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Not so sweet dreams: adults' quantity, quality, and disruptions of sleep during the initial stages of the COVID-19 pandemic

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ABSTRACT

Objectives: The purpose of this study was to investigate Ontario adults' reported sleep quantity, quality, and disturbances during the early months of the COVID-19 pandemic (April–July 2020).**Methods:** As part of a larger, chronic disease-focused, and ongoing longitudinal study designed to explore Ontario adults' health and wellness-related behaviors during the pandemic, participants completed an online survey that included demographic information and the Pittsburgh Sleep Quality Index (PSQI). The PSQI consists of 19 items, one of which is open-ended, designed to assess an individual's quantity, quality, and patterns of sleep on seven domains (ie, subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction over the last month). Summative content analysis was used to analyze responses to the open-ended question regarding participants' sleep disturbances.**Results:** This study included 2192 individuals, 85% of whom slept 6+ hours/night. The mean global PSQI score was 7.57, out of a possible 21 (SD = 4.09). The self-reported sleep disturbances of largest concern were: (1) general fear/anxiety/worry (n = 203); (2) children (n = 167); (3) mind wandering/overthinking (n = 118); (4) pain/injury (n = 78); (5) partner (n = 78); and (6) fear/anxiety/stress related to COVID-19 (n = 74).**Conclusion:** The global PSQI score was indicative of poor sleep quality, and Ontario adults experienced a number of sleep disturbances during early days of the COVID-19 pandemic. These findings are noteworthy as sleep is a crucial component in positive health and wellbeing.

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1. Introduction

Sleep is essential to human functioning and can positively or negatively impact one's neural development, memory, emotional reactivity [1], learning [2], and cardiovascular [3] and metabolic function [4]. Further, inadequate sleep can impair immune function [5], increase risk for chronic disease (eg, obesity, diabetes; [6]), and undermine healthy lifestyle choices such as physical activity [7] and healthy dietary intake [8]. Simply put, sleep is a vital component of

good health and overall wellbeing [6]. In 2006, Colten et al. [9] reported that humans spent approximately one-third of their lives asleep. That said, over the past century, researchers have found that the prioritization of sleep has declined internationally, as adults have placed a greater emphasis on daily activities such as work, commuting time [10], and technology use [11]. In fact, adequate sleep sufficiency (ie, achieving an adequate quality and quantity of sleep) was deemed concerning during pre-pandemic times, with one quarter of Canadian adults not getting enough sleep, and about half experiencing trouble falling and/or staying asleep [12]. Specifically, in 2017, Chaput and colleagues [13] found that 43% of Canadian men and 55% of Canadian women between the ages of 18 and 64 years reported difficulties falling asleep and/or staying asleep. Although children tended to achieve recommended sleep

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time, adults fared less well with sociodemographic (eg, education, employment status) and health-related factors (eg, chronic disease, stress, mood disorders, sense of belonging) contributing to their sleep challenges and habits [14]. The COVID-19 pandemic has created additional stressors, unusual strains, and unprecedented lifestyle changes [15], all of which might make sleep insufficiency an even greater concern at the present time. Specifically, in Canada, the government has taken steps to mitigate the spread of the disease by strongly emphasizing community-based measures (inclusive of physical distancing, rigorous hygiene practices, isolation and quarantine, use of face masks; Government of Canada, [16]). Physical distancing and other mandates have been introduced to control the spread of COVID-19, how these public health measures influence lifestyle-related health behaviours, including those associated with sleep, of Canadian adults is largely unknown.

