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CLINICAL REVIEW

Effects of COVID-19 home confinement on sleep in children: A systematic review

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SUMMARY

Our main aim was to examine the evidence of the effects of coronavirus disease confinement on the sleep of children aged 12 years and younger. A systematic review was conducted following the recommendations for Preferred Reporting Items for Systematic Reviews and Meta-Analyses. MEDLINE, Cumulative Index for Nursing and Allied Health Literature, Excerpta Medica Database, Psychological Information Database, and Web Of Science were systematically searched between the period of January 2020 and March 2021. The quality assessment was analysed with the Newcastle–Ottawa quality assessment scale and the National Institutes of Health quality assessment tool for observational cohort and cross-sectional studies. The appraisal tool for cross-sectional studies was applied to cross-sectional studies and each longitudinal study was assessed with the critical appraisal skills programme. Data analysis was carried out through a narrative review. Eight studies were included in the review. Seven studies reported changes in sleep routines and five studies focused on sleep disturbances during confinement. The most important findings were a longer duration of sleep time, an increase in sleep latency, and daytime sleepiness. Whether or not the adverse changes to sleep patterns and bedtime routines seen during the home confinement period have any long-term consequences for children's sleep and daytime functioning remains unknown.

Introduction

The World Health Organization (WHO) [1,2] considered the coronavirus disease (COVID-19) a global pandemic in March 2020. Thus, governments imposed social distancing measures to prevent disease spread, and several countries went so far as to decree strict home confinement. This involved the closure of schools, playgrounds, and non-essential establishments, and the cessation of unjustified mobility on public roads [3–8]. Social relationships are a very significant factor in maintaining balance in daily activities, as there is evidence that a pandemic situation can impact on all areas of everyone's lives [9,10]. Similarly, studies have been carried out on the consequences of disruption of daily activities, more specifically in children's lives [11].

In this sense, structuring a daily routine is a protective factor in children's well-being [11] and important for their development. Their routines include academic activities, help with household chores, and play, which in turn is key in the development of cognitive and creative skills [12]. Evidence reveals that the disruption of routine due to confinement led to a destructuring of daily activities [4], which can have a direct impact on sleep [13]. In line with this, it has been previously reported that a lack of social activities may trigger sleep disturbances [14]. Previous researchers studying other situations of home confinement have described in children [3], even under the age of two years [12], feelings of

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List of abbreviations

AXIS	Appraisal tool for cross-sectional studies
BISQ	Brief infant sleep questionnaire
CASP	Critical appraisal skills programme
COVID-19	Coronavirus disease
CSHQ	Children's sleep habits questionnaire
GRADE	Grading of Recommendations Assessment, Development and Evaluation
NIH	National Institutes of Health
NOS	Newcastle–Ottawa quality assessment scale
PICO	Participants, interventions, comparisons, outcomes
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PSQI	Pittsburgh sleep quality index
ROBINS-E	Risk of bias in non-randomized studies of exposures
SDSC	Sleep disturbance scale for children
WHO	World Health Organization

loneliness, worry, restlessness, nervousness, and anxiety [3], which have been related to sleep problems [15].

Moreover, several authors have found that poorer sleep quality has negative repercussions on children's social, emotional [15–17], cognitive, and functional areas [7]. Therefore, it has an impact on children's health and behaviour, which in turn can have a negative effect on daily functioning [15]. As a result, it is evident that sleep is essential in all areas of daily life [3]. Specifically, previous studies have linked sleep problems in childhood with impaired motor and cognitive skills, such as concentration [18], as well as with difficulties in academic activities, emotional regulation, quality of life, growth, body composition [19], and immune function [18]. Sleep is also related to brain development and neural functional connectivity [15,19].

Sleep disorders involve the impairment of one or more dimensions of sleep, including duration, timing, basic patterns, and quality. Sleep disruptions can be triggered by acute, chronic, or total loss or deprivation. In animal models, sleep deprivation leads to impaired neuroplasticity, and brain and behavioural alterations produced at an early age are maintained over time [19]. In children, even aside from confinement, one of the most frequently manifested disorders is daytime sleepiness, which in turn causes inattention and other behavioural and academic problems. Periods of stress can negatively influence and trigger difficulty falling asleep, or fear of falling asleep, and this can result in difficulty waking, feeling tired during the day, or falling asleep in inappropriate situations [15].

Some authors have stated that a daily routine, including a sleep schedule, is a fundamental aspect of children's developing healthy behaviours and adequate energy levels. Evidence points to maladjustment in different areas during confinement, including the excessive use of devices, decreased physical activity, and increased sleep duration [14,20]. In line with this, some authors have highlighted the importance of measuring the impact of the current situation on children, as there is little research on this population [3].

However, no reviews on the impact of confinement, specifically on sleep behaviour in children, have been identified so far. For all of the above reasons, it can be understood that there is a direct influence from the lack of structure and the limitation of the activities of daily life on the quality of sleep, but an analysis of the results of the research carried out to date is still needed. The aim of this systematic review is to examine the evidence of the effects of the COVID-19 confinement on the sleep of children aged 12 years and younger and the relationship between sleep disturbances and daily routines.

