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Review

The impact of the COVID-19 pandemic on adolescent sleep behavior

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Abstract

Restorative sleep is a fundamental component of adolescent wellbeing, and the COVID-19 pandemic presented both challenges and opportunities for adolescents' sleep. In this review, we synthesize emergent themes from the growing scientific evidence for the impact of the pandemic on adolescent sleep behavior across different stages of the pandemic and in different locations around the world. We also highlight the ways in which COVID-19 shaped sleep patterns among college students—a subgroup of adolescents transitioning to emerging adulthood that were particularly impacted by the shift to remote learning. Finally, we discuss variations in the impact according to several potential moderating factors in adolescents' lives and point to areas that require additional longitudinal research.

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Sleep, Insomnia, Adolescence, Transition to college, COVID-19 pandemic.

Introduction

The onset of the COVID-19 pandemic and subsequent school closures raised simultaneous concern and optimism regarding potential impacts on adolescent sleep behavior [1]. Adolescents' daily lives were disrupted by the pandemic's sweeping changes to learning and social environments, with multiple potential consequences for sleep. On the one hand, the transition to remote learning during the initial waves of the pandemic obviated the need to prepare for and commute to school, freeing up that time for other activities like sleep [2]. Delaying school start times has previously been shown to improve adolescent sleep outcomes [3,4], suggesting that remote learning could permit sleep schedules that are better aligned with adolescents' circadian rhythms. On the other hand, the increased flexibility in morning routines and sleep-wake schedules during periods of school closure were offset by heightened feelings of loneliness and psychological distress as youth were isolated from their peers [5]. Fears of COVID-19 infection and worries about the future trends of the pandemic further contributed to sleep difficulties among adolescents [6,7]. Compounding these uncertainties about the impact on sleep was the substantial regional variability in the timing of COVID-19 case peaks and the duration and frequency of school closures—implying potentially heterogeneous influences on adolescent sleep across time and regions.

A number of systematic reviews [8–11] and one narrative review [12] have synthesized research on child and adolescent sleep during the months following the initial outbreak of the COVID-19 pandemic, though to the authors' knowledge none have focused specifically on adolescents. These reviews observed substantial heterogeneity in sleep patterns by regional context but documented a general trend of increased sleep duration and delayed bedtime following the onset of the COVID-19 pandemic [8,9,11,12]. Findings for sleep quality, sleep disturbance, and insomnia were markedly less positive, with many studies reporting a high prevalence of sleep disturbance and insomnia among children and adolescents [8–12]. Yet, these findings may not fully describe the experiences of adolescents given substantial developmental differences in circadian rhythms and autonomy over bedtime schedules between children (i.e., youth ages 0–7 years) and adolescents (increasingly considered ages 8–25). Furthermore, many of the synthesized studies only assessed sleep following the outbreak of the pandemic [7,13,14], limiting conclusions about the pandemic's causal effect on adolescent sleep behavior. Given these limitations, we have focused our discussion on longitudinal, cross-sectional, and retrospective research studies across the globe that assessed sleep at multiple time points.

Evidence of adolescent sleep changes following the COVID-19 outbreak

The pandemic onset and lockdown procedures likely had immediate impacts on adolescent sleep patterns. For example, a longitudinal study of high school students in Brazil found that time in bed during lockdown (measured July 2020) was over 2 h longer than it had been the year prior to the pandemic, and that bedtime was delayed by about an hour [15]. Overall sleep quality did not change, but levels of daytime sleepiness and napping decreased during lockdown [15]. These findings are consistent with sleep trends observed across large cross-sectional studies of adolescents in the United Kingdom [16], Switzerland [17], and Korea [18] that also reported increases in sleep duration and a tendency for later bed and wake times. Studies relying on retrospective reports of pre-pandemic sleep in Singapore, India, Italy, Canada and the United States (U.S.) echoed these increases in duration and delays in bedtime [19–23], with one global survey reporting 90% of adolescents going to bed past 10pm on weekdays (compared to only 57% prior to lockdown) [24]. In China, where the first COVID-19 cases were documented, findings on sleep duration were mixed [25,26], though researchers observed quite high rates of insomnia symptoms (23%) among adolescents [7].

While the pandemic overall may have had initially positive impacts on adolescent sleep duration, emerging research suggests that sleep benefits were not sustained across 2020. For example, a Canadian study of children and adolescents found that improvement in sleep duration during the first wave of the pandemic (measured April 2020) had diminished by the second wave (measured October 2020), with fewer youth meeting recommended sleep guidelines [27,28]. Consistent with this, data from the American Time Use Survey suggested that the time U.S. adolescents spent sleeping from May to December 2020 was not significantly different than the pre-pandemic levels [29].

