



Screen media use and sleep patterns in Spanish adolescents during the lockdown of the coronavirus pandemic

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Abstract

Purpose The aim of this study was to investigate screen media use and sleep patterns among Spanish adolescents during the lockdown (LD) of the first peak of the coronavirus pandemic.

Methods Cross-sectional community-based study of adolescents aged 11–18 years. An online questionnaire with queries about screen time, sleep, and other healthy habits was completed by parents or guardians.

Results Overall 265 adolescents were enrolled. The mean age was 13.6 ± 2.3 years, 58% were boys, 68% were in secondary school and 72% lived in urban areas. Before the LD (BLD) 87% of adolescents used electronic devices < 4 h/d, while during the LD (DLD) screen time was > 4 h/d in 75% of cases ($p < 0.0001$). A delayed wake time and bedtime weekdays (BLD wake time weekdays: later than 09:45 0.0% vs. DLD 30%, $p < 0.0001$, and BLD bedtime weekdays: later than 00:30 3% vs. DLD 35%, $p < 0.0001$) and weekends DLD was observed. Adolescents who used electronic devices > 4 h/d DLD compared with those who used < 4 h/d reported more frequently long sleep latency (93% vs. 7%, $p = 0.007$), low sunlight exposure (77% vs. 23%, $p = 0.031$), less physical activity (86% vs. 15%, $p = 0.011$) and weight gain (78% vs. 22%, $p = 0.049$).

Conclusions During the lockdown Spanish adolescents reported elevated screen time and delayed sleep patterns. An increase in screen media use was associated with unhealthy habits.

Keywords Adolescence · COVID-19 · Chronobiology · Healthy habits · Screen time · Sleep

Abbreviations

BLD Before the lockdown
DLD During the lockdown
LD Lockdown

Introduction

Adolescence is a transitional period between childhood and adulthood characterized by a variety of physical, neurological and behavioral changes [1–5]. Epidemiological studies worldwide confirm that adolescents are not getting enough weekdays sleep [6–8]. In 2010 insufficient sleep was recognized as a serious health problem in adolescents by the

American Medical Association/American Academy of Sleep Medicine [9]. Consequences of chronic sleep deprivation could compromise daytime functioning of adolescents and youth adults [10–12].

In parallel, average of screen time among adolescents has increased, especially by the end of the day [13, 14]. According to the National Sleep Foundation American Poll published in 2006 the vast majority of adolescents had at least one electronic device in their bedroom [6]. It is known that the light of screens during bedtime suppresses melatonin release and disrupts circadian rhythms [15], even when the light intensity of screens is low likely due to EEG brain activation [16]. Difficulties to falling sleep, nighttime awakening and short sleep duration have been described as some of the negative effects related to excessive screen time consumption [14, 15, 17]. Moreover, unhealthy eating behaviors, high body mass index, low physical activity and an increased risk of metabolic syndrome have been also associated to elevated screen time [13].

Social interactions and e-learning methods are particularly important during adolescence. The lockdown during the first peak of COVID-19 pandemic in 2020

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represented a unique opportunity to assess the impact of relaxed homeschool schedule and social isolation on some behaviors and habits among adolescents. Therefore, the aims of this study were 1) to investigate changes in screen media use and sleep patterns in Spanish adolescents during the home confinement of the first peak of the COVID-19 pandemic in 2020 and 2) to assess the association between screen time consumption, sleep variables and other healthy habits such as sunlight exposure, physical activity and weight.

Material and methods

Study population

This cross-sectional study was conducted at the first peak of the coronavirus pandemic in Spain. Recruitment process, from June to July 2020, was done via social media, to increase the sample size and to improve cost-effectiveness, through educational and parental associations and scientific societies (Spanish Pediatric Sleep Network). The survey was anonymous and was completed by parents or guardians of adolescents who consented to participate in the study by an e-agreement. Inclusion criteria were: adolescents of both genders, from 5th grade of primary school to 18 years old, who were active students during the academic year 2019–2020, and who suffered an imposed home confinement from March to the end of June of 2020. It was estimated that the sample size necessary to demonstrate an increase of 7% of screen consumption per day during the lockdown compared to before the lockdown with an alpha value of 0.05 and a power of 0.8 was of 240. This study was approved by the Ethics Committee of Quirónsalud-Catalonia.