Methods

Design

With the purpose of exploring the available evidence on the impact of home confinement [21] as an exposure variable, a systematic review was used following the recommendations for Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [22]. The Cochrane guidelines for systematic reviews of observational studies will be considered [23]. Similarly, the results will be interpreted with increased caution, assessing the risk of bias by applying the risk of bias in non-randomized studies of exposures (ROBINS-E tool) [21] as part of the guide Grading of Recommendations Assessment, Development and Evaluation (GRADE) [24].

Search strategy

First, both the Cochrane Library and PROSPERO were reviewed to check for previous systematic reviews on this topic. The systematic review was conducted by reviewing MEDLINE (PUBMED), Cumulative Index for Nursing and Allied Health Literature (CINAHL), Excerpta Medica Database (EMBASE), Psychological Information Database (PSYCINFO), Web Of Science (WOS) databases through the participants, interventions (exposure), comparisons, outcomes (PICO) search tool [25] for articles dated between the period of January 2020 and March 2021. Finally, Google Scholar was also reviewed to broaden the search.

The terms that were entered in the search were P ("child" OR "children"), I (COVID-19), O ("Sleep" OR "Rest"/"Activities of Daily Living" OR "Routines" OR "Daily Routines" OR "Daily life" OR "Daily Activities"). In PUBMED, Medical Subject Headings Terms (MesH) were entered as such in addition to the free-format terms. In the rest of the databases, the terms were entered in free format. Three reviewers (L.R.C-M, R.M.M–P and M.P-T) independently assessed the eligibility of the studies and extracted the data.

Inclusion/exclusion criteria for study selection

The systematic review included studies that met the following inclusion criteria: (1) the study population ranged in age from 0 to 12 years; (2) strict home confinement due to COVID-19 of at least one month duration was considered as an exposure variable; (3) standardized sleep instruments needed to be the method of data collection because the outcome of interest was the impact of COVID-19 confinement on sleep and its relationship to other habits or routines; (4) the typology of the studies needed to be quantitative or mixed methodology, in which quantitative data could be extracted without filtering by type of scientific article; (5) and the articles needed to be in English or Spanish.

Studies focusing on other populations, such as adolescents, adults, or the elderly, or articles for children aged 0–12 years with a diagnosis of COVID-19 or other diseases were excluded. Similarly, qualitative research and secondary literature such as other systematic reviews and case series were discarded.

Quality appraisal

The appraisal process was conducted independently by three reviewers (L.R.C-M, R.M.M–P and M.P-T). There was high agreement regarding quality assessment, and items that were rated differently were resolved through discussion. The quality assessment of each individual study was analysed with the Newcastle–Ottawa quality

assessment scale (NOS) [26,27] and the National Institutes of Health (NIH) quality assessment tool for observational cohort and cross-sectional studies [28]. To assess the quality of cross-sectional studies the appraisal tool for cross-sectional studies (AXIS Tool) was applied [29], and the longitudinal study was assessed with the critical appraisal skills programme (CASP Tool) [30]. (See Additional file 1. Quality appraisal.)

Assessment of risk of bias

To assess the risk of bias in non-randomized studies of exposure, we used the ROBINS-E, which analyses several domains that can produce biases in individual studies, such as bias due to confounding, bias in selecting participants in the study, bias in departure from intended exposure, bias due to missing data, bias in outcome measurement, and bias in selection of reported results [21].

Data extraction

Data were extracted and organized in a table. Data included were baseline, objectives, country, design, participants (sample size and sample ages), period of data collection, assessment tools, statistical analysis, main results, and biases [31].

Results

Search outcome

Through the search strategies described above, 1,909 articles were initially identified. After removing duplicates, 1,413 were reviewed for title and abstract. From these, 51 studies were selected for full reading. Finally, eight studies were included in the present review, taking the selection criteria into account. The full details are presented in the PRISMA flow diagram (Fig. 1).

Study characteristics

All articles included were observational studies, seven of cross-sectional design [11,13,15,33–36] and one of longitudinal design [37]. The purpose of all studies was to assess possible sleep disturbances or changes in children's sleep during COVID-19 home confinement. Some studies also explored the relationship between