Early research suggests that the return to in-person learning may have even exacerbated sleep problems among adolescents. During a period of partial school reopening in Austria (i.e., February–April 2021), adolescents reported that their sleep was worse quality than it had been pre-pandemic [30]. They also reported more irregular and delayed bedtimes, with older adolescents reporting delays of two or more hours [30]. Similar findings were observed in cross-sectional studies that compared sleep during school closure to sleep after school reopening, with youth reporting significantly shorter sleep duration and higher insomnia after the return to in-person learning [31–33].

Adolescent sleep patterns during school closure share similarities to sleep during vacation periods, which are also characterized by increased sleep duration, delayed bedtime, and high sleep variability [34]. Remote learning appears to have offered adolescents a brief respite from early wake-times, but delayed and irregular sleep-wake patterns established during lockdown may have left youth unprepared for the subsequent return to in-person learning. Consistent sleep routines are an integral component of sleep hygiene [35]. Additional longitudinal research is necessary to assess whether youth have been able to successfully readjust to the early wake times required for in-person learning.

The transition to college: COVID-19 challenges to sleep

College students are often excluded from discussions of pandemic-influences on adolescent sleep, despite overlaps in age and the heightened prevalence of sleep disturbance and mental health concerns among college students [36]. Traditional-aged college students are in a dynamic transitional period between adolescence and young adulthood, wherein students navigate newfound autonomy over their daily activities and balance sleep with a multitude of academic, social, and work obligations [37]. The pandemic caused sweeping changes to college and university campuses as students chose or were required to move out of campus dormitories. College courses switched to remote or hybrid learning formats following the pandemic onset, with some transitioning to fully asynchronous learning models that allowed students substantial flexibility in their morning routines. As with middle and high school-aged adolescents, research suggests that the COVID-19 pandemic had complex effects on college student sleep behavior [38–40]. While campus closures and the curtailment of evening social activities eased strains on sleep, heightened feelings of social isolation and depressive symptomatology, as well as issues of access, created challenges for students' sleep [38].

Longitudinal studies of U.S. college students found that sleep duration significantly increased following the pandemic onset [41–44]; however, in some cases sleep duration eventually plateaued or declined as the semester progressed [43,44]. Research on sleep quality was mixed, with studies finding no changes to sleep quality [45], slight positive changes [46,47], negative changes [48–52] or initially positive changes that decreased over time [43]. Geographic location and the nature and duration of lockdown procedures at the timing of measurement may have contributed to the mixed picture of college student sleep quality; however, a meta-analysis suggested that approximately a third of college students overall showed signs of sleep disturbance during the pandemic [38]. The timing of college student sleep also appeared to be affected by the pandemic, with multiple studies documenting delayed bed and wake times among college students

[41,42,47,53]. Taken together, studies suggest a mixed but potentially negative impact of the pandemic on college student sleep health [40]. Further investigation of sleep trends following the return to on−campus activities is needed to elucidate whether these are lasting effects. Still, worsening sleep trends raise concern for student wellbeing, implicating sleep behavior as a potential intervention target to alleviate college student mental health burden.

Moderators

Several key factors likely conferred greater risk of sleep problems among adolescents during the pandemic, with poor mental health perhaps the most notable. The COVID-19 pandemic was an acutely distressing and isolating event for youth who experienced sudden changes to their daily routines and social connections. Adolescence is a period of heightened vulnerability to psychiatric disorders [54], and research suggests that mental health issues were highly prevalent among adolescents during the pandemic (31%) and tended to get worse from 2020 into 2021 [10,55]. Rising mental health issues have implications for sleep health, given well established correlations between sleep and multiple psychiatric conditions (e.g., depression, anxiety, PTSD) [56]. The same finding was evidenced in work during the pandemic; survey studies across the pandemic suggested that adolescents with mental health issues were more likely to experience sleep disturbance [6,7,18,25,26,57] though conclusions on the directionality of the association are constrained by limited longitudinal research. Future studies can assess whether changes in mental health are long-lasting; however, indicators of heightened mental health risk are likely to have lingering implications for adolescent sleep health.

Second, lockdown restrictions limited young peoples' ability to engage in outdoor physical activity. Exercise and natural night exposure are important regulators of youths' sleep-wake cycles and overall health [58]. With many youth sport clubs placed on hiatus and recreation centers closed following the pandemic onset, adolescents spent greater time indoors engaged in sedentary behavior [59]. These reductions in physical activity and natural light exposure had consequences for sleep—studies found that adolescents who engaged in less physical activity were more vulnerable to sleep problems during the pandemic [6,30,50,60]. In a similar vein, screen time among adolescents significantly increased [61]. A meta-analysis found that pandemic-era screen time among youth ages 12−17 was 110 min per day longer than pre-pandemic screen time [61]. Blue light exposure from screens signals wakefulness to brain regions involved in regulating circadian rhythms [62]. Extended screen time, particularly during evening hours, can cause difficulties falling asleep and lead to poor sleep quality [58]. To this end, research across various countries has found that higher screen time was associated with poor sleep outcomes among adolescents [19,21,30,63,64]. While remote learning necessitated extended time exposed to screens, research suggests adolescents also engaged in high amounts of screen time for leisure, placing strains on sleep [27].

