, more time available for social media use or video games or TV, decreased physical/sport activity, others).

A further question asked if the child/adolescent was typically developing or if he/she had specific diseases, such as neurodevelopmental disorders, migraine, epilepsy, allergies, etc.

2.3. Data analysis

Descriptive statistics were applied to characterize sociodemographic variables, sleep patterns and sleep disturbances. Data were

reported as frequencies and percentages. Chi-square tests were conducted to compare the changes in sleep patterns and sleep schedule and in the incidence of sleep disturbances. For all comparisons, p-values less than 0.05 were considered to be statistically significant.

3. Results

A total of 5805 participants completed the survey. From this sample, we excluded for this study all subjects who were reported to have some specific diseases in order to evaluate only heathy and typically developing children and adolescents.

The final sample consisted of 4314 subjects: 2217 males (50.4%) and 2097 females (49.6%). Age distribution was: 1–3 years 1263 (29.3%), 4–5 years 893 (20.7%), 6–12 years 1848 (42.8%) and 13–18 years 310 (7.2%).

Descriptive statistics of the sample are reported in Table 1. The age with the highest number of participants group was that of school-age children (46.49% of the entire sample). No differences were found between the regions most affected by COVID-19 (Lombardy, Piedmont, Veneto, Emilia Romagna) and the other regions of Italy.

Mothers were the main compilers of the survey questionnaires (93.5%). As for the education level, the majority of participants had a graduate or high school degree. Most families had a middle income.

Of interest was that, during the lockdown, only 14.2% of mothers and 25.0% of fathers went normally at work. Smart-working was reported by 26.3% of mothers and 25.3% of fathers and 41.0% of mothers and 19.9% of fathers were at home without working.

Of the participants in the survey. 1.9% reported to be (or have been) positive for Sars-Cov-2 while 0.7% preferred not to answer.

We found a significant delay in bedtime and risetime in all age groups, either on weekdays or weekend. School-age children and adolescents experienced the most significant delay in the sleep schedule: weekday bedtime ≥23 was reported by 28.4% of 6- to 12-year-old children during lockdown vs. 0.9% before and by 63.5% of 13- to 18-year-old adolescents during lockdown vs. 12.3% before (Table 2). Furthermore, risetime was also delayed with most subjects waking up after 8 a.m. in all age groups (Table 3).

The delay was evident also during the weekend, but less pronounced. Risetime during the weekend was also delayed with most subjects waking up after 9 a.m. in all age groups.

Sleep duration on weekdays increased slightly but significantly in the 4–5, 6–12 and 13- to 18-year-old groups but not in the youngest group; on weekend, sleep duration changed with a slight increase only in the 6- to 12-year-old group (Table 4).

Sleep latency also increased during lockdown, either in the weekdays or in the weekend, with a decrease in number of subjects that took 5–15 min to fall asleep, paralleled by a higher percentage of subjects who took more than 30 min to fall asleep, that almost doubled in all age groups with significant differences (Table 5).

Naps tendentially decreased during lockdown: in the 1- to 3-year-old group the percentage of subjects that did not nap

Table 1
Characteristics of the participants.