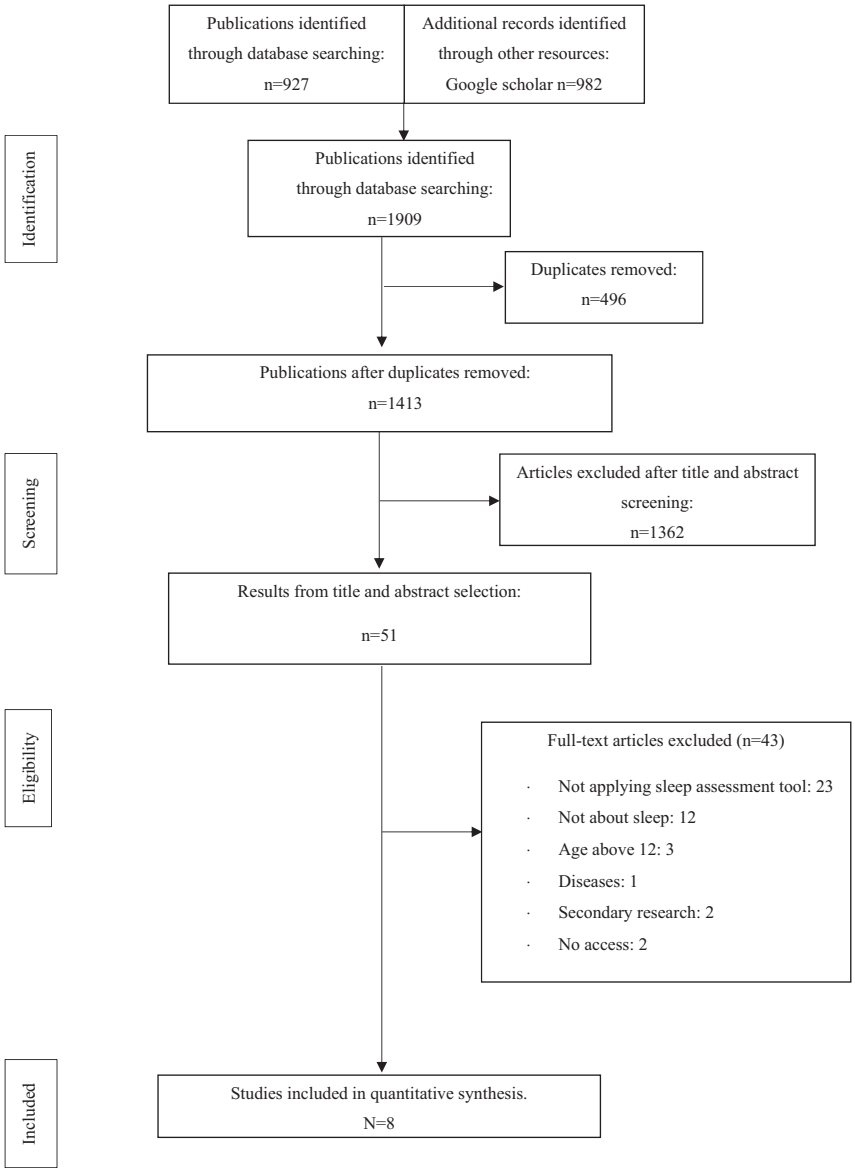

Fig. 1. PRISMA flow diagram.

changes in routine and sleep [11,13,35]. Children were the study population for all studies, with a total of 7,960 children aged 0–18 years, with this study focusing on children up to 12 years old. Three studies included infants aged 0–2 years old [33,34,37]; six were about preschool-aged children, 2–5 years old [11,13,15,33,34,37]; and six covered school aged children, 6–12 years old [13,15,33,34,36,37]. All studies used an online survey composed of standardized tools as a method of data collection. More than half, at 57% of the studies, administered the sleep disturbance scale for children (SDSC) [11,15,34,35]; 43% implemented the children's sleep habits questionnaire (CSHQ) [13,33,37], of which two applied the brief infant sleep questionnaire (BISQ) [33,37], and one applied the Pittsburgh sleep quality index (PSQI) [36]. Three studies were conducted in Italy [11,34,35], one in China [13], one in Israel [33], and one in Tunisia [36]. Two studies were conducted in more than one country, namely Markovic et al.'s [37] which covered Switzerland, Spain, France, Italy, Germany, the USA, Argentina, Canada, Serbia, Austria, Belgium, Chile, Bangladesh, Brazil, Colombia, the Czech Republic, Great Britain, the Netherlands, Romania, Peru, Sweden, and Syria; and Baptista et al.'s [15], which covered Portugal and Brazil Table 1.

Data analysis

Due to the heterogeneity across included studies a meta-analysis was not possible. Data analysis was carried out through a narrative review, in which quantitative results were synthesized, after being analysed for the interconnectedness of the data from the various included studies [32].

Results of the synthesis

Of the included studies, 43% (n = 3) focused on changes in children's routines, in which parents reported not only changes in routine [15,35], but also difficulties in following these routines on a day-to-day basis [11,35]. Specifically, seven studies reported changes in sleep routines and patterns [11,13,33–37], and five studies focused on sleep disturbances during confinement [11,15,34–36].

Tools

Sleep disturbance scale for children (SDSC). This 26-item scale has a score ranging from 26 to 130, with higher scores indicating greater sleep difficulties. A score higher than 39 can be considered a cut-off for identifying children with disturbed sleep [11,15,34,35].

Pittsburgh sleep quality index (PSQI). This instrument consists of 19 questions that are grouped into scores with the following parameters: sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication and daytime dysfunction. The total score for the PSQI varies from 0 to 21. A PSQI total score >5 is indicative of poor sleep [36].

