



EDITORIAL

Challenges and opportunities related to pediatric sleep research during the Covid-19 pandemic

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Challenges

On March 11, 2020, the World Health Organization (WHO) declared the novel coronavirus outbreak (2019-nCoV) to be a pandemic, leading governments around the world to impose societal restrictions to reduce its spread. The restrictions included lockdowns, curfews, quarantines, stay-at-home orders, social isolation, social distancing orders, and school/university closures or adaptation to distance learning. These steps triggered a flood of coronavirus research, i.e. studies aiming to understand the illness and to document how the societal restrictions impacted people's lives.

Pediatric sleep researchers mobilized quickly, launching large-scale studies aiming to determine the impact of pandemic-related societal restrictions on the sleep of children and adolescents. Since the societal changes were implemented abruptly following the declaration of the novel coronavirus outbreak as a Pandemic, there was no warning and researchers were only able to respond to the implementation of societal restrictions "after the fact." As a result, most of these studies used cross-sectional or retrospective designs (e.g. [1, 2, 3, 4]). In addition, since social distancing was mandatory, it was difficult to conduct studies in ways that would have been usual in the pre-pandemic period. This explains why most studies used online remote surveys to document sleep behaviors, relying solely on child/parent's reports rather than combining objective and subjective measures of sleep. The practicality of this research method might also have contributed to its use, given the expanding availability of online platforms allowing for remote data collection and commercial data collection services that recruit participants and run questionnaires online. The combination of barriers to in-person

data collection and increased feasibility of and access to online remote surveys resulted in a surge of large cross-sectional and/or retrospective online surveys.

On the bright side, this rapid and efficient move by the research community coupled with the availability of online remote data collection methods yielded a quick initial impression of the sleep of children and adolescents during the early phase of the COVID-19 pandemic.

On the flip side, the cross-sectional nature of the designs and the bidirectional nature of the relationships between sleep and mental and physical health and illness, limited the contributions of these studies. In the absence of an interventional, experimental, or longitudinal design, it is impossible to know if sleep was disrupted leading to downturns in daytime functioning or health, or vice versa. In addition, without valid documentation of the mental or physical health of the participants prior to the pandemic, it is not possible to determine if the observed associations were due to pandemic-related changes or simply reflected conditions and challenges that were in place regardless of the pandemic and prior to its onset. Limited internet access of children and adolescents of lower socioeconomic status (SES) might have introduced selection bias

The extremely large sample sizes in many of these studies complicated the interpretability of the results. Although studies with large sample sizes have multiple strengths, their contribution could be limited if the large sample size is not representative of the population to which the results should be generalized. In addition, large sample sizes can increase biases caused by sampling error or study design, and can magnify minor associations or differences that lack real-life or clinical significance.

Many of the studies aiming to document children's and adolescents' sleep during the pandemic sought to capture what was happening in the moment. Frequently, these studies did not ground their efforts in a conceptual framework and did not specify a particular well-defined and justified research gap to be filled. The duration, course, and impacts of the COVID-19 pandemic on the sleep of children and adolescents was (and still is) an unknown entity that represented a giant gap. However, information obtained solely based on this gap is at risk for making only a limited contribution to the existing body of knowledge. This is increasingly the case now as we are experiencing an explosion of studies seeking to capture the changes in youth sleep as they were unfolding rather than embarking on more intentional information-seeking endeavors based on clearly formulated research questions and specific hypotheses.

Taken together, the cross-sectional designs, presence of undocumented pre-pandemic confounders, insufficient use of a combination of subjective and valid objective measures, oversized sample sizes, insufficient grounding in a conceptual framework, and inherent bi-directional nature of the interplay between sleep and daytime outcomes collectively limit the contributions made by studies that aimed to examine the impact of the pandemic and related changes on the sleep of children and adolescents.

Opportunities

It is not possible to go back to a pre-COVID-19 time point and initiate prospective longitudinal studies, or design studies to utilize the situation as an opportunity to test presumed models and mechanisms, yet much can be learned from the changes that are still unfolding. Right now, we can switch to using a proactive scientific approach that is grounded in existing models, uses existing technology to supplement subjective online measures, and defines specific and clearly justified research questions and hypotheses related to pediatric sleep.