	Age group				Total
	1–3 years	4–5 years	6–12 years	13–18 years	
Sex					
M	679 (53.76%)	455 (50.95%)	936 (50.65%)	147 (47.42%)	2217 (51.39%)
F	584 (46.24%)	438 (49.05%)	912 (49.35%)	163 (52.58%)	2097 (48.61%)
Total	1263 (29.35%)	893 (20.75%9	1848 (42.94%	310 (7.20%)	4314
Region					
COVID-19 region[a]	652 (51.62%)	501 (56.10%)	898 (48.59%)	156 (50.32%)	2207 (51.16%)
No COVID-19 region	611 (48.38%)	392 (43.90%)	950 (51.41%)	154 (49.68%)	2107 (48.84%)
Compiler					
Mother	1186 (93.98%)	837 (93.83%)	1734 (94.24%)	271 (87.42%)	4028 (93.59%)
Father	65 (5.15%)	51 (5.72%)	94 (5.11%)	34 (10.97%)	244 (5.67%)
Both	7 (0.55%)	3 (0.34%)	7 (0.38%)	0	17 (0.39%)
Others	4 (0.32%)	1 (0.11%)	5 (0,26%)	5 (1.6%)	15 (0.35%)
Education level					
Graduation	713 (56.72%)	492 (55.22%)	959 (52.03%)	141 (45.48%)	2305 (53.59%)
High schools	471 (37.47%)	342 (38.38%)	729 (39.56%)	143 (46.13%)	1685 (39.18%)
Middle schools	71 (5.65%)	56 (6.29%)	139 (7.54%)	26 (8.39%)	292 (6.79%)
Elementary schools	2 (0.16%)	1 (0.11%)	16 (0.87%)	0 (0.00%)	19 (0.44%)
Family income					
Low	157 (12.54%)	87 (9.83%)	173 (9.50%)	28 (9.21%)	445 (10.44%)
Middle	1015 (81.07%)	714 (80.68%)	1482 (81.38%)	243 (79.93%)	3454 (81.04%)
High	80 (6.39%)	84 (9.49%)	166 (9.12%)	33 (10.86%)	363 (8.52%)
Siblings					
Only child	763 (60.46%)	332 (37.18%)	445 (24.09%)	60 (19.35%)	1600 (37.11%)
2 children	439 (34.79%)	489 (54.76%)	1134 (61.40%)	174 (56.13%)	2236 (51.86%)
3 children	53 (4.20%)	62 (6.94%)	231 (12.51%)	64 (20.65%)	410 (9.51%)
>4 children	7 (0.55%)	10 (1.12%)	37 (2.00%)	12 (3.87%)	66 (1.53%)
Employment during lockdown					
Mother					
at home without working	615 (48.81%)	383 (42.94%)	648 (35.24%)	288 (28.48%)	1734 (40.33%)
normally at work	160 (12.70%)	128 (14.35%)	300 (16.31%)	63 (20.39%)	651 (15.14%)
in part at work in part at home	198 (15.71%)	157 (17.60%)	358 (19.47%)	70 (22.65%)	783 (18.21%)
at home with smart-working	287 (22.78%)	224 (25.11%)	533 (28.98%)	88 (28.48%)	1132 (26.33%)
Father					
at home without working	246 (19.63%)	179 (20.32%)	336 (18.60%)	55 (18.90%)	826 (19.29%
normally at work	292 (23.30%)	227 (25.77%)	454 (25.14%)	87 (29.90%)	1060 (25.05%)
in part at work in part at home	375 (29.93%)	263 (29.85%)	547 (30.29%)	78 (26.80%)	1263 (29.85%)
at home with smart-working	340 (27.13%)	212 (24.06%)	469 (25.97%)	71 (24.40%)	1092 (25.81%)

[a] Lombardy, Piedmont, Veneto, and Emilia Romagna.

Table 2
Changes in bedtime before and during lockdown.

	[<20]	[20-21]	[21-22]	[22-23]	[23-24]	[>24]	Chi square	p
Weekdays								
1–3 years								
before	24 (1.91%)	311 (24.72%)	649 (51.59%)	227 (18.04%)	44 (3.50%)	3 (0.24%)	226.45	<0.0001
during	8 (0.64%)	141 (11.24%)	510 (40.67%)	407 (32.46%)	156 (12.44%)	32 (2.55%)		
4–5 years								
before	5 (0.56%)	241 (27.05%)	513 (57.58%)	120 (13.47%)	11 (1.23%)	1 (0.11%)	384	<0.0001
during	1 (0.11%)	68 (7.63%)	318 (35.69%)	332 (37.26%)	136 (15.26%)	36 (4.04%)		
6–12 years								
before	10 (0.54%)	465 (25.27%)	1146 (62.28%)	203 (11.03%)	16 (0.87%)	0 (0.00%)	1352.62	<0.0001
during	1 (0.05%)	61 (3.32%)	506 (27.56%)	746 (40.63%)	424 (23.09%)	98 (5.34%)		
13–18 years								
before	0 (0.00%)	10 (3.24%)	123 (39.81%)	138 (44.66%)	33 (10.68%)	5 (1.62%)	190	<0.0001
during	0 (0.00%)	2 (0.66%)	27 (8.88%)	82 (26.97%)	118 (38.82%)	75 (24.67%)		
Weekend								
1–3 years								
before	5 (0.40%)	120 (9.63%)	439 (35.23%)	480 (38.52%)	178 (14.29%)	24 (1.93%)	145.89	<0.0001
during	1 (0.08%)	60 (4.82%)	308 (24.74%)	445 (35.74%)	314 (25.22%)	117 (9.40%)		
4–5 years								
before	4 (0.45%)	81 (9.17%)	288 (32.62%)	335 (37.94%)	149 (16.87%)	26 (2.94%)	98.04	<0.0001
during	2 (0.23%)	39 (4.41%)	183 (20.68%)	335 (37.85%)	226 (25.54%)	100 (11.30%)		
6–12 years								
before	9 (0.49%)	147 (8.06%)	617 (33.83%)	737 (40.41%)	264 (14.47%)	50 (2.74%)	190.67	<0.0001
during	5 (0.27%)	75 (4.11%)	413 (22.64%)	685 (37.55%)	484 (26.54%)	162 (8.88%)		
13–18 years								
before	3 (0.97%)	22 (7.12%)	96 (31.07%)	117 (37.86%)	54 (17.48%)	17 (5.50%)	39.88	<0.0001
during	2 (0.65%)	14 (4.58%)	52 (16.99%)	100 (32.68%)	91 (29.74%)	47 (15.36%)		

Table 3
Changes in risetime before and during lockdown.