Measurements

The online survey contained 57 items. The first part included general questions about demographic and anthropometrical data (date of data collection, date of onset of the lockdown, gender, age, weight, height, place of living during the lockdown, number of family members), socioeconomic families' information (education level of parents, employment situation before and during the lockdown) and medical information (medical history, sleep disorders and coronavirus infection of family members). The second part of the survey included questions about the main variables of the study: screen media consumption, sleep patterns and other healthy habits such as sunlight exposure, physical activity and diet. Finally, few questions about potential comorbidities were also included.

Screen media use

To investigate electronic devices consumption parents of adolescents were asked about: 1) access to electronic devices during the lockdown, 2) type of electronic devices that adolescent used regularly (TV, cell phone, tablet, laptop, video games), 3) frequency of e-learning methods (homework, classes) before and during the lockdown, 4) number of daily screen time consumption previously and during the lockdown (0–2 h/d, 2–4 h/d, 4–6 h/d, 6–8 h/d, > 8 h/d) and 5) schedule of screen consumption before and during the lockdown (A: morning 9 am–13 pm, B: afternoon 16–20 pm, C: evening before dinner time 20–21:30 pm, D: evening after dinner time > 21:30 pm and E: in bed).

Sleep patterns

Assessment of sleep was investigated based on the next queries about the situation before and during the lockdown: 1) sleep latency (5–10 min, < 30 min, < 60 min, > 60 min, > 120 min, > 240 min), 2) bedtime weekdays and weekends (20:00–21:00, 21:00–22:15, 22:15–00:30, 00:30–1:45, later than 1:45), 3) wake time weekdays and weekends (5:00–6:30, 6:30–7:45, 7:45–9:45, 9:45–11:00, later than 11:00 am), 4) presence and frequency of nighttime awakenings, 5) presence, schedule and duration of naps, 6) wake up method (clock alarm, parents, by themselves, don't know), 7) daytime hypersomnolence, 8) sleep satisfaction during the last 2–3 months, 9) medical treatment for sleep problems, 10) xanthine intake (> 3 days/week), 11) type of activities performed 2 h previous to sleep time (TV, read, listen music, homework, social media, relax, others).

Other healthy habits and comorbidities

Additional health covariates during the lockdown were also collected in the survey such as: 1) frequency of regular (15–30 min/day) sunlight exposure (5–7 days/week, 3–4 d/week, 1–2 d/week, 0 d/week (due to lack of outdoor place in the house, he/she did not want to be outside, other reasons)), 2) frequency of regular physical activity (5–7 d/week, 3–4 d/week, 1–2 d/week, 0 d/week), 3) diet (do you consider that your child have a healthy diet?, daytime and bedtime sweet consumption before and during the lockdown). Moreover, few questions about potential comorbidities (academic results, social skills, behavioral problems and mood disorders) were also included.

Statistical analysis

Characteristics of the sample population were summarized by means and standard deviation (SD) for normally distributed continuous variables such as age, medians, interquartile

ranges for non-normally distributed continuous variables and counts and/or percentages for categorical variables with 95% confidence intervals. The vast majority of variables were categorized. In those cases, first unilateral and later bilateral Wilcoxon test was conducted to investigate differences in the frequency of sleep variables and screen time consumption before and during the lockdown. The χ^2 test was conducted to evaluate differences on demographic and socio-economical characteristics, sleep latency, sunlight exposure, physical activity, weight, academic results, social skills, behavioral problems and mood disorders according to the range of daily screen time consumption during the lockdown (0–2 h/d, 2–4 h/d, 4–6 h/d, 6–8 h/d, > 8 h/d). Differences were considered statistically significant if p value was < 0.05. Statistical analysis was conducted using SPSS 15.0 (IBM, Armonk, NY).

Results

A total of 265 families of adolescents completed the survey by the end of the lockdown (June and July) in 2020, and all of them were included in the current analysis. The characteristics of the study population are shown in Table 1.