Although a paucity of Canadian-specific COVID-19-related sleep research currently exists, sleep quality challenges related to the pandemic have been reported elsewhere [17]. Among Chinese residents (18–44 years; $n = 5461$), stress, anxiety, and depression related to living through the COVID-19 pandemic contributed to participants' insomnia, frequent waking, early waking, nightmares, and other sleep disorders [17]. Similarly, Huang and Zhao [18] surveyed 7236 Chinese residents and found that one fifth of participants reported depressive symptoms and sleep problems. Specific to Wuhan, China, Fu et al. [19] found that among 1242 respondents, approximately one third reported sleep disorders/difficulties, which the authors attributed to individuals' concern regarding COVID-19. In Italy, Gualano and colleagues [20] surveyed 1515 adults during the last 14 days of their initial lockdown (April 19–May 3, 2020) and found that 42.2% of respondents reported sleeping difficulties. The researchers attributed sleep disturbances to use of the internet, fear of leaving the house, and self-medication [20]. In another Italian study, Cellini and colleagues [21] compared residents' quality of sleep before (February 3–10, 2020) and during (March 17–23, 2020) the lockdown and found that the pandemic, and the lockdown in particular, negatively impacted participants' sleep. Specifically, the percentage of individuals who experienced poor sleep prior to the lockdown was 40.5%; this number increased to 52.4% during the lockdown [21]. In the context of these global findings, it is anticipated that Canadian populations will also have experienced sleep difficulties, and yet the extent of the situation is currently unknown. As new wave(s) of the pandemic are upon us, understanding adults' sleep experiences during the early stages of the pandemic may help (1) citizens know what to anticipate, and (2) health care providers be better prepared to target sleep issues moving forward.

1.1. Objectives

The purpose of this study was to investigate Ontario adults' reported sleep quantity, quality, and disturbances, during the early stages of the COVID-19 pandemic (ie, April 24–July 13, 2020).

2. Methods

2.1. Study design

This study is part of a larger, chronic disease-focused, and ongoing longitudinal study designed to explore Ontario, Canada adults' health and wellness-related behaviors during the pandemic. Adults aged 30–59 years were specifically targeted for the larger study due to this age group being at highest risk for lost years of life due to chronic disease [22]. The larger study design includes three data collection time points (baseline, spanning the dates of April 24–July 13, 2020); immediately following the initial full provincial

reopening, spanning the dates of July 29–August 30, 2020; and 1-year following the second timepoint. The current study includes an interim analysis of sleep quantity, quality, and disturbances collected at baseline. The study received ethics approval from the host institution's Health Sciences Research Ethics Board (HSREB #115827).

2.2. Participants

Participants were recruited via social media platforms (eg, Facebook, Instagram, Twitter, LinkedIn) posted by the research team and shared by others (eg, health units, community health centres). To be eligible for the study participants needed to be: (1) an Ontario resident, (2) aged 30–59 years at baseline and, (3) able to read and write in English.

2.3. Data collection

Upon clicking on the social media distributed study link and QR code, interested Ontario adults were directed to the study's letter of information, eligibility criteria, consent, and an online survey hosted on Qualtrics. For the purpose of this study, only the demographic questions and the Pittsburgh Sleep Quality Index (PSQI) [23]; described in detail below) data were examined. To diminish social desirability bias, *honesty demands* were used at the beginning of the questionnaire [24]. The instructions included the statement: "Please answer as honestly as possible. There are no right or wrong answers. Whatever you truly think or feel is the answer you should pick."

2.4. Measures

2.4.1. Demographic survey

A demographic questionnaire was administered at baseline. Questions included: 'What is your age? (years)', 'To which gender do you most identify? (Refers to current gender which may be different from sex assigned at birth and may be different from what is indicated on legal documents)', and 'What is your ethnicity?'

2.4.2. Pittsburgh Sleep Quality Index (PSQI)

The PSQI has been previously validated (Cronbach $\alpha = 0.83$) and is used to measure adults' quantity, quality, and patterns of sleep using 19 self-reported items on seven domains: (1) subjective sleep quality (1 item); (2) sleep latency (ie, the length of time to transition from being fully awake to being asleep; 2 items); (3) sleep duration (1 item); (4) habitual sleep efficiency (ie, the amount of time asleep compared to the total amount of time in bed; 3 items); (5) sleep disturbances (9 items); (6) use of sleep medication (1 item); and, (7) daytime dysfunction (2 items); [23]. Prior to implementation, minor adaptations were made to the questionnaire to ensure the questions were applicable for people who work shifts/have different sleep schedules (ie, those who may sleep during the day and are awake at night). Participants were asked to reflect on their usual sleep habits in the past month. Examples of scale questions included, 'How many hours of actual sleep do you get at night?' (domains 3 and 4), and 'During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?' (domain 7). With regard to the sleep disturbances domain, participants were asked to identify how often they had trouble sleeping because they: (1) could not get to sleep within 30 min; (2) woke up in the middle of the night or early morning; (3) had to get up to use the bathroom; (4) could not breathe comfortably; (5) coughed or snored loudly; (6) felt too cold; (7) felt too hot; (8) had bad dreams; and (9) had pain. Using the one open-ended item, participants were invited to provide