Brief infant sleep questionnaire (BISQ). This instrument quantifies the following parameters: (a) sleep onset time, (b) sleep duration, (c) daytime sleep duration, (d) number of night awakenings, (e) sleep latency, (f) nocturnal wakefulness and (g) the degree to which parents perceived their child's sleep as problematic (rated on a five-point scale, ranging from 1 [not at all] to 5 [very difficult problem]) [13,33,37].

Children's sleep habits questionnaire (CSHQ). CSHQ is a 33-item validated instrument used to screen for sleep disturbances. A higher score is indicative of more disturbed sleep; a total score of >41 has been defined as the cut-off for overall sleep disturbance. Data on co-sleeping, bedtimes, wake times, frequency and duration of napping, and nocturnal sleep duration were collected [13,33,37].

Sleep patterns

Duration of sleep was reported in 75% (n = 6) of the studies [13,33–37]. Studies involving infants found a reduction [34,37]. In one study, 35% of mothers of children aged 6–72 months reported an increase in sleep while 25% reported a decrease [33]. Sleep was significantly increased in the 4- to 12-year-old age group [34]. In preschoolers, in particular, greater variability was found despite the assessment method not allowing for the inclusion of duration [37]. Some authors found greater sleep duration during confinement [13], while others found no significant differences [36]. Examining the studies that reported total sleep, the mean changed by 1 h 36 min [13,35]. Another aspect that increased was the time children spent in bed—an average of 27 min longer. The midpoint of sleep was only reported in a single study [35].

Half of the studies examined the time of awakening (n = 4); all showed a delay in the time of awakening, which was on average 1 h 16 min [11,13,35]. Most of the included studies that considered bedtime (n = 5) reported a significant delay, with a mean of 1 h 3 min [11,13,35], the mean bedtime being 22:59 p.m. [11,13,34,35]. Specifically, the proportion of children going to bed later than 23:00 p.m. increased by 28% for children between 6 and 12 years old, by 18% for those between 4 and 5 years old, and by 11.26% for those between 1 and 3 years old [34]. Delays in sleep timing were greater in older children [34,35]. Cellini et al. [35] reported that children went to bed on average at 22:48 p.m., 1 h and 18 min later; Di Giorgio et al. [11] at 22:52 p.m., 54 min later; and Liu et al. [13] at 22:36 p.m., 57 min later. On the other hand, they reported a delay in infants, and in the case of preschool children, they did not specify the time of going to bed, although reduced regularity of bedtime was reported [37].

The time to fall asleep was also considered in 50% (n = 4) of the studies, and a significant increase in the minutes of latency was observed [36], with the proportion of children taking more than 30 min to fall asleep rising considerably; specifically, the mean was even as high as 1 h [34]. The same was reported in infants, on average 8 ± 21 min longer. The same is not true for preschoolers, however, who were less likely to fall asleep within 20 min and thus had a shorter latency period [37]. Other authors pointed out that 26.1% of mothers detected a change in the way their children fell asleep, specifying a mean latency time of 23.97 min during confinement [33]. The proportion of children who napped decreased [13,34], to 28% from 80% on weekdays in a 2018 sample [13]. At the same time, nap time was reduced in the youngest children aged 1–4 years [34]. In 4-6-year-old children, the duration of naps was shorter during confinement, and those who did not nap had a longer duration of sleep [13].

Sleep disturbances

Only 38% (n = 3) reported SDSC total scores [11,15,35]. One study showed sleep disordered breathing, sleep–wake transition disorders, arousal disorders, excessive sleepiness, and sleep hyperhidrosis [15]. Other studies found no significant change in the total SDSC score, nor in the proportion of children with a score above 39, the cut-off point for sleep disturbance [11,35]. There was an increase in the percentage of children with scores >39, by 3% [11], and in the means of the total score, from 38.6 to 39.9 [35], although this was not statistically significant. Another study indicated a significant worsening of sleep disturbance and consequent daily dysfunction and a decrease in sleep efficiency as determined by the PSQI [36]. In contrast, another study noted a significant decrease of 22% in overall CSHQ sleep disturbances in their preschool sample in 2018, compared to the sample recruited during confinement [13].

Table 1
Characteristics of studies included in the systematic review.