	[6-7]	[7-8]	[8-9]	[9-10]	[>10]	Chi square	p
Weekdays							
1–3 years							
before	288 (22.97%)	663 52.87%)	243 (19.38%)	50 (3.99%)	10 (0.80%)	263.93	<0.0001
during	159 (12.82%)	404 (32.58%)	438 (35.32%)	182 (14.68%)	57 (4.60%)		
4–5 years							
before	179 (20.18%)	576 (64.94%)	121 (13.64%)	9 (1.01%)	2 (0.23%)	595.29	<0.0001
during	36 (4.10%)	226 (25.74%)	345 (39.29%)	195 (22.21%)	76 (8.66%)		
6–12 years							
before	628 (34.17%)	1121 (60.99%)	68 (3.70%)	17 (0.92%)	4 (0.22%)	1976.07	<0.0001
during	36 (1.97%)	422 (23.03%)	785 (42.85%)	445 (24.29%)	144 (7.86%)		
13–18 years							
before	174 (56.31%)	118 (38.19%)	13 (4.21%)	2 (0.65%	2 (0.65%)	300.2263	<0.0001
during	8 (2.64%)	102 (33.66%)	135 (44.55%)	38 (12.54%)	20 (6.60%)		
Weekend							
1–3 years							
before	88 (7.06%)	334 (26.81%)	476 (38.20%)	257 (20.63%)	91 (7.30%)	302.01	<0.0001
During	144 (11.46%)	385 (30.65%)	135 (10.75%)	524 (41.72%)	68 (5.41%)		
4–5 years							
before	54 (6.14%)	228 (25.91%)	342 (38.86%)	186 (21.14%)	70 (7.95%)	267.13	<0.0001
during	39 (4.38%)	195 (21.89%)	96 (10.77%)	466 (52.30%)	95 (10.66%)		
6–12 years							
before	113 (6.19%)	488 (26.71%)	682 (37.33%)	412 (22.55%)	132 (7.22%)	873.16	<0.0001
during	30 (1.63%)	200 (10.90%)	172 (9.37%)	1097 (59.78%)	336 (18.31%)		
13–18 years							
before	20 (6.51%)	73 (23.78%)	106 (34.53%)	76 (24.76%)	32 (10.42%)	227.01	<0.0001
during	2 (0.65%)	11 (3.57%)	12 (3.90%)	134 (43.51%)	149 (48.38%)		

changed from 7.3% to 20.7% as well as in the 4- to 5-year-old group that changed from 62.7% to 79.1% (Table 6). Also, there was a decrease in the percentage of subjects that took naps of 1 and 2 h of duration in the two younger groups. Contrarily to the younger groups, the adolescent group showed a tendency to increase napping although not significant.

Cosleeping did not change during lockdown in all age groups as well as the use of over the counter (OTC) or drugs for sleep. Cosleeping was present in 37.0% of 1- to 3-year-old subjects before vs. 36.7% during lockdown, in 26.7% vs. 27.1% of 4- to 5-year-old group; in 13.3% vs. 15.6% of 6- to 12-year-old group and in 2.3% vs. 1.9% of 13- to 18-year-old group, respectively. OTC or drugs for sleep were used in 3.8% of 1- to 3-year-old subjects before vs. 4.1% during lockdown, in 2.8% vs. 3.7% of 4- to 5-year-old group; in 1.2% vs. 2.2% of 6- to 12-year-old group and in 2.6% vs. 2.6% of 13- to 18-year-old group, respectively.

Table 4
Changes in sleep duration before and during lockdown.