reasons, other than those specifically listed on the tool, they had trouble sleeping. Per the originators' scoring protocol [23], the seven domains are to be scored separately and then summed to yield one "global" score that has a possible range of 0–21 (zero indicating no difficulty and 21 indicating severe difficulties in all areas). A global score greater than 5 indicates poor sleep quality [23]. For a detailed account of the scoring protocol, refer to Buysse and colleagues [23].

2.5. Data analysis

Following the scoring protocol noted above, domain specific and global PSQI scores were computed and descriptive statistics were conducted in SPSS (version 26). Descriptive statistics for demographic data were also computed in SPSS. Using gender and age as predictor variables and the accepted PSQI threshold of '5' to denote "poor" vs. "good sleepers" [23], logistic regressions were used to investigate *who* were at risk of sleep difficulties.

Data from the open-ended question regarding participants' sleep disturbances were analyzed using summative content analysis [25], which involved quantifying and providing meaning by assigning themes to the different types of sleep disturbances submitted. It was conducted independently and simultaneously by two researchers to help ensure confirmability (per [26]). The process initially involved the researchers reading through the responses, assigning working titles to the key words, and computing frequencies. Once the researchers quantified and finalized themes individually, they met to discuss and agree upon final themes.

3. Results

The PSQI was completed by 2192 individuals, most of whom were Caucasian (European decent; $n = 1,790$, 91.5%) and identified as female ($n = 1,744$, 89.6%). The mean age was 43 years ($SD = 8.82$). The means, ranges, and frequencies of the PSQI scale and its respective domains can be found in Table 1. The mean score of the global PSQI was 7.57, with 63.95% of participants classified as being "poor sleepers". Results from the logistic regression analyses reported that women ($OR = 2.3$; 95% $CI = 1.25$ to 5.39 ; $p = 0.02$) and individuals over the age of 40 ($OR = 1.2$; 95% $CI = 0.02$ to 3.1 ; $p = 0.04$) had higher odds of being classified as "poor sleepers".

Summative content analysis of the single open-ended item revealed 1284 entries by participants, representing 41 inter-related sleep disturbances (Table 2). The most concerning sleep disturbances (ie, the top 30%) reported by participants were: (1) general fear/anxiety/worry; (2) children; (3) mind wandering/overthinking; (4) pain/injury; (5) partner; and (6) fear/anxiety/stress related to COVID-19. While some comments transcended more than one theme, the primary focus of each theme is presented separately for the sake of clarity, and illustrative quotations are presented under the relevant themes.

Regarding the first sleep disturbance theme, general fear/anxiety/worry ($n = 203$), a common comment offered by participants was that they "can't stop worrying"; the majority of participants who noted this as a concern referenced "anxiety" as a major sleep disturbance. One individual said they "wake up anxious to begin tasks", which was paralleled by another participant who described "waking and feeling a bit panicky". Many individuals underscored "worry" about the future and about family members, specifically their children. One participant explained the feeling of anxiety as "not being able to calm down".

The second theme reflects participants' reports that their children's frequent waking, co-sleeping, and noise negatively influenced their sleep ($n = 167$). Some described challenges with co-sleeping, as highlighted by one participant who said, "[my] kids

are often sleeping beside me and they don't normally". The children who disrupted their parents' sleep ranged from infants to teenagers; one individual underscored that their "baby wakes up at night", while another participant referenced their "loud teenager saying up late". Other participants described their children "waking frequently" and "com[ing] into [their] room in the middle of the night".

The third theme captures participants' comments indicating their sleep was disturbed due to their mind wandering or overthinking ($n = 118$). This was underscored by one participant who said they "wak[e] up in the middle of night and [are] not able to fall back asleep because there's too much going on in [their] mind [and] too much thinking". Other participants described that their "brain won't shut off" and that their "mind races".