Authors, year	Country	Study design	Aims	Population Sample size, % male	Sample aged M (SD)	Data collection, time study	Outcome measures	Main results	Statistics analysis	Risk of bias
Abid et al., 2021 [36]	Tunisia	Cross-sectional study	To examine the effect of these restrictions on sleep quality, screen time and physical activity in Tunisian children with a special focus on gender differences.	n = 100	5–12	Online survey April 24-May 10, 2020	PSQI	The majority of the PSQI items showed a significant difference between before and during confinement. There were a decreased in both sleep quality and efficiency. Latency, sleep disturbances and daytime dysfunction were increased during confinement.	Two-way ANOVA with repeated measures. Bonferroni posthoc/ Wilcoxon tests.	Bias in selection Bias in outcome measurement (self-report)
Baptista et al., 2021 [15]	Portugal (49.8%) Brazil (50.2%)	Cross-sectional study	To evaluate sleep disorders among Brazilian and Portuguese children during social distancing	n = 255, 52.2%	7.5 ± 3.4	Online survey April 24–26, 2020	SDSC	72.2% change in children's routine. 42.7% report poorer sleep quality.	Likelihood ratio chi-square test. Kruskal–Wallis test.	Bias in selection Bias in exposure classification Bias in outcome measurement (self-report)
Bruni et al., 2021 [34]	Italy	Cross-sectional study	To examine the impact of confinement during the COVID-19 pandemic on the sleep patterns and sleep disturbances in Italian children and adolescents.	n = 4314 1–3 years: 1263, 53.76% 4–5 years: 893, 50.95% 6–12 years: 1848, 50.65%	1–18	Online survey May 7th-June 15th, 2020	Modified SDSC	Significant delay in going to sleep and waking up. Poorer quality of sleep.	Chi-square tests.	Bias in selection Bias in outcome measurement (self-report)
Cellini et al., 2021 [35]	Italia	Cross-sectional	To investigate how confinement during the national lockdown has impacted sleep in mothers and their school-age children in terms of timing and quality.	n = 299, 53.51%	6–10 7.96 ± 1.36	Online survey April 1–9, 2020 (after 3 weeks of confinement)	SDSC	Total score SDSC did not significantly change during the lockdown. Proportion of children with some sleep difficulties (i.e., SDSC >39) was stable, from 41.46% before the lockdown to 44.72% during the lockdown.	A series of linear mixed models. Holm method to correct post- hoc comparisons. McNemar's test. A linear regression model.	Bias in selection Bias in outcome measurement (self-report)
Di Giorgio et al., 2020 [11]	Italy	Not specified	Characterizing the changes in mothers' and children' sleep quality, subjective time experience, emotional symptoms, and self-regulation capacity during the lockdown compared to the period immediately before	n = 245, 52.24%	2–5 4.10 ± 0.92	Online survey April 1–9, 2020	SDSC	Significant delay in going to sleep and waking up. Sleep disturbance increases from 41 to 44%.	McNemar's test. ANOVA. Tukey HSD test: for post-hoc comparisons. Pearson correlations: to investigate the relationship between changes in sleep variables, emotional and behavioral symptoms. A multiple linear regression model.	Bias in selection Bias in exposure classification Bias in outcome measurement (self-report)
Markovic et al.,	Switzerland, Spain, France, Italy, Germany,	Longitudinal	To identify longitudinally the dynamics of sleep behaviour in young	n = 864 452 babies, 48.45%	0–35 months 1.5 ± 0.8	Online survey Baseline: April 2020	BISQ CSHQ	In April, sleep quality decreases significantly compared to before	Linear mixed models.	Bias in selection Bias in outcome

(*continued on next page*)

Table 1 (*continued*)

Authors, year	Country	Study design	Aims	Population Sample size, % male	Sample aged M (SD)	Data collection, time study	Outcome measures	Main results	Statistics analysis	Risk of bias
2021 [37]	USA, Argentina, Canadá, Serbia, Austria, Belgium, Chile, Bangladesh, Brazil, Colombia, Czech Republic, Great Britain, Netherlands, Rumania, Peru, Sweden Syria		children and the corresponding familial circumstances during the COVID- 19 confinement.	412 preescolar, 56.79%	36–71 months 4.5 ± 1	First follow- up assessment: May 2020. Second follow-up assessment: June 2020.		confinement. Increased sleep duration in preschoolers and decreased sleep duration in infants. Delayed bedtime.		measurement (self-report)
Liu et al., 2021 [13]	China	Cross-sectional	To examine the sleep patterns and sleep disturbances in Chinese preschoolers confined at home as compared to our previous data collected during a normal school term one year prior.	n = 1619 2018 Sample: 50.5% male COVID-19 sample: 48.9% male	4–6	Online survey 17-19th February 2020 Comparison sample: December 2018	CSHQ	Significant delay in going to sleep and waking up. Increased duration of sleep time. Reduction in daytime naps.	Chi-square test, independent t test and ANOVA. Cohen's d and η2. Spearman correlation: to explore the relation between napping duration and sleep duration. The random intercept model was fitted to examine the effect of other variables.	Bias in selection Bias in exposure classification Bias in departure from intended exposure Bias in outcome measurement (self-report)
Zreik et al., 2020 [33]	Israel	Cross-sectional	To explore whether mothers experienced a change in the child's sleep during the current crisis compared to pre-crisis period	264	6–72 months	Online survey 20–30April 2020 (4 weeks into the national lockdown)	BISQ CSHQ	29% negative change in sleep quality. 35% reduced sleep duration. 25% increased sleep duration.	Pearson correlation coefficients ANCOVA	Bias in selection Bias in exposure classification Bias in outcome measurement (self-report)

Note: M, mean; SD, Standard deviation; COVID- 19, Coronavirus disease; PSQI, Pittsburg Sleep Quality Index; SDSC, Sleep Disturbance Scale for Children; BISQ, Brief Infant Sleep Questionnaire; CSHQ, Children's Sleep Habits Questionnaire; ANOVA, Analysis of variance; ANCOVA, Analysis of covariance.