	[6–7 h]	[7–8 h]	[8–9 h]	[9–10 h]	[10–11 h]	[>11 h]	Chi square	p
Weekdays								
1–3 years								
before	85 (6.78%)	176 (14.05%)	398 (31.76%)	401 (32.00%)	169 (13.49%)	24 (1.92%)	5.60	NS
during	98 (7.81%)	158 (12.60%)	384 (30.62%)	389 (31.02%)	190 (15.15%)	35 (2.79%)		
4–5 years								
before	21 (2.36%)	130 (14.59%)	305 (34.23%)	316 (35.47%)	106 (11.90%)	13 (1.46%)	27.73	<0.001
during	20 (2.26%)	95 (10.72%)	274 (30.93%)	299 (33.75%)	171 (19.30%)	27 (3.05%)		
6–12 years								
before	29 (1.58%)	316 (17.26%)	799 (43.64%)	571 (31.19%)	110 (6.01%)	6 (0.33%)	63.5	<0.001
during	45 (2.45%)	223 (12.17%)	730 (39.83%)	602 (32.84%)	214 (11.67%)	19 (1.04%)		
13–18 years								
before	37 (12.01%)	124 (40.26%)	121 (39.29%)	24 (7.79%)	2 (0.65%)	0 (0.00%)	21.87	<0.005
during	41 (13.31%)	80 (25.97%)	134 (43.51%)	42 (13.64%)	8 (2.60%)	3 (0.97%)		
Weekend								
1–3 years								
before	73 (5.82%)	164 (13.07%)	394 (31.39%)	411 (32.75%)	181 (14.42%)	32 (2.55%)	2.99	NS
during	88 (7.02%)	155 (12.36%)	378 (30.14%)	406 (32.38%)	187 (14.91%)	40 (3.19%)		
4–5 years								
before	13 (1.47%)	101 (11.43%)	268 (30.32%)	329 (37.22%)	154 (17.42%)	19 (2.15%)	7.25	NS
during	16 (1.81%)	94 (10.61%)	241 (27.20%)	319 (36.00%)	188 (21.22%)	28 (3.16%)		
6–12 years								
before	15 (0.83%)	163 (8.97%)	686 (37.73%)	709 (39.00%)	231 (12.71%)	14 (0.77%)	23.74	<0.001
during	26 (1.42%)	143 (7.82%)	614 (33.57%)	720 (39.37%)	292 (15.97%)	34 (1.86%)		
13–18 years								
before	8 (2.60%)	43 (13.96%)	119 (38.64%)	93 (30.19%)	39 (12.66%)	6 (1.95%)	10.19	NS
	13 (4.22%)	34 (11.04%)	93 (30.19%)	114 (37.01%)	41 (13.31%)	13 (4.22%)		

Table 5
Changes in sleep latency before and during lockdown.

	[5–15']	[15–30']	[30–60']	[>60']	Chi square	p
Weekdays						
1–3 years						
before	466 (37.79%)	572 (46.39%)	179 (14.52%)	16 (1.30%)	148.06	<0.00001
during	276 (21.99%)	547 (43.59%)	352 (28.05%)	80 (6.37%)		
4–5 years						
before	436 (50.23%)	347 (39.98%)	80 (9.22%)	5 (0.58%)	120.41	<0.00001
during	277 (31.26%)	372 (41.99%)	174 (19.64%)	63 (7.11%)		
6–12 years						
before	1098 (61.24%)	569 (31.73%)	116 (6.47%)	10 (0.56%)	375.93	<0.00001
during	675 (36.74%)	615 (33.48%)	412 (22.43%)	135 (7.35%)		
13–18 years						
before	163 (54.15%)	97 (32.23%)	37 (12.29%)	4 (1.33%)	44.75	<0.00001
during	105 (34.09%)	111 (36.04%)	53 (17.21%)	39 (12.66%)		
Weekend						
1–3 years						
before	426 (33.97%)	619 (49.36%)	190 (15.15%)	19 (1.52%)	128.23	<0.00001
during	275 (21.93%)	541 (43.14%)	354 (28.23%)	84 (6.70%)		
4–5 years						
before	401 (45.12%)	381 (42.76%)	104 (11.67%)	4 (0.45%)	88.83	<0.00001
during	284 (31.91%)	371 (41.69%)	172 (19.33%)	63 (7.08%)		
6–12 years						
before	1045 (57.07%)	611 (33.37%)	161 (8.79%)	14 (0.76%)	269.80	<0.00001
during	700 (38.21%)	599 (32.70%)	389 (21.23%)	144 (7.86%)		
13–18 years						
before	153 (49.68%)	106 (34.42%)	42 (13.64%)	7 (2.27%)	31.51	<0.00001
during	110 (35.95%)	103 (33.66%)	53 (17.32%)	40 (13.07%)		

Another important finding of the study was that the screen time (excluding online lessons) greatly increased during the lockdown, mainly in older children but also surprisingly in younger children with 30.8% of 1- to 3-year-old subjects that spent more than 3 h/day on screen during lockdown vs. only 2.3% before. Impressively, 93.1% of the 13-18-year-old group spent more than 3 h per day on screen during lockdown vs. only 31.5% before (Table 7).