Some participants described waking in the night due to pain or injuries ($n = 78$), and this represents the fourth sleep disturbance theme. Pain ranged from "headaches" to "chronic pain". A number of participants described "sore joints", while some noted "back injuries" and "recovering from surgery".

With regard to the fifth theme, some participants described their partner as a sleep disturbance ($n = 78$). The majority of these disruptions were created by their partner's snoring, while some described their partner's body temperature as problematic. This was highlighted by one participant who compared their partner to a "furnace". Some underscored their partners as being "restless" throughout the night making it difficult to sleep, while others described that their partner's "waking up in the middle of the night" as a challenge.

Lastly, the sixth theme identified the sleep disturbance 'collection' of fear, anxiety, and stress related directly to the COVID-19 pandemic ($n = 74$). Angst took many different forms as one individual expressed "concern regarding [their] mother living alone and not being able to see [their] mother in-law in long term care", while another participant expressed that they were "anxious from reading [the] news". One participant underscored their "anxiety over dealing with physical distancing, limiting family, friend and social gatherings" and another expressed worry over whether or not they "cleaned enough", particularly noting concern over potentially "touch[ing] something that might infect [them]". Some participants disclosed being frontline workers and expressed concerns going to work as a "nurse", "PSW", and "medical professional". Many participants underscored concern for elderly relatives and one individual expressed wanting their "old life back".

4. Discussion

The purpose of this study was to investigate Ontario adults' reported sleep quantity, quality, and disturbances during the early months of the COVID-19 pandemic (ie, April 24–July 13, 2020). Prior to COVID-19, sociodemographic and health-related factors (such as employment status, chronic disease, stress, mood disorders, and sense of belonging) contributed to Canadians' poor quality of sleep [14]. Therefore, it is no surprise that participants in the current study noted a number of sleep disturbances during the initial days of the pandemic, as the pandemic might have magnified pre-existing sleep challenges. The mean global PSQI score was 7.57 on a scale that ranged from 0 to 21 and given that scores greater than 5 indicate poor sleep quality [23], adults' sleep experiences during the early stages of COVID-19 are concerning. Interestingly, although the PSQI score raises concerns about sleep quality, the majority of participants reported that they did receive the recommended amount of sleep, according to the newly released Canadian 24-Hour Movement Guidelines [27]. That is, most participants reported sleeping for more than seven hours per night. However, the Canadian Society for Exercise Physiology (CSEP) specifically

Table 1
Baseline frequencies for the pittsburgh sleep quality index (PSQI).

Domain	Total Responses	Frequency/Category
Subjective sleep quality	1994	Very good = 267 Fairly good = 1009 Fairly bad = 579 Very bad = 139
Sleep latency	1991	0 = 345 1-2 = 639 3-4 = 465 5-6 = 542
Sleep duration	1982	>7 h = 1193 6-7 h = 488 5-6 h = 205 <5 h = 96
Habitual sleep efficiency	1904	>85% = 970 75-84% = 496 65-74% = 225 <65% = 213
Sleep disturbances	1985	0 = 81 1-9 = 1225 10-18 = 629 19-27 = 50
Use of sleep medication	1988	Not during the past month = 1437 Less than once a week = 161 Once or twice a week = 127 Three or more times a week = 263
Daytime dysfunction	1998	0 = 260 1-2 = 972 3-4 = 665 5-6 = 92
Global PSQI (mean score = 7.57, SD = 4.09)	1884	0-5 = 698 6-10 = 745 11-15 = 358 16-20 = 83

recommends that adults get 7–9 h of *good-quality* sleep on a nightly basis [27]. While most of the participants achieved the recommended *quantity* of sleep, the *quality* of that sleep was evidently rather poor, and may have resulted in overall sleep insufficiency (ie, the combination of an appropriate quantity *and* quality).

