Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Unprecedented times and uncertain connections: A systematic review examining sleep problems and screentime during the COVID-19 pandemic

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ABSTRACT

Objective: Sleep has been impacted by the COVID-19 pandemic around the world. Furthermore, screen time has been reported to influence sleep and has increased during pandemic quarantines. This systematic review searched databases to determine if screen time affected sleep during the COVID-19 pandemic.

Methods: PubMed, Nursing and Allied Health Proquest, and Science Direct Health and Lifescience college edition were searched for articles that fit the inclusion criteria. There were 2750 articles initially screened. Then, 119 articles were further assessed to determine eligibility, creating a final sample of 18 articles that explored whether screen time affected sleep.

Results: After reviewing the included articles (n = 18), the main theme revealed that screen time negatively affected sleep during the COVID-19 pandemic, specifically aspects such as sleep duration, sleep quality, sleep onset latency, and wake time. However, several articles countered this implication. Therefore, it is important to consider other factors that may influence the relationship between screen time and sleep.

Conclusions: Although the number of articles included is limited, the overall synthesis suggests that COVID-19-related lifestyle changes, such as increased screen time, may negatively affect sleep health. However, other unidentified factors may have contributed to these findings and warrant further research. Nonetheless, community leaders must consider the long-term consequences of the pandemic and implement initiatives to address sleep challenges due to the intricate connection between sleep and well-being.

1. Introduction

In 2019, COVID-19 emerged out of Wuhan, China, and in the first few months of 2020, much of the world was impacted, and a global pandemic was declared (World Health Organization [45]). As a result, countries worldwide implemented various quarantine and lockdown measures. People were confined to their homes, and jobs and schools transitioned to remote/online platforms [13]. In addition, people increased their time indoors as over 100 counties initiated partial or full lockdown measures, restricting the reasons people were allowed to leave their homes [13]. Consequentially, home confinement impacted health and well-being, which included decreased physical activity [3,27,38,41,54–56]; reduced cognition (i.e., attention) [56]; weight gain [48,54,58].

A large sample of adults in Brazil revealed a 266% increase in TV viewing alongside increased sedentary behaviors [11]. A study of adults residing in Canada found a 60% increase in screen time (e.g., TV and internet usage) [51]. Sedentary behaviors, such as increased screen time, related to higher levels of depression [47,53]. Increased screen time may also contribute to other health consequences such as suicidal ideation [50], obesity [19,29], and changes to brain networks [40]. Furthermore, heavy screen users demonstrated the highest level of perceived stress and rated their health the lowest [43]. Screen time also increased due to COVID-19-related distress, which decreased sleep duration [3]. However, digital platforms, such as social media, provided a means of social and emotional connections during these periods of isolation and social distancing [58].

Throughout the world, sleep was impacted during the COVID-19 pandemic. An international survey across 14 countries discovered that between May to August 2020, each country reported significant changes to all sleep-related factors examined (e.g., sleep quality, sleep maintenance, nightmares, sleep onset latency) [31]. The systematic review and meta-analysis performed by [57] discovered that among the 39 countries represented, sleep problems occurred in 18% of the general population, 31% of the healthcare population, and in 57% of COVID-19 patients. Research studies conducted before the COVID-19 pandemic hypothesized that screen time may explain these results. For example, greater screen time has been related to decreased sleep quality [29,43] and decreased sleep quantity [43]. In children, screen time before bed negatively correlated with their sleep duration and contributed to later bedtimes compared to time spent with books before bed [6]. Moreover,