Younger groups had an increased prevalence of sleep disorders during the lockdown, mainly represented by difficulty falling asleep that changed in all age groups (from 16.8% to 29.5% in 1- to 3-year-old children, from 13.3% to 25.9% in the 4- to 5-year-old group, from 11.6% to 26.5% in 6- to 12-year-old subjects and from 12.3% to 21.9% in the 13- to 18-year-old group). Anxiety at bedtime increased in the first three groups (from 4.7% to 12.7%, from 7.4% to 19.1%, and from 7.0% to 15.2%, respectively). Also, night awakenings

Table 6
Changes in napping before and during lockdown.

		No	1 h	2 h	>2 h	Chi square	p
1–3 years	before	92 (7.3%)	325 (25.7%)	688 (54.5%)	125 (9.9%)	96.66	<0.00001
	during	262 (20.7%)	284 (22.5%)	567 (44.9%)	113 (8.9%)		
4–5 years	before	558 (62.7%)	179 (20.1%)	115 (12.9%)	8 (0.9%)	64.13	<0.00001
	during	704 (79.1%)	72 (8.1%)	75 (8.4%)	6 (0.7%)		
6–12 years	before	1745 (95.00%)	29 (1.60%)	9 (0.50%)	1 (0.10%)	0.45	NS
	during	1739 (94.70%)	24 (1.30%)	9 (0.50%)	0 (0.00%)		
13–18 years	before	286 (92.90%)	12 (3.90%)	1 (0.30%)	1 (0.30%)	4.99	NS
	during	268 (87.00%)	21 (6.80%)	3 (1.00%)	3 (1.00%)		

increased from 19.7% to 26.2%, from 7.1% to 12.9%, and from 3.5% to 7.5%, respectively (Table 8).

There was also an upsurge of nightmares in the first three groups (from 1.8% to 4.4%, from 8.5% to 20.5%, and from 7.1% to 16.1%, respectively). Sleep terrors increased from 3.4% to 6.7% in 1- to 3-year-old children, and from 2.1% to 4.5% in the 4- to 5-year-old group (Table 8).

Finally, daytime sleepiness was also affected with a higher percentage of children that reported this problem (1.5% vs. 4.2% in 1- to 3-year-old children, 1.9% vs. 5.9% in the 4- to 5-year-old group, and 4.7% vs. 10.1% in 6- to 12-year-old subjects) (Table 8).

Adolescents seemed to be the group in which the lockdown had less impact (beside that on their sleep/wake schedule, reported above), reporting only difficulties in falling asleep, without any other difference for other sleep disturbances.

The only disorder that showed an inverted trend was bruxism that decreased from 11.3% to 8.7% in the 6- to 12-year-old group. No differences were found for the prevalence of rhythmic movement disorders, restless sleep and snoring/apneas in all age groups (Table 8).

4. Discussion

Our study demonstrates that confinement due to COVID-19 determined a big change in sleep/wake schedule of children in all age groups, with a high percentage of them reporting a significant delay in bedtime and risetime. School-age children and adolescents experienced the most significant delay, with a high percentage of subjects falling asleep after 23.

According to our study, different reports also showed that the most important negative consequence of the lockdown was the delay of sleep onset and offset. A recent study showed that the confined children had significantly later bedtime and waketime and increased nocturnal sleep duration [5]. Our results on preschoolers are in agreement with this study and with another research carried out on Italian preschoolers in which the lockdown determined a delay of about 1 h on bedtime and risetime [13]. This phase shift during lockdown in preschoolers is associated with a decrease in napping in our two younger groups, in agreement with a Chinese report in preschoolers [5]. In our study, school age children and adolescents showed the most relevant phase delay with about 28% of schoolers and 64% of adolescents falling asleep after 11 p.m. during lockdown vs. 0.87% and 12%, respectively, before. Accordingly, other investigations reported that school-age children and adolescents were going to bed later with more than 1-h difference [14,15]. The changes in bedtime during lockdown are also reflected by the increase in sleep latency, with a higher percentage of subjects who took more than 60 min to fall asleep.

Regarding sleep duration, we found a slight but significant increase during lockdown in all age groups but the 1- to 3 year-olds on weekdays, while only schoolers showed a trend for a longer sleep duration in the weekend.

According to our findings, other investigations reported that school-age children and adolescents were sleeping more hours during a 24-h period (including naps) than they had been prior to the COVID-19 pandemic [14,15]. Liu et al. [5] described an increase in total sleep duration also in preschoolers. However, data on sleep duration in preschoolers are inconsistent across studies because an Israelian research on infants and children aged 6–72 months reported variable changes in sleep duration, either increase, or decrease or no changes [16].