As the pandemic is waxing and waning, it is not too late to examine the impact of changes in societal factors known to affect the sleep and circadian rhythms of children and adolescents. The global nature of the pandemic and the different ways in which various countries impose societal restrictions could allow investigators to rigorously compare and contrast the impact of societal, biological, and environmental factors presumed to play roles in shaping the sleep of children and adolescents. The interaction of these factors with culture, geography, and individual differences in psychological and/or physical characteristics could maximize our ability to learn from the natural experiment that is unfolding.

An example can be found in studies that used COVID-19-related changes as a means to test the impact of delaying school start time on adolescents' sleep duration. A large proportion of adolescents obtained less than the recommended amount of nightly sleep but efforts to delay school start times faced logistical barriers and doubts about whether the shift will translate to improved or extended sleep. Several studies [5, 6, 7] examined the impact of the transition to remote learning that eliminated the morning commute and delayed school time on adolescents' sleep patterns during the COVID-19 pandemic. Findings from these studies showed that among typically developing adolescents, sleep schedules were delayed, sleep duration was

extended, and daytime sleepiness decreased. This is important because it addressed the decades long debate regarding school start time and provided empirical evidence showing that adolescents' sleep deprivation during the school week could be prevented or diminished by delaying the school start time.

The use of well-designed studies and well-phrased research questions could further expand and enrich these models by enabling researchers to identify factors that are not considered in conceptual frameworks related to pediatric sleep, and/or by refining or further validating the factors already included in these models. Objective sleep data could be collected safely using valid home sleep studies and wearable devices and using existing technologies that allow precise measurements to be gathered using remote tools.

Knowledge Gaps Related to Pediatric Sleep in the Context of the COVID-19 Pandemic

Several key questions have not yet been sufficiently addressed in COVID Research related to pediatric sleep. There is a large knowledge gap around the impact of the pandemic and related societal changes on the sleep of children and adolescents with primary sleep disorders. For example, societal changes resulting in greater schedule flexibility could improve the symptoms of children or adolescents suffering from circadian rhythm sleep/wake disorders (especially the delayed sleep phase type) or narcolepsy [8], whereas for other pediatric populations, such as adolescents with insomnia, the high level of uncertainty and social isolation could worsen sleep disorders. Also, elevated rates of obesity during the pandemic represent an enhanced risk for obstructive sleep apnea.

A troubling knowledge gap is related to the potential impact of sleep health or pre-existing sleep disorders on the recovery and illness of children and adolescents who contract the COVID-19 virus. Are children or adolescents with primary sleep disorders more vulnerable to the impact of the virus? Does better sleep health translate to a better ability to cope with the illness or to a less severe course of illness? Are children or adolescents with certain sleep disorders at greater risk for development of the COVID "long haul" syndrome? Given that children and adolescents are increasingly affected by the COVID-19 virus and at times become severely ill, it is essential that we ask and answer these questions.

Extensive efforts have been made to document changes in children and adolescents' sleep and physical activity during the COVID-19 pandemic, and compare it to the recommendations provided by existing guidelines produced with a pre-pandemic lifestyle in mind, presuming a certain level of physical movement even if the child did not participate in any sport and had limited access to screens during school time. The decreased movement in lockdown or part-time/hybrid learning situations and the increased reliance on screens across all age groups, suggest that pre-pandemic benchmarks for physical activity, sleep, and sedentary behavior may require reconsideration.

In summary, as the pandemic lingers and society creates a revised version of life-as-we-know it, scientific work in the field of pediatric sleep must be designed in way that allows researchers to produce high-quality evidence and provide specific answers to specific questions. Such work is expected to yield strong scientific evidence. This is important because in a world that already

suffers from limited or insufficient resources, and in the face of multiple needs, society needs to be able to prioritize interventions based on the immediate risk of the problem being addressed. In addition, the results of such studies could be used reliably to inform the development of specific evidence-based strategies to reduce potential mismatches between adolescents' physiology and psychology and societal pressures or requirements in the post-pandemic revised world. This could be used to support the long-term maintenance of healthier sleep for children and adolescents, inform advocacy efforts in the pandemic and post-pandemic eras, and advance the field of pediatric sleep.

Disclosure Statement

None declared.

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