Finally, gender emerged as another potential moderator of the effect of COVID-19 on adolescent sleep behavior. Across various studies, adolescent girls reported higher rates of poor sleep quality, sleep disturbance, and insomnia compared to male adolescents during the pandemic [7,16,30,65−67]. The underlying reasons for poorer sleep outcomes among adolescent girls are not fully understood, but may in part be attributable to a higher reliance on social support networks that were disrupted during lockdown [68]. Gender disparities in adolescent sleep precede the pandemic, with adolescent girls significantly more likely to experience insomnia symptoms than adolescent boys [69], potentially related to the higher prevalence of mood disorders like depression and anxiety among female adolescents [54]. Preliminary evidence suggests that increases in depressive symptoms and sedentary during the pandemic behavior may have contributed to sleep difficulties among adolescent girls [65], further highlighting the importance of mental health and exercise for adolescent sleep quality.

Conclusions and future research

The COVID-19 pandemic shaped multiple aspects of adolescent sleep behavior. Lockdown restrictions and school closures were related to increases in adolescent sleep duration, and bed and wake times that were more aligned with adolescents' tendency toward eveningness. The picture of adolescents' overall sleep quality during the pandemic is less clearly positive, and sleep quality may have even gotten worse for adolescents attending colleges or universities, whose transition to higher education was interrupted by the COVID-19 pandemic. Understandably, the majority of the literature has concentrated on sleep changes in the immediate months following the COVID-19 outbreak; however, emerging research from the later waves of the pandemic suggest that changes to sleep may not have been sustained. Future longitudinal research across the three years of the pandemic can elucidate whether behavioral changes among adolescents were transitory or whether they will have lasting impacts on adolescent sleep and wellbeing. As researchers continue to study the impacts of the pandemic on adolescent sleep behavior, they should consider focusing on youth who may have been especially vulnerable to sleep disruption, such as adolescents from low socioeconomic backgrounds. The closure of nonessential businesses and layoffs during the COVID-19 pandemic created acute financial difficulties for many families in this demographic group [70], and even before

the pandemic, research suggested that adolescents of lower socioeconomic status (SES) are at higher risk for poor sleep [71,72]. Collecting information on changes to family routines, parental work schedules, and sleep environment characteristics (e.g., overcrowding, noise) can help us understand the potential underlying mechanisms of sleep disturbance for youth from disadvantaged backgrounds. Importantly, sleep is a modifiable health behavior, and intervening to improve sleep (e.g., through sleep hygiene changes or alterations in household routines) could help minimize the effects of the COVID-19 pandemic on adolescents' long-term wellbeing and promote health during their transition to young adulthood.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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* of special interest
** of outstanding interest

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This online, cross-sectional survey study of N = 5245 adolescents across the U.S. compared sleep opportunity (i.e., time between self-reported bedtime and waketime) and nightly sleep variability of adolescents in different instructional environments (i.e., in-person, online, hybrid). In-person instruction was associated with shorter sleep opportunity compared to online instruction, even at the same school start time. Hybrid instruction was linked with increased nightly sleep variability compared to online-only instruction. This study provides important insight into the relationship between different instructional formats and adolescent sleep.

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This is a review of 29 studies from 16 countries on child and adolescent sleep following the COVID-19 pandemic. Eight studies were included in a meta-analysis, which found a significant increase in youth sleep duration, delay in bedtime, and reduction in sleep efficiency during the pandemic. The authors also briefly summarized evidence for sleep changes specific to adolescents, noting that adolescents overall showed improvements in sleep duration during the pandemic, but did not show consistent improvements in sleep quality or prevalence of sleep disorders.

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This is one of two recent meta-analyses that quantified prevalence of sleep disturbance among children and adolescents. Using data from 50 studies across the globe (N = 104,219) the authors observed that the pooled prevalence of sleep disturbance was 42%. Findings varied depending on the screening tool and threshold value used, with a pooled prevalence of 48% for studies using a Pittsburgh Sleep Quality Index (PSQI) score >5. Additionally, there were significant regional differences in sleep disturbance prevalence, with highest rates found in the Eastern Mediterranean region and lowest rates in the Western Pacific region, though the number of studies from each region varied substantially.

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This is a recent meta-analyses of 250 studies from 49 countries (N = 493,475) that quantified prevalence of sleep disturbance among different subpopulations, including children and adolescents. Using data from 13 of these studies, the authors found a 46% pooled prevalence of sleep problems among children and adolescents. Children and adolescents had higher rates of sleep disturbance than the general population (37%) and were second only to patients infected with COVID-19 (52%). A higher prevalence of sleep problems was found for studies published in 2021 compared to 2020.

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