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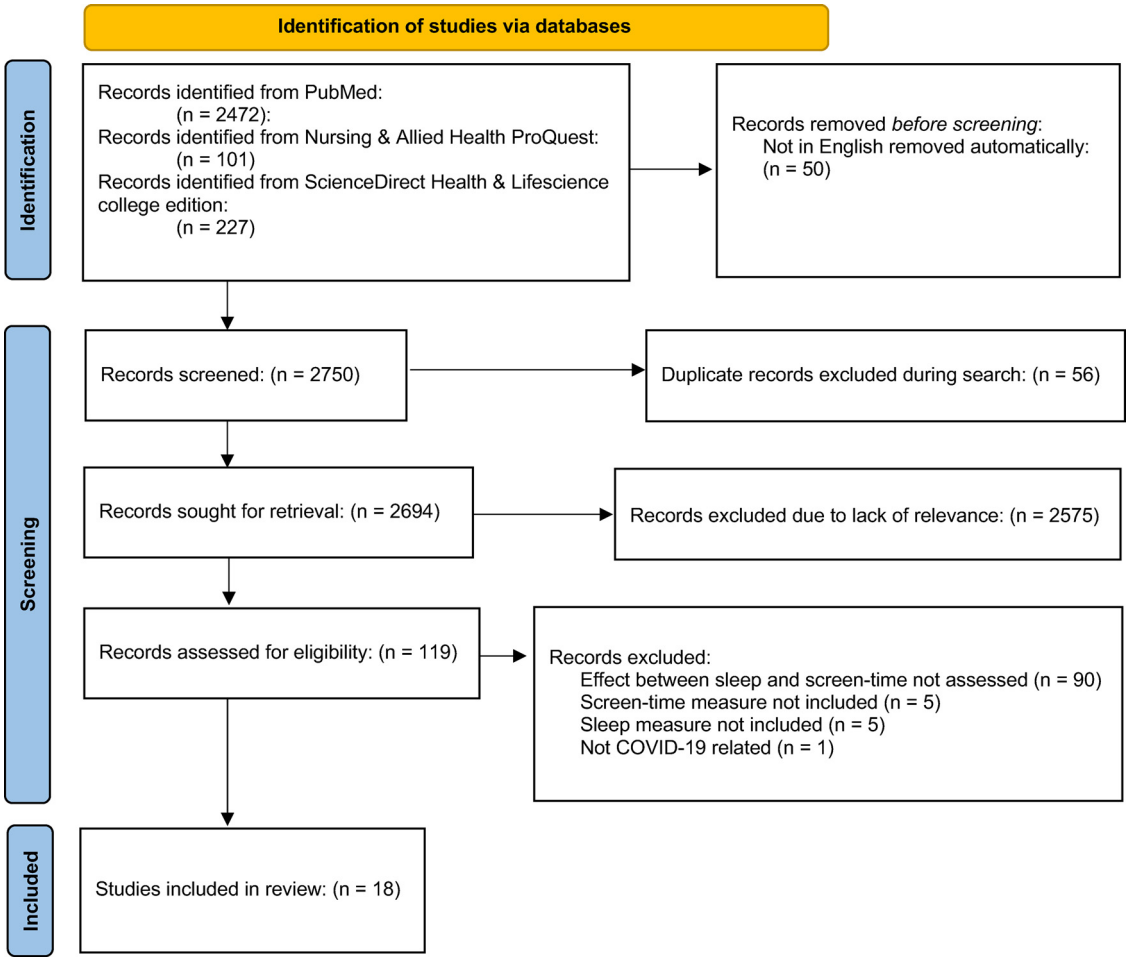

Fig. 1. PRISMA 2020 flow diagram.
From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71
For more information, visit: http://www.prisma-statement.org/.

children who increased their screen usage were more likely to be labeled as overweight and demonstrated a shorter sleep duration [29]. For adults, shorter sleep durations related to a significantly greater amount of screen time and a higher BMI [21]. Furthermore, greater screen time at bedtime related to reduced sleep quality, efficiency, and a greater sleep onset latency in adults [10]. Finally, sleep problems that occurred during the COVID-19 pandemic were associated with psychological distress (i.e., depression and anxiety) among the general public, healthcare workers, and COVID-19 patients across a sample of 39 countries [57].

The significance of sleep to overall health and well-being exemplifies the critical need to identify factors that negatively affect it, especially during unprecedented times such as the COVID-19 global epidemic, and it requires an overarching investigation. Therefore, the current systematic review was created to address this need and was guided by the following research question: Did increased usage of screen-based technology (e.g., cellphones, tablets, etc.) during the COVID-19 pandemic significantly impact sleep (e.g., quality or quantity)?