Sleep patterns before and after the lockdown

Approximately 17% of adolescents reported sleep problems prior to the lockdown, 27% a delayed sleep phase and 8% were on treatment for sleep problems. Long sleep latency was considered in those cases that took more than 60 min to fall sleep after “lights out.” Before of the lockdown only 2% of adolescents reported long sleep latency, while during the lockdown a significant increase in the frequency of long sleep latency was observed (17%, $p < 0.0001$). See Table 2. Regarding to sleep schedules a significant delay in bedtime more evident on weekdays than weekends, but equally statistically significant, was reported by Spanish adolescents during the lockdown. Before the lockdown bedtime weekdays was later than 00:30 am only in 3% of cases, but during the lockdown the frequency raised up to 32%. Similar results were obtained for wake time schedules. None of adolescents reported wake time weekdays later than 9:45 am before the lockdown compared to during the lockdown whose frequency was about one-third. See Table 2. Regarding the wake up methods, during the lockdown 34% of adolescents woke up by themselves vs. 11% before the lockdown. No statistically significant differences were observed in the frequency of naps during the lockdown compared with the frequency before. However, a higher percentage of subjects suffered from nighttime awakenings, daytime

Table 1 Characteristics of the study population

	N(%)
Age	13.6 ± 2.3
Gender	
Male	154 (58.1)
Female	111 (41.9)
Education level of student	
Primary school	83 (31.3)
Secondary school	180 (67.9)
Others	2 (0.8)
Education level of parents	
Both graduated	148 (55.8)
Both elementary education	9 (3.4)
Both not elementary education	39 (14.7)
One graduated/One elementary education	57 (21.5)
One elementary/One not elementary education	8 (3.0)
Others	4 (1.5)
Family members	
2	5 (1.9)
3	48 (18.1)
4	159 (60.0)
5	42 (15.8)
> 5	11 (4.2)
Family employment situation BEFORE the lockdown	
Both parents employed	229 (86.4)
One employed + one unemployed	31 (11.7)
Both parents unemployed	2 (0.8)
Others	3 (1.1)
Family employment situation DURING the lockdown	
Both parents employed	180 (67.9)
One employed/one unemployed	65 (24.5)
Both parents unemployed	14 (5.3)
Others	6 (2.3)
Place of living during the lockdown	
Countryside	16 (6.0)
Urban area	192 (72.5)
Others	57 (21.5)
Medical history previously to the lockdown	
General medical conditions	18 (6.8)
Sleep disorders	44 (16.6)
COVID-19 infection by family members	
Adolescent	1 (0.4)
Family members (parents, sisters or brothers)	12 (4.5)

hypersomnolence and increased xanthine intake during the lockdown (Table 2). Regarding the type of activities performed 2 h prior to sleep time, before the lockdown they watched TV + / – read or did homework 25% vs. 20% during the lockdown, and they watched TV + use social media 17% before the lockdown vs. 27% during the lockdown. Finally, sleep was considered unsatisfied or very unsatisfied in the last 2–3 months in 7% of the study population.

Screen media use before and after the lockdown

During the lockdown 97% of families considered that adolescents had adequate access to electronic devices, and a significant increase in the frequency of online homework (35%), especially in online classes (86%) was observed. Tablets and video games were used less frequently than the other electronic devices (cell phone 75%, computer 72%, TV 62%, tablet 41% and video games 34%). Regarding the number of hours per day of screen consumption, before the lockdown 13% of adolescents used electronic devices more than 4 h and only 2% more than 8 h, while during the lockdown 75% used electronic devices more than 4 h per day and 16% more than 8 h (Table 2). Interestingly, the distribution of the schedule of use of electronic devices varied widely during the lockdown compared to the previous situation (Fig. 1). Meanwhile before the lockdown the vast majority of adolescents used electronic devices from 16 pm onwards (frequency of this schedule before LD 82% vs. during LD 18%, $p < 0.0001$), during the lockdown three interesting changes were observed. First, a predominance of schedules of screen consumption starting in the morning (frequency before 18% vs. during 82.0% $p < 0.0001$). Second, a wider distribution of use of electronic devices throughout the day. Third, a decrease of use of electronic devices around bedtime (frequency before 32% vs. during 2% $p < 0.0001$). See Fig. 1.