While some of the reasons for disrupted sleep identified in this COVID-19 study were similar to those reported in the China and Italy pandemic-focused studies [17,20], Ontarians in the current study also reported additional, unique disturbances. In terms of similarities to previous studies, participants' difficulty sleeping was largely attributed to fear, anxiety, worry, and stress. Participants attributed these mental health challenges to general mental health concerns, overthinking, occupational stress, and specific concerns regarding COVID-19. Interestingly, screen use, a sleep disturbance reported by residents of Italy, was not a substantive focus reported by Ontario adults. Considering the government's physical distancing requirements and restrictions during the time when data was collected for the current study, one would suspect screen use to be at an all-time high in our sample; however, it was not noted as a primary sleep-related concern. In fact, screen time during COVID has been reportedly high by Canadians, as individuals reported that they increased their TV and Internet use (Statistics Canada, 2020). Screen time has also been associated with shorter sleep duration and poor sleep efficiency [28]. The small number of individuals who reported screen use as a sleep disturbance might be due to the fact that our sample was between the ages of 30 and 59 and screen use is known to be more prevalent in younger generations [29] or that individuals in our sample were not concerned by their screen use.

Worth noting is the imbalance of gender of our sample (90% identified as female). Researchers have found there are numerous issues dominating women's, in particular, concerns during COVID-

19 (eg, employment situations, career progression, childcare responsibilities; [30,31]). A number of participants in the current study described sleep disturbances related to working from home difficulties. While there is a shift towards parents sharing childcare and household responsibilities in general [32], such tasks have disproportionately fallen on mothers during the COVID-19 pandemic, with mothers' employment more negatively impacted by the pandemic than that of fathers [31]. Given the proportion of those who identified as female in the current study, it is possible that some of their experiences of fear, anxiety, and worry were rooted in employment and childcare responsibilities, negatively impacting their sleep.

Knowing that sleep quality issues and the reasons Ontario adults had trouble sleeping during the early stages of the pandemic is particularly important as we are currently in the midst of a second wave of COVID-19. By underscoring Ontario adults' sleep disturbances at the beginning of COVID-19, health care providers and the public will have a better idea of what to expect and how to prepare, should the province's current (December 2020) exponential growth in, and associated consequences of, COVID-19 cases continue to increase and/or repeat another time in the future. Findings from the current study are particularly important to support Ontarians experiencing worry, anxiety, and stress, and, based on our findings of sleep disturbances, may be especially poignant for mothers, although the maternal status of our sample was not collected. Participants' described sleep disturbances primarily related to their mental health (eg, stress, anxiety, worry, fear) as well as their children. Regarding children, in a study conducted by Moore and colleagues (2020) [33], the researchers investigated the health behaviours of Canadian school-aged children during the initial COVID-19 pandemic and found that children were less physically active, more sedentary, spent more time engaged in screen-

Table 2
Sleep disturbances reported by Ontario adults during lockdown and stages 1 and 2 of Ontario's plan for reopening.

Described Sleep Disturbance	Frequency (N)	Percent (%)
General fear/anxiety/worry	203	8.4
Children	167	6.9
Mind wandering/overthinking	118	4.9
Pain/injury	78	3.2
Partner	78	3.2
Fear/anxiety/stress regarding COVID-19	74	3.1
General stress	69	2.9
Occupational anxiety/stress	57	2.4
Menstrual/menopausal discomfort	56	2.3
Disturbance of Pets	47	1.9
General noise	29	1.2
General discomfort	27	1.1
Wake frequently	17	0.7
Insomnia	16	0.7
Shift work	16	0.7
Breastfeeding	15	0.6
Pregnancy	14	0.6
Grieving/death	14	0.6
Lack of sleep as a habitual pattern	12	0.5
Depression/sadness	10	0.4
Allergies	10	0.4
Nightmares/night terrors	9	0.4
Stress regarding lack of access to healthcare personnel due to COVID-19	9	0.4
Chronic conditions (not specified)	8	0.3
Fibromyalgia	8	0.3
PTSD	8	0.3
Arthritis	8	0.3
Work from home challenges due to COVID-19	8	0.3
Not tired	8	0.3
Screen use	7	0.3
Restless leg syndrome	7	0.3
Nap during the day	6	0.2
Lack of physical activity	6	0.2
Caffeine	5	0.2
Bathroom	5	0.2
CPAP mask issues	4	0.2
COVID-19 (general)	4	0.2
Alcohol use	4	0.2
Job loss	3	0.1
Sleep apnea	2	0.1
Other	38	1.6