On the other hand, 50% (n = 4) analysed the proportion of specific sleep disturbances. Using a modified version of the SDSC, they detected significant increases in the following categories: 13.4% in difficulty falling asleep; 9% in anxiety at bedtime; 5% in night-time awakenings [more than two]; 1.7% in sleep fears among those aged 1–12 years old; nightmares, specifically in the 4- to 12-year-old age group; and 2.3% in night hypnic jerks or involuntary movements in the 1–3 year olds [34]. These studies also reported problems with nocturnal awakenings and half of them with daytime sleepiness. Regarding night-time awakenings, one study reported a mean of 1.28 during confinement [33], while another reported increases of 7%, 6%, and 4% in the children aged 1–3, 4–5, and 6–12 years old, respectively [34]. Markovic et al. [37] reported similar findings in both infants and preschoolers, but these groups had greater sleep fragmentation. However, in another group of preschoolers in China, sleep fragmentation was significantly reduced [13]. Daytime sleepiness was also a prevalent sleep disturbance, with a reported increase of 2.7% in 1- to 3-year olds, 4% in 4- to 5-year olds, and 5% in 6- to 12-year olds [34]. In other samples, the CSHQ sleepiness subscale score decreased by 4.4 points from 2018 to the isolation period [13].

Sleep quality

Only 50% (n = 4) studied children's sleep quality during confinement, indicating significantly poorer subjective sleep quality [36]. Some authors noted that mothers perceived lower sleep quality in their children [15,33,37]. Specifically, 42.7% of mothers in the study by Batipsta et al. [15] and 29% in the study by Zreik et al. [33].

Variables influencing children's sleep

All included studies examined several factors that could influence sleep. Specifically, a healthy diet, adequate family environment, and good parent-child communication were negatively correlated with sleep disturbances [13], while the use of digital devices was positively correlated [13,34]. Another study pointed to age as a predictor of problems, and female gender as a predictor of poorer sleep quality [11,35,36], and this was also a predictor of greater emotional difficulties [11,35]. Similarly, caregiver stress and infant sleep were associated, and even in infants whose mothers were quarantined increasing the minutes of falling asleep but this was not the case among preschoolers [37]. Insomnia in mothers was also linked to sleep disturbances in children [33,35]. These variables were similarly modified during confinement. In the case of devices, the percentage of children who had more than 3 h per day of screen time increased by 29% in children aged 1–3 years old, 37.8% in children aged 4–5 years old, and 37.9% in children aged 6–12 years old [34].

Risk of bias

All studies had a moderate risk of bias. Specifically, almost all had a low risk of bias in confounding, in the selection of reported outcomes, and for missing data, with three exceptions [13,34,36]. There was a moderate risk in participant selection, as all except for one study [36] used non-probabilistic recruitment [37,38]. There was a moderate risk in the assessment of the outcome variable because, despite using validated tools, the studies applied self-reported methods. There were also biases due to classification, with respect to exposure [39], as results may be considered biased if participants are from different areas, as well as if results are from another point in time. In this regard, the risk was moderate in most cases [11,13,15,33,36] (see Additional file 2. Risks of bias.)

Discussion

The main objectives of the current review were to examine the available evidence of the impact of COVID-19 confinement on sleep and its relationship to routines in children up to 12 years of age. The reviewed studies described the effects of disruption in daily life due to the COVID-19 lockdown on sleep [11,13,35,36]. Sleep duration, as in the pre-confinement literature [40], was the most studied parameter in children (75% of studies). Most children slept between 9 and 10 h, consistent with previous results [3,5,7,8,12,41]. Another study reported that younger children slept longer, in line with other authors [33,42]. However, this finding did not coincide with other included studies, in which the majority slept between 8 and 10 h [34,36]; the shortest duration was among the oldest children aged 8–12 years old [8,43].

A beneficial aspect found for children's sleep during confinement is that these sleep times are within the recommendations [18,44], except for the older ages [34,36]. These schedules are similar to those of the weekends prior to confinement, reflecting that, in the absence of school routines, sleep needs can be met [7]. Conversely, but no less relevant, other authors have highlighted the structuring of the day [15] and the repercussions that the variability in sleep schedules and routines can have on children [40]. The COVID-19 lockdown, due to lack of routines [7], led to 'social jetlag' as was reported on holidays or weekends prior to confinement, which can have negative effects on health [40].

In agreement with the results of the included studies, other studies have reported increases in sleep duration [3,7,41,42,45,46]. In infants, sleep time decreased during the confinement; prior to the pandemic, this reduction had been observed and associated with breastfeeding [47]. In preschoolers there were inconsistencies: according to the results of the included studies [13,37] some authors showed an increasing trend [42], while others showed a decrease [46]. Other authors reported an increase of 35% and a decrease of 25% [33] without dividing by age range, so it is not possible to attribute the decrease to infants or to preschoolers, as is the case with other studies [48,49].