Sunlight exposure, physical activity and diet

During the lockdown lack of regular sunlight exposure was reported by 26% of families, lack of physical activity by 20% and 26% of adolescents gained weight. Overall, sweet intake increased from 37 to 57% during the lockdown, and from 9 to 14% after dinner (nighttime).

Association between screen media use, demographic characteristics and some healthy habits

No statistically significant differences were found in daily screen time consumption between genders, number of family members, place of living during the lockdown and economical status of families. Nevertheless, there was a trend to report a lower number of hours of use electronic devices (< 4 h/day) in those families whose parents, both, were unemployed during the lockdown compared with families whose parents were employed (50% vs. 22%, $p = 0.064$). Interestingly, adolescents who used electronic devices > 4 h/d during the lockdown compared with those who used < 4 h/d reported more frequently long sleep latency (93% vs. 7%, $p = 0.007$). Moreover, an association between screen time consumption, sunlight exposure, physical activity and weight was also found. Adolescents who use

electronic devices more than 4 h/d reported more frequently lack of sunlight exposure (77% vs. 23%, $p = 0.031$), less physical activity (85% vs. 15%, $p = 0.011$) and an increase on weight (78% vs. 22%, $p = 0.049$). See Table 3 and Fig. 2. Finally, although the association between use of electronic devices, academic results, social skills, behavioral problems and mood disorders was also investigated, differences were not statically significant.

Discussion

Findings of the present study demonstrate that social isolation and relaxed schedules during the lockdown were associated with significant changes, reported by parents, in screen time use and sleep patterns among Spanish adolescents compared to the previous pandemic situation. Changes in other healthy habits such as sunlight exposure, physical activity, diet and weight were also observed during this period.

Insufficient sleep has been recognized as an important medical issue, not only in adulthood, but also in childhood and adolescence [9]. Epidemiological studies worldwide have shown an important decrease in sleep duration in adolescents [6–8]. Factors involved in suboptimal total sleep duration in this developmental period of life are probably multifactorial. However, the circadian rhythm, a key factor that affects sleep patterns, sleep duration and other physiological functions, is frequently overlooked. In the present study significantly delayed sleep patterns have been observed during the home confinement. These findings are in agreement with an Italian study performed in the same period in a pediatric population aged from 1 to 18 years old [18]. During the academic year adolescents frequently suffer sleep delayed phase and oversleep on weekends [19], not only to compensate sleep debt on weekdays, but also to get circadian rhythm alignment. Interestingly, the risk for insulin resistance and metabolic syndrome secondary to sleep deficiency and changes in sleep architecture is not minimized after oversleeping [20].

In the last two decades concern about the negative effect of screen time consumption has increased. During the lockdown an increase of the daily consuming of electronic devices was observed in adolescents. Families reported that before of the pandemic 13% of adolescents used electronic devices ≥ 4 h, while during the lockdown it is was almost sixfold higher (75%). Several factors might be involved in the high rate of screen consuming from changes in learning methods, social isolation to easier and wider access to electronic devices [21–23]. Previously, the negative impact of screen use on sleep was associated basically with two factors: number of hours of use of electronic devices and a schedule of use close to bedtime [15, 17, 24]. Interestingly,