Note. The categories presented above are not mutually exclusive, and the primary focus of each theme is presented separately for the sake of clarity. These themes were generated based on responses to an open-ended question on the PSQI.

based activities, and slept more compared to before the COVID-19 public health restrictions were implemented. As such, parents' worry over their children might be warranted given the impact that the pandemic has had on children's health behaviours thus far. This said, the researchers proposed that parental co-participation in healthy activities, as well as set routines including regular sleep and wake times, might be strategies to mitigate the negative impacts of the pandemic on children's behaviours [33]. Thus, it is imperative that support and resources be provided to help Ontarians improve their sleep sufficiency and mitigate sleep disturbances during subsequent wave(s) of COVID-19. The European Academy for Cognitive-Behavioral Treatment of Insomnia (The European CBT-I Academy) has made a number of recommendations to curb sleep problems during COVID-19 and more specifically during home confinement as a result of stringent physical distancing [30]. Such recommendations include but are not limited to: (1) maintaining a regular night-time and wake-time routine; (2) scheduling brief time blocks during the day to allow yourself to stress and reflect upon the stressful situation to reduce the chance of the stressor interfering with sleep; (3) only using your bed for sleep and/or sex; (4) using social media positively by connecting with friends and family, but not using your electronics in the bedroom; (5) exercising regularly; and (6) engaging in relaxing activities before bed (eg, reading, yoga; [30]).

The CBT-I Academy also made recommendations specific to women and children including: (1) being mindful of the gender gap to avoid women and mothers becoming overloaded with childcare and household tasks; (2) maintaining a regular sleep routine for children; (3) avoiding co-sleeping; (4) avoiding children using electronics after dinner or too close to bedtime; and (5) encouraging child play and activity (specifically physical activity; [30]). With these recommendations in mind, Ontario adults may be better equipped to deal with sleep problems and/or stressors that negatively impact their sleep throughout the remainder of the pandemic and as we experience any additional restrictions throughout the province.

4.1. Strengths and limitations

There are a number of strengths of our study, including the mixed-methods approach used to analyse data, the large number of participants who completed the survey, and the steps taken to minimize any potential biases. However, this study is not without limitations. Firstly, the PSQI is a self-report tool, which lends itself to social desirability bias although, as noted previously, we did attempt to combat this using *honesty demands* [24]. Second, the study consisted of adults aged 30–59 years only, and the majority was Caucasian and identified as female, limiting the

generalizability of our findings. The large proportion of women in our sample is not uncommon as Gualano and colleagues [20] and Lin and colleagues [17] also reported a higher proportion of females to males in their studies. Finally, this study included Ontario residents only. While this may be perceived as a limitation (ie, to not include all Canadians), COVID-19 rates differ by province/territory, and therefore, public health realities and measures employed in each province/territory differ to account for severity. As such, this work included adults from Ontario only. Future studies might consider targeting males more specifically, a wider age range, and other provinces/territories to increase generalizability.

5. Conclusion

While sleep quantity was suitable, the overall quality of sleep among Ontario residents during the early stages of the COVID-19 pandemic was poor and may be attributable to the vast number of sleep disturbances reported by participants. It is important to recognize recommendations to improve sleep quality throughout the remainder of the pandemic. Learning from the experiences during the first wave of the pandemic can help to inform and support citizens during future wave(s).

Ethics approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (Western University, Health Sciences Research Ethics Board #115827) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Credit Author Statement

KS contributed to study design, recruitment, collection of data, data analysis and was a major contributor in the writing of this manuscript. LMV contributed to study design, recruitment, data analysis, and critical revision of the manuscript. SB, NG, and PT contributed to study design, recruitment, and critical revision of the manuscript. JI contributed to study design, study conception, recruitment, data analysis and was a major contributor in the writing and revision of this manuscript. All authors read and approved the final manuscript.

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Conflict of interest

The authors declare that they have no conflict of interest.

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: <https://doi.org/10.1016/j.sleep.2021.02.028>.

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