An interesting consideration that emerges from the adolescent studies is that the changes favored by the lockdown seem to make their sleep-wake schedule more physiological. Different investigations reported that, during the confinement, adolescents' sleep duration increased by approximately 1 h, their sleep quality improved with less daytime sleepiness, the difference in the sleep duration between weekdays and weekends disappeared and the percentage of nappers decreased [17,18].

The increase in sleep duration of adolescents has been attributed to the delay of school start time. It is widely recognized that delaying high school start time could extend adolescent school night sleep duration and lower their need to catch-up sleep on weekends, suggesting that later start time could be a durable strategy for counteracting population-wide adolescent sleep deficits. In Italy, the guidelines of the Italian Ministry of Education suggested that high schools maintained the same schedule as before the pandemic, with school start time at 8.00 a.m. However, the different regions and even the single schools adopted different timetables with some maintaining the previous timetable and

Table 7
Changes in screen time before and during lockdown.

		[<1 h]	[1–2 h]	[3–4 h]	[>4 h]	Chi square	p
1–3 years	before	813 (61.08%)	483 (36.29%)	33 (2.48%)	2 (0.15%)	400.44	<0.00001
	during	435 (38.70%)	327 (29.09%)	295 (26.25%)	67 (5.96%)		
4–5 years	before	421 (39.79%)	571 (53.97%)	61 (5.77%)	5 (0.47%)	669.20	<0.00001
	during	105 (11.77%)	255 (28.59%)	389 (43.61%)	143 (16.03%)		
6–12 years	before	934 (35.30%)	1474 (55.71%)	206 (7.79%)	32 (1.21%)	1964.17	<0.00001
	during	162 (7.17%)	532 (23.54%)	1033 (45.71%)	533 (23.58%)		
13–18 years	before	73 (11.87%)	323 (52.52%)	150 (24.39%)	69 (1.22%)	464.49	<0.00001
	during	7 (1.25%)	32 (5.69%)	198 (35.23%)	325 (57.83%)		

Table 8
Sleep disturbances before and during lockdown.

		1–3 years	4–5 years	6–12 years	13–18 years	Total
Difficulties falling asleep	before	**212 (16.8%)**	**119 (13.3%)**	**214 (11.6%)**	**38 (12.3%)**	**583 (13.5%)**
	during	**373 (29.5%)**	**231 (25.9%)**	**489 (26.5%)**	**68 (21.9%)**	**1161 (26.9%)**
Anxiety at bedtime	before	**59 (4.7%)**	**66 (7.4%)**	**129 (7.0%)**	6 (1.9%)	**260 (6.0%)**
	during	**161 (12.7%)**	**171 (19.1%)**	**280 (15.2%)**	15 (4.8%)	**627 (14.5%)**
Hypnic jerks	before	**57 (4.5%)**	43 (4.8%)	92 (5.0%)	14 (4.5%)	**206 (4.8%)**
	during	**116 (9.2%)**	69 (7.7%)	105 (5.7%)	17 (5.5%)	**307 (7.1%)**
Rhythmic movement disorder	before	43 (3.4%)	12 (1.3%)	21 (1.1%)	4 (1.3%)	80 (1.9%)
	during	60 (4.8%)	16 (1.8%)	28 (1.5%)	9 (2.9%)	113 (2.6%)
Night awakenings >2	before	**249 (19.7%)**	**63 (7.1%)**	**65 (3.5%)**	9 (2.9%)	**386 (8.9%)**
	during	**331 (26.2%)**	**115 (12.9%)**	**138 (7.5%)**	16 (5.2%)	**600 (13.9%)**
Restless sleep	before	554 (43.9%)	338 (37.8%)	453 (24.5%)	50 (16.1%)	1395 (32.3%)
	during	595 (47.1%)	357 (40.0%)	443 (24.0%)	46 (14.8%)	1441 (33.4%)
Snoring/apneas	before	46 (3.6%)	45 (5.0%)	55 (3.0%)	11 (3.5%)	157 (3.6%)
	during	41 (3.2%)	41 (4.6%)	47 (2.5%)	9 (2.9%)	138 (3.2%)
Sleepwalking	before	**50 (4.0%)**	32 (3.6%)	56 (3.0%)	4 (1.3%)	142 (3.3%)
	during	**89 (7.0%)**	39 (4.4%)	55 (3.0%)	3 (1.0%)	186 (4.3%)
Sleep terrors	before	**43 (3.4%)**	**19 (2.1%)**	20 (1.1%)	1 (0.3%)	**83 (1.9%)**
	during	**84 (6.7%)**	**40 (4.5%)**	31 (1.7%)	2 (0.6%)	**157 (3.6%)**
Bruxism	before	50 (4.0%)	128 (14.3%)	**209 (11.3%)**	23 (7.4%)	410 (9.5%)
	during	64 (5.1%)	128 (14.3%)	**160 (8.7%)**	14 (4.5%)	366 (8.5%)
Nightmares	before	**23 (1.8%)**	**76 (8.5%)**	**132 (7.1%)**	3 (1.0%)	234 (5.4%)
	during	**56 (4.4%)**	**183 (20.5%)**	**297 (16.1%)**	13 (4.2%)	549 (12.7%)
Daytime sleepiness	before	**19 (1.5%)**	**17 (1.9%)**	**86 (4.7%)**	25 (8.1%)	**147 (3.4%)**
	during	**53 (4.2%)**	**53 (5.9%)**	**186 (10.1%)**	40 (12.9%)	**332 (7.7%)**