Table 2 Sleep variables and use of screens before and during the lockdown

	BEFORE the lockdown <i>N</i> (%)	DURING the lockdown <i>N</i> (%)	<i>p</i> value
Sleep latency (min)			
< 30	230 (86.8)	169 (63.7)	< 0.0001
< 60	29 (10.9)	52 (19.6)	
> 60	6 (2.3)	44 (16.6)	
Bedtime weekdays			
20:00–21:00	13 (4.9)	2 (0.8)	< 0.0001
21:00–22:15	121 (45.7)	32 (12.1)	
22:15–00:30	122 (46.0)	145 (54.7)	
00:30–1:45	8 (3.0)	58 (21.9)	
Later than 1:45	1 (0.4)	28 (10.6)	
Bedtime weekends			
20:00–21:00	0 (0.0)	0 (0.0)	< 0.0001
21:00–22:15	25 (9.4)	12 (4.6)	
22:15–00:30	155 (58.5)	131 (49.4)	
00:30–1:45	74 (27.9)	86 (32.4)	
Later than 1:45	11 (4.2)	36 (13.6)	
Wake time weekdays			
5:00–6:30	7 (2.6)	1 (0.4)	< 0.0001
6:30–7:45	168 (63.4)	10 (3.8)	
7:45–9:45	90 (34.0)	175 (66.0)	
9:45–11:00	0 (0.0)	54 (20.4)	
Later than 11:00	0 (0.0)	25 (9.4)	
Wake time weekends			
5:00–6:30	1 (0.4)	1 (0.4)	< 0.0001
6:30–7:45	7 (2.6)	3 (1.1)	
7:45–9:45	110 (41.5)	87 (32.8)	
9:45–11:00	117 (44.2)	116 (43.8)	
Later than 11:00	30 (11.3)	58 (21.9)	
Nighttime awakenings	98 (37.0)	109 (41.1)	< 0.0001
Naps	44 (16.6)	48 (18.1)	0.271
Xanthines (> 3 d/week)	25 (9.5)	38 (14.4)	0.002
Frequent diurnal hypersomnolence	74 (27.9)	91 (34.3)	0.014
Hours of screen time per day			
0–2 h/d	130 (49.1)	7 (2.3)	< 0.0001
2–4 h/d	101 (38.1)	59 (22.3)	
4–6 h/d	20 (7.5)	106 (40.0)	
6–8 h/d	9 (3.4)	50 (18.9)	
> 8 h/d	5 (1.9)	43 (16.2)	
Online homework (sometimes or always)	166 (62.6)	262 (98.8)	< 0.0001
Online classes (sometimes or always)	22 (8.4)	250 (94.3)	< 0.0001

Significant *p* values (<0.05) are in bold

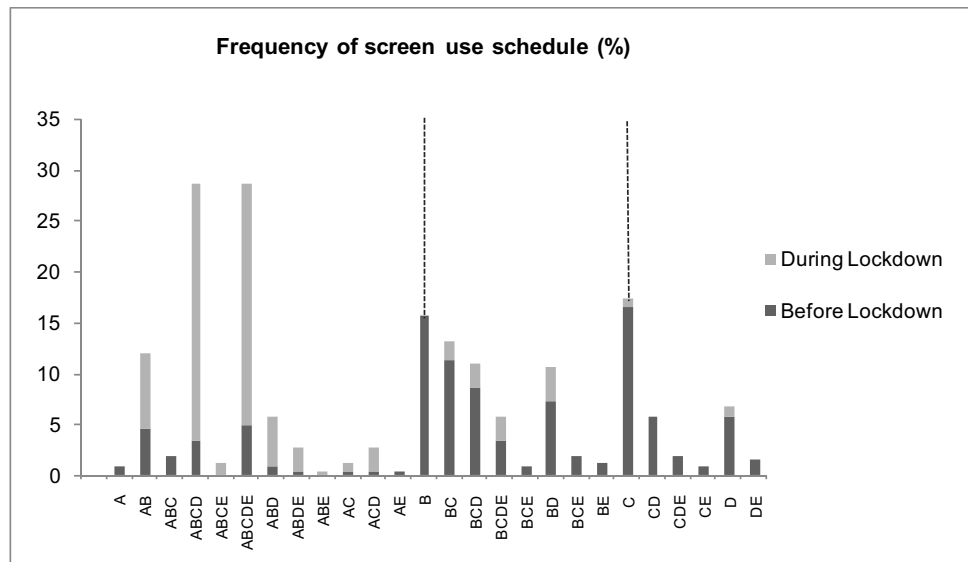
findings of the present study show that although important changes in learning methods occurred during the lockdown and an excess of screen time consuming was associated with long sleep latency, the schedule of use of electronic devices was distributed throughout the day and even decreased at the bedtime period. Therefore, it appears that delayed sleep patterns, at least during the confinement, should be related to circadian rhythm alignment due to relaxed school schedules.