All age groups went to bed and woke up later during confinement [11,13,34–37], in line with other studies [7,43]. Before confinement, the mean bedtime was 21:00 p.m. and 7:00 a.m. for waking up [13,18] which is not different from the means of studies detailing pre-confinement times retrospectively [11,34,35]. Sleep delay occurred even in infants and preschoolers, who had less regularity in their sleep routines [37]. In this sense, other authors have reported that variability in sleep schedules can have consequences. Longer sleep in periods without school routines has been associated with depressive symptoms, and differences in sleep time from structured days has been associated with poorer academic performance [40]. Moreover, some authors observed weekend sleep compensation induced by a lack of sleep on weekdays which, consequently, could result in delayed sleep phase disorder [40]. These results suggest that a delay in bedtime and risetime during confinement could also lead to delayed sleep phase disorder.

Sleep delay was most prevalent in older children, the group with the greatest increase in digital device use [34]. In line with this, delayed bedtimes have been linked to increased screen time [3,50]. Screen time displaces other sleep–beneficial activities, such as physical activity [51], and excessive use at night can trigger sleep problems [34]. Specifically, in pre-confinement research, it has been estimated that for every hour of screen use, sleep is delayed by 5–10 min [50]. For this reason, the American Academy of Pediatrics suggests avoiding their use for at least 1 h before bedtime [51]. In addition, the increase in sleep latency could be explained by the

fact that bright light might lead to cognitive and emotional activation, producing a state of hyperarousal [18,52], and could reduce melatonin production [52]. Other authors also related bright light and melatonin suppression to delayed sleep phase disorder [36].

As a result of confinement, screen time increased among children of all ages [5,13,34,36,53]. This increase may be linked to the lack of routine [12]. Pandemic-linked increased device use could have an impact on sleep [18,52]. In line with this, both in our results and in other research [43], a rise in latency time has been observed at all ages, by as much as 1 h [34,36,37], with the exception of one study, in which preschool-aged children decreased latency time [37]. Some authors reported that napping decreased [7,13,34], while other authors reported an increase, which may be associated with daytime sleepiness [43]. Other reasons for an increase in naps may be the lack of routine, the absence of peer interaction, and even lower levels of cognitive activity compared to a school day [13].

One of the included studies found a decrease in sleep disturbances [13], although other authors reported that the proportion of children with scores classified as disorders increased [11] as did the mean total scores, but this was not statistically significant [11,35]. However, in one study, sleep disturbances were significantly higher during confinement [36]. The similarities between sleep disturbances in the two time periods may be because, under normal [pre-pandemic] conditions, disturbances already tended to be prevalent in children [52]. Specifically, the most frequent disturbances were resistance to going to bed, problems waking up or falling asleep, and nocturnal awakenings [53]. With regard to specific problems during confinement, significantly higher scores were observed, namely for anxiety at bedtime, night-time awakenings, nightmares, hypnic jerks, and involuntary movements during sleep [34].

While only one study reported a decrease in daytime sleepiness, night-time awakenings, sleep anxiety, bedtime resistance, and parasomnias [13], other authors reported several sleep problems [15,33,34,37], which is consistent with other studies during confinement [43]. Nevertheless, these authors [13] are the only ones that compared the situation with a previous collection of data in 2018, which could explain the differences with other authors. Similarly, there were significantly more night-time awakenings [34,37]; however, even before the pandemic, studies indicated that a large proportion of infants did not sleep through the night [46]. One study found increased anxiety at bedtime [34]. Anxiety disorders in turn have been more prevalent during confinement, and these have been positively correlated with sleep problems [3,54]. Nightmares have also increased [3,7,34,41], and have previously been related to problems in both the cognitive and the psychosocial spheres, specifically depression, impulsivity, and impaired decision-making [40].

As for daytime sleepiness disorders [15], which are related to poor academic performance [18], some authors reported an increase [15,34], although others reported a decrease [13]. Along these lines, other authors [43] described that daytime sleepiness was manifested during confinement by a small percentage of children.

The articles included in this study indicated poorer sleep quality [15,33,34,36,37], in congruence with other studies performed during confinement [42,43,54]. Nevertheless, the study by Abid et al. [36] applied the PSQI, which it is not validated for the paediatric population. The study by Di Giorgio et al. [11] reported a positive correlation between changes in the sleep quality of children and their mothers. In line with this, other authors found a significant relationship between emotional sociofamiliar behaviour habits and sleep quality in children [55]. However, there are inconsistencies with these results [5,49], as some authors found no change in sleep quality in 70% of children, and a decrease in only 13.3% [48]. On the other hand, other authors have included sleep efficiency, reporting a reduction in sleep efficiency [14].

Emotional problems, along with gender, age, diet, device use, stress, and environment are factors that have been considered in studies as moderators of children's sleep [11,13,15,33–35,37]. During confinement, girls were more likely to suffer from sleep disturbances [35,56], although previous research has indicated that this is truer in boys [56]. Younger boys spent more time in bed and went to sleep earlier [11,35]. Screen time, as noted above, increased considerably [5,14,41–43,45,46], even up to 5 h a day for recreational use [5], although the American Academy of Pediatrics recommends limiting to <1–2 h a day [51].