Significant differences at $p < 0.001$ re in bold.

others that delayed school start time of about 1 h. Nevertheless, in general, we believe that the risetime was delayed just because the adolescents woke up later and did not need time to move from home to school, gaining about 1 additional hour of sleep.

On the contrary, we found no differences in the percentage of nappers in school age children and adolescents, Later bedtime and increase of sleep latency might be also a consequence of excessive screen time at night. Indeed, screen time (excluding online lessons) greatly increased during the lockdown, in all age groups. Staying at home during lockdown exposes exposure of children and adolescents to digital screens because of their excessive use of virtual platforms (TV, laptop, mobile etc.). There is strong evidence in the literature of a daunting longer screen time spent by children and adolescents for leisure during the COVID-19 pandemic, with a 20–66% increase in screen time [19,20]. The increase in leisure screen time, that was reported to be more evident in older children with more than 6 h/day engaged in leisure screen-based activities [14], but also in preschoolers [5]. Accordingly, in our subjects, we observed a great increase of the leisure screen time, mainly in older children and adolescents but also in the younger age group with 30.85% of 1- to 3-year-old subjects that spent more than 3 h/day on screen during lockdown vs. only 2.33% before.

An important finding of our study is the increase of specific sleep disturbances, mainly represented by falling asleep difficulties, anxiety at bedtime, nightmares, and sleep terrors that were evident in the three younger age groups. Adolescents seems to be the age group in which sleep was less affected by the lockdown since they showed only an increase of difficulties in falling asleep. Other items such as respiratory disorders, restless sleep or rhythmic movement disorders were not influenced by lockdown, in all age groups.

The fact that sleep disturbances did not worsen in adolescents might be related to the fact that, as mentioned above, the changes observed during lockdown simply made their sleep-wake schedule more compliant with their physiological sleep need.

The increase in symptoms of insomnia, nightmares and sleep terrors in our younger children might be related to the anxiety for the uncertainty about the pandemic, as reported also in adults by different studies [1,10,21] or high school students [22]. In particular, the significant increase in frequency of nightmares, in all age groups but adolescents, might be interpreted as an indicator of acute stress symptomatology linked to COVID-19; this interpretation was also mentioned in an adult Italian study [9]. Furthermore, there might be a bidirectional influence between anxiety and poor sleep quality: a) anxiety determined poor sleep quality [23]; b) poor sleep quality increased the levels of depression, anxiety, and stress in affected subjects [8].

To the best of our knowledge, this study is the first evaluating the frequency of sleep disturbances (before vs. during lockdown), in children and adolescents, using a standardized questionnaire, and it is surprising that most of the studies carried out during the pandemic did not report an analysis of specific sleep disturbances.

Di Giorgio et al. [13] used our same questionnaire (SDSC) but evaluated the total score of the SDSC without analyzing the frequency of the single items; these authors reported that the proportion of preschoolers with some sleep difficulties was stable from 41.5% before the lockdown to 44.7% during the lockdown. Another Chinese study used the Children Sleep habits Questionnaire (CSHQ) reporting even a decrease of overall sleep disturbance, from 55.6% to 77.7% found in a sample previously collected by the same authors in 2018, but including different subjects [5].

Our data are in agreement with other Chinese surveys in adolescents and young adults, reporting an increase in the prevalence of insomnia symptoms during the COVID-19 epidemic period [24,25] and also with other studies carried-out in Asia and Europe that showed sleep disturbances in up to a third of their samples [26,27].