In addition, studies prior to the lockdown also showed an association between an excessive use of electronic devices and other unhealthy habits such as eating behaviors or lack

of physical activity. The present study carried out during the lockdown confirms the negative effect of screen time consumption on physical activity, diet and weight. However, a German study about the impact of the COVID-19 in physical activity and screen time in children and adolescents showed that there was a decrease in sport activity among boys and girls, more strongly pronounced in adolescents, whereas recreational screen time increased [25].

Several strengths should be noted. First, the lockdown during the COVID-19 pandemic in 2020 represented a unique opportunity to investigate how social isolation and relaxed

Fig. 1 Frequency of screen use schedules before and during the lockdown



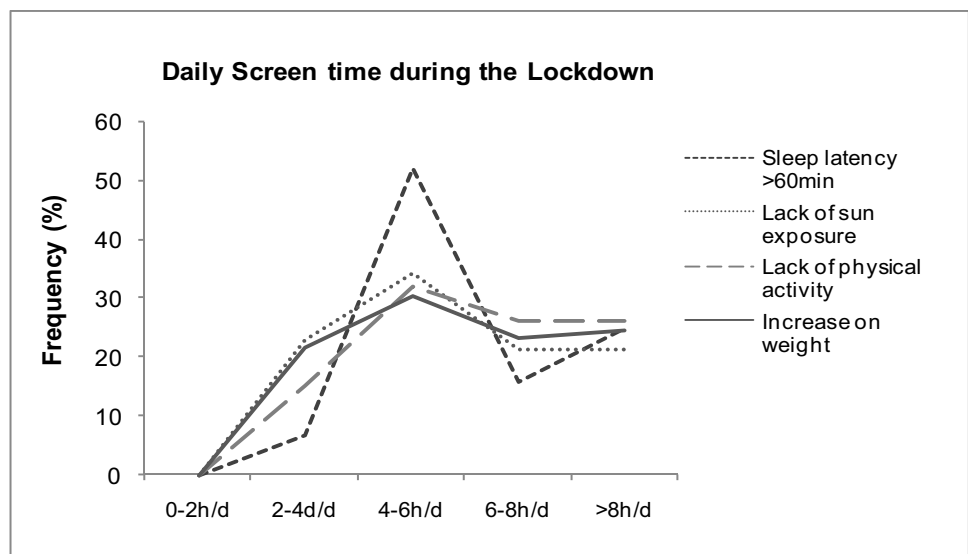
Schedules of electronic devices before and during the lockdown: A: morning 9am-13pm, B: afternoon 16-20pm, C: evening before dinner time 20-21:30pm, D: evening after dinner time >21:30pm, and E: in bed. The first line is for schedules that started in the afternoon, and the second line is for schedules that started in the evening (before or after dinner time or in the bed)

Table 3 Association between range of screen time use per day, demographic characteristics, sunlight exposure, physical activity and weight, behavioral and mood disorders and academic results