Screen exposure has been correlated with sleep disturbances [57]. Excessive screen time, in turn, has been associated with sleep deprivation, sedentary lifestyles, and consumption of processed foods [51]. In this line, one study found regular diet was one of the precursors of sleep improvement [13]. Despite exercise being related to better sleep [58], sedentary behaviour is an aspect that was only considered in one study, in which a significant increase in sedentary behaviour was found [36]. However, other authors reported a decrease in physical activity during confinement [3,14,42,45,45,46,49].

Each society has different habits or patterns, and the perception of what is abnormal may vary from one society to another. The lifestyles of urban societies are more prone to lead to sleep disorders [18]. In this regard, mothers' working conditions can impact healthy habits, and changes in such conditions due to confinement have affected children's patterns and routines [11]. Negative sleep outcomes have been pronounced in the children of mothers who stopped working or who were teleworking, as they had greater flexibility in their schedules [35]. For all these reasons, each family unit experienced different obstacles in maintaining routines and sleep in children [15]. However, apart from mothers' working conditions, the included articles did not consider more information about other cultural aspects such as the socioeconomic status or ethnic mix.

To sum up, during confinement, children had more time available to themselves, and this has been unevenly distributed with increasing screen time and decreasing physical activity, both of which influence sleep [15,43,56]. A very high percentage of parents reported a change in children's routines [15]. Moreover, most studies reported an increase in sleep disturbances, such as anxiety at bedtime, night-time awakenings, nightmares, hypnic jerks, and involuntary movements during sleep [34].

This paper provides an overview of the current evidence on the changes in sleep in children aged 12 years and younger during the COVID-19 confinement. This assessment of the literature found a longer duration of sleep time and delayed bedtimes and waking up times. These results suggest that sleep delay during confinement due to the lack of routines could lead to delayed sleep phase disorder, in addition to other described sleep disturbances. To address these needs, it is essential to understand the behaviour [3]. Understanding specifically how sleep patterns were affected during the COVID-19 pandemic may enable the development of interventions and mitigate adverse effects, so future research is needed to objectively measure how this situation may impact sleep as well as children's health and health-influencing behaviours. Similarly, more longitudinal studies are needed to analyse the long-term impact of the pandemic on both sleep routines and sleep-related variables.

The findings from the present review need to be interpreted in light of the following limitations. With regard to the limitations of each individual study, it should be noted that all studies were based on self-reports rather than on objective measures to collect sleep data. Also, most of them included retrospective information, which can lead to recall biases [31]. Regarding both sleep parameters and sleep disturbances, not all studies indicated the total statistical results of assessment tools administered making comparison between studies difficult. One study compared sleep disturbances during confinement with respect to 2018; however, the samples were not the same. Additionally, although it claimed to be homogeneous, its estimates could be biased.

Regarding the limitations of the review, the narrative synthesis did not permit proper weighting of the analysed studies. Moreover, the risk of publication bias is probably higher as all of the designs included observational studies, so, due to the methodological quality of the studies, the results may be biased. On the other hand, the estimates of the syntheses may also be biased from not identifying other studies on the topic or those published in languages other than Spanish and English [59]. However, we attempted to mitigate this bias by conducting a comprehensive search. Another limitation might be to have included only eight studies, but each study needed to apply standardised sleep instruments to be included. Other of the identified studies only measured sleep duration, without using validated instruments, and was therefore excluded from this study. Not all of the included studies used the same methodology, in terms of design or data collection, so the overall statistical results cannot be compared, which has made it difficult to develop meta-analyses, so a narrative review was carried out instead. In addition, one of the included studies [36] applied the PSQI to measure sleep quality; this tool is not validated for the paediatric population.

Conclusions

The lack of routines and schedules during confinement had a negative impact on children's behaviour; in particular, changes have been observed in sleep habits. The most important changes have been a longer duration of sleep time, delayed bedtimes and waking up times, an increase in sleep latency, daytime sleepiness, and other sleep disturbances. These results suggested that sleep delay during confinement could lead to delayed sleep phase disorder. However, whether or not the adverse changes to sleep patterns and bedtime routines seen during the home confinement period have any long-term consequences for children's sleep and daytime functioning, remains unknown.

Practice points

1. Some evidence suggests that the absence of a regular sleep schedule and sleep disturbances can have consequences even in the long term in children.
2. Included studies found delayed bedtimes and waking up times in children during confinement, as well as an increase in sleep latency, daytime sleepiness, and other sleep disturbances.
3. The results suggest that sleep delay during confinement could lead to delayed sleep phase disorder in children.
4. Only one of the included studies had a longitudinal design, indicating that the results should be interpreted with caution.

Research agenda

More studies are required:

1. To better understand the causal pathways between sleep problems and the COVID-19 pandemic.
2. To rate the objective impact of the pandemic on sleep applying objective measures.
3. To examine the long-term consequences of the COVID-19 pandemic on sleep.
4. To develop prevention or intervention programmes that establish sleep routines and hygiene for the paediatric population.

Conflicts of interest

The authors do not have any conflicts of interest to disclose.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.smrv.2022.101596.

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