Other authors reported also an increase in hypnotic use in adults [10,28] that we did not find in our sample of children and adolescents.

Some of the discrepancies on sleep duration or sleep disturbances between our study and other reports might be related to the different methodology and questionnaires used, but also to the fact that there is no uniform effect of the lockdown on sleep quality. The changes in sleep patterns and quality during the COVID-19 pandemic are varied and no unified change for the worse should be expected [3,4]. Indeed, Kocevska et al. [29] reported that COVID-19 lockdown measures more often worsened sleep complaints in pre-pandemic good sleepers, whereas a subset of people with pre-

pandemic severe insomnia symptoms underwent a clinically meaningful alleviation of symptoms. This might be influenced by the degree to which people are engaging in coping strategies during the pandemic [28,30,31] or to the fact that home confinement might allow a better adherence to good sleep hygiene behaviors in some individuals.

4.1. Limitations and strengths

This study has some limitations. First, this is a cross-sectional study, thus we can only speculate about a causal relationship between sleep disorders and related risk factors, such as screen use. The present research, similarly to other recent studies on the COVID-19 pandemic, used retrospective questions with the risk of pitfalls and biases although data elicited by retrospective questions are quite consistent. The parental-report nature of the study may affect our findings and it is possible that the parental perception of their child behavior was heightened during the lockdown, with a potential inadvertent bias in their responses. Because of the epidemic, an online survey was conducted, this represented a selection bias resulting in the collection of questionnaires filled-in by more highly educated people who were better at using internet or mobile phones. In addition, the adoption of the online survey limits the generalizability of the results, although it currently represents the best solution for data collection in times of social distancing. Considering the richness of the survey, we did not collect data on other related influencing factors in order to ensure the best return rate. Our sample cannot be considered representative of all the mothers of the Italian population and results may not generalize to other countries.

Some strengths of the study should be also acknowledged: our study, differently from the others, used a standardized questionnaire for evaluating sleep disturbances which allowed to report changes in the prevalence of several sleep disturbances during lockdown. We also evaluated four different age groups, in order to assess age-related changes.

5. Conclusions

This study shows that COVID-19 lockdown greatly impacted on the sleep/wake rhythm of children and adolescents, who showed a phase delay and an important increase in screen time, associated with an increase of the prevalence of sleep disturbances.

The findings of this study highlight the need to build and deploy actions to address distinct profiles of sleep problems. It is still not known if these sleep problems may be transient, but the scientific community and clinicians should ensure they do not evolve into chronic sleep disorders with downstream consequences for other aspects of mental and physical health.

In younger children the main interventions should be related to the sleep health education through parents, cognitive behavioral therapy for insomnia and interventions related to a treatment of a possible post-traumatic stress disorders, as indicated by the increase of anxiety at bedtime and nightmares. In older children and adolescents, cognitive behavioral therapy for insomnia and chronobiotic therapies for delayed bedtimes (eg, morning light therapy and exogenous melatonin intake about 2 h before habitual sleep time) should be implemented [32].

Public health messages regarding the importance of sleep schedules and sleep quality for children and adolescents should be disseminated by health/school authorities: a) sunlight exposure during daytime hours should be encouraged by parents/guardians; b) bedtimes/waketimes should be established; c) screen devices should be removed from bedrooms to limit blue light exposure; d) use of developmentally appropriate educational tools should be associated with extended family members/friends reading to promote feelings of connectiveness [33].

Future research should examine whether the COVID-19 crisis and associated physical distancing impact child and adolescent sleep over time, or if special subgroups, such as those with neurodevelopmental diseases, experience more severe or longer-term sleep disturbances. It is thus imperative that sleep considerations be part of both clinical and research initiatives aimed at mitigating and understanding the impact of the COVID-19 pandemic in children and adolescents [4]. The impact of the COVID-19 pandemic might cause in children and adolescents very severe repercussions that, if not addressed, could have even worse outcomes in the future.

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Authorship Responsibility

Each author made a substantive intellectual contribution to the study.

- Oliviero Bruni: conceptualization and study design, data collection, data analysis, interpretation, writing and revision of the manuscript; approved the final manuscript as submitted.
- Emanuela Malorgio: conceptualization and study design; data collection; revision of the manuscript; approved the final manuscript as submitted.
- Mattia Doria: conceptualization and study design; data collection; revision of the manuscript; approved the final manuscript as submitted.
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- Raffaele Ferri: conceptualization and study design, data analysis, writing and revision of the manuscript; approved the final manuscript as submitted.

Conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: https://doi.org/10.1016/j.sleep.2021.02.003.

Appendix A. Supplementary data

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