Screen time use per day	0–2 h/d N (%)	2–4 h/d N (%)	4–6 h/d N (%)	6–8 h/d N (%)	> 8 h/d N (%)	<i>p</i> value
Gender						
Male	1 (0.6%)	33 (21.4%)	63 (40.9%)	28 (18.2%)	29 (18.8%)	0.119
Female	6 (5.4%)	26 (23.4%)	43 (38.7%)	22 (19.8%)	14 (12.6%)	
Family members						
2	0 (0.0%)	1 (20.0%)	1 (20.0%)	1 (20.0%)	2 (40.0%)	0.164
3	2 (4.2%)	9 (18.8%)	23 (47.9%)	4 (8.3%)	10 (20.8%)	
4	5 (3.1%)	39 (24.5%)	62 (39.0%)	30 (18.9%)	23 (14.5%)	
5	0 (0.0%)	7 (16.7%)	13 (31.0%)	15 (35.7%)	7 (16.7%)	
> 5	0 (0.0%)	3 (27.3%)	7 (63.6%)	0 (0)	1 (9.1%)	
Place of living DURING the lockdown						
Countryside	0 (0.0%)	3 (18.8%)	8 (50.0%)	1 (6.3%)	4 (25.0%)	0.477
Urban area	6 (3.1%)	40 (20.8%)	77 (40.1%)	41 (21.4%)	28 (14.6%)	
Residential area	0 (0.0%)	12 (29.3%)	13 (31.7%)	8 (19.5%)	8 (19.5%)	
Other	1 (6.3%)	4 (25%)	8 (50.0%)	0 (0.0%)	3 (18.8%)	
Family employment situation DURING the lockdown						
Both parents employed	5 (2.8%)	35 (19.4%)	73 (40.6%)	38 (21.1%)	29 (16.1%)	0.064
One employed/one unemployed	1 (1.5%)	17 (26.2%)	27 (41.5%)	11 (16.9%)	9 (13.8%)	
Both parents unemployed	0 (0.0%)	7 (50.0%)	2 (14.3%)	1 (7.1%)	4 (28.6%)	
Other	1 (16.7%)	0 (0)	4 (66.7)	0 (0)	0 (0)	
Sleep latency > 60 min	0 (0.0%)	3 (6.8%)	23 (52.3%)	7 (15.9%)	11 (25.0%)	0.007
Nighttime awakenings	5 (4.6%)	26 (23.9%)	48 (44.0%)	14 (12.8%)	16 (14.7%)	0.134
Lack of sunlight exposure	0 (0.0%)	16 (22.9%)	24 (34.3%)	15 (21.4%)	15 (21.4%)	0.031
Lack of physical activity	0 (0.0%)	8 (15.1%)	17 (32.1%)	14 (26.4%)	14 (26.4%)	0.011
Increase of weight	0 (0.0%)	15 (21.7%)	21 (30.4%)	16 (23.2%)	17 (24.6%)	0.049
Low academic results	0 (0.0%)	10 (29.4%)	8 (23.5%)	8 (23.6%)	8 (23.6%)	0.178
Good social skills	6 (3.4%)	38 (21.5%)	74 (41.8%)	32 (18.1%)	27 (15.3%)	0.591
Frequent behavioral problems	0 (0.0%)	11 (21.2%)	21 (40.4%)	10 (19.2%)	10 (19.2%)	0.130
Mood disorders	1 (1.6%)	8 (12.9%)	29 (46.8%)	11 (17.7%)	13 (21.0%)	0.252

Significant *p* values (<0.05) are in bold

Fig. 2 Association between daily screen time, long sleep latency and some unhealthy habits (lack of sunlight exposure, lack of physical activity and weight gain)



schedules impacted on some behaviors and some healthy habits during this important developmental period that represents adolescence. Second, the aim of this study was not only to investigate changes on sleep patterns and screen time consumption, but also to assess how chronobiological behavioral changes in adolescents played a role on other variables such as weight or physical activity that might have negative long-term effects on their health and quality of life. Third, the target population is important since early identification of sleep problems may provide a window of opportunity to intervene and potentially minimize developmental and behavioral problems prior to adulthood. Fourth, results of the present study allow us to compare the effect of lockdown in Spanish adolescents with previously published studies performed in the same period in other countries and continents. Despite these strengths, there are several limitations. One limitation was the lack of a control group. The recruitment process was based on a parental online report and objective data were not available. Nevertheless, this methodological process allowed us to increase the sample size and improve cost-effectiveness of the study. Finally, these results should not be generalized due to the heterogeneity of the research sample throughout the Spanish geography.

In summary, the lockdown during the first peak of the COVID-19 pandemic was associated among Spanish adolescents with significant changes in screen time consumption, delayed sleep patterns weekdays and weekends and changes in other health habits. Further studies to investigate long-term consequences of delayed sleep patterns, e-learning methods and changes in health habits in adolescents are needed.

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Author contribution MM contributed to study design, interpretation the data, drafting the article, revision and approval of the final version of the manuscript. JA and GP contributed to revision and final approval of the version to be published.

Declarations

Ethics approval and consent to participate This research was conducted in accordance with the World Medical Association Declaration of Helsinki (seventh revision, Fortaleza 2013) and complies with the guidelines for Good Clinical Research Practices and the Biomedical Research Law 14/2007. This study was approved by Ethics Committee of Quirónsalud-Catalonia (2020/67-MSU-CMT). Informed consent was obtained from all individual participants included in the study.

Conflict of interest The authors declare no competing interests.

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