2. Materials and methods

The current systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Four databases were systematically searched to obtain relevant articles. Article titles and abstracts were initially screened. Articles were selected for further review if the relationship between screen time and sleep was potentially assessed. Two researchers independently screened and determined the eligibility of selected articles. See Fig. 1 for more details.

2.1. Inclusion criteria

After the initial screening of the title and abstract, the research team retrieved and assessed the articles selected for further review. The current systematic review used the following inclusion criteria:s (1) the study collected an outcome variable related to the extent of screen-based technology usage (e.g., hours of tablet use per day, average screen time exposure per day, etc.); (2) the study included an outcome variable related to sleep (e.g., sleep quality, sleep quantity, sleep difficulty); (3) the research was conducted during the COVID-19 pandemic and quarantines (March 2020-August 2021); (4) the article was published from January 2020 up to August 26, 2021; (5) the association between the screen time variable and the sleep variable was analyzed. Table 1 presents additional details regarding the articles included.

2.2. Exclusion criteria

Non-English articles were automatically excluded from the systematic review by a search filter. In addition, further exclusion criteria included (1) the research did not relate to COVID-19 specifically; (2) the study did not measure both a screen time variable and a sleep-related variable; (3) the relationship between screen time and sleep was not analyzed or (4) were explored separately in the study.

Table 1
Included articles.

Authors	Country	Population	Sample	Gender (M)	Age ($M \pm SD$)	Sleep Assessment
Ali et al. [1]	Pakistan	Young Adults	251	29.5%	(19.4 ± 1.6)	Researcher developed
Ara et al. [2]	Bangladesh	Not specified	1128	55.1%	Not reported	Researcher developed
Barrea at al. [5][a]	Italy	Adults	121	35.5%	(44.9 ± 13.3)	PSQI
Bruni et al. [7]	Italy	Parents	992	85.4%	(11.5 ± 3.2)	SDSC
Cellini et al. [8]	Italy	Young Adults	1310	32.8%	(23.9 ± 3.6)	Italian PSQI
Dai et al. [12]	China	Young Adults	930	24.6%	22.4 ± 3.77	Researcher developed
Facer-Childs et al. [14]	Australia	Athletes	399	42.6%	(26.5 ± 0.4)	Researcher developed
Kim et al. [18]	South Korea	Parents	217	56.3%	(9.2 ± 1.4)	CSHQ Short Version
Kumar et al. [20]	India	Adults with PD	832	Not reported	Not reported	Researcher developed
Lim et al. [22]	Singapore	Parents	593	Not reported	Not reported	Researcher developed
Lin et al. [23][b]	Iran	Young Adults	1078	41.7%	(26.2 ± 7.4)	Persian ISI
Liu et al. [25][c]	China	Caregiver of Preschoolers	2018: 436 2020: 1619	2018: 50.5% 2020: 48.9%	Not reported	CSHQ
Majumdar et al. [26]	India	Students Professionals	325 203	39.07% 81.77%	(22.1 ± 1.66) (33.1 ± 7.11)	ESS, MCTQ
Robillard et al. [33]	Canada	Adults	5525	32.9%	(55.6 ± 16.3)	PSQI, rMEQ, QIDS-SR16
Salfi et al. [36]	Italy	Adults	2123	18.8%	(33.1 ± 11.6)	PSQI, ISI, rMEQ
Souza et al. [39]	Brazil	Adults	1368	19.7%	Not reported	Researcher developed
Werneck et al. [44]	Brazil	Adults	45,161	Not reported	Not reported	Researcher developed
Zhang et al. [52]	China	Adolescents	99	Not reported	(15.8 ± 0.7)	PROMIS Pediatric Sleep Disturbance Short Form and Sleep-related Impairment Scale

Abbreviations: PSQI: Pittsburg Sleep Quality Index; ISI: Insomnia Severity Index; rMEQ: Reduced Morning-Eveningness Questionnaire; CSHQ: Children's Sleep Habit Questionnaire; SDSC: Sleep Disturbance Scale for Children; BSMAS: Bergen Social Media Addiction Scale; PD: Parkinson's Disease; QIDS-SR16: Quick Inventory of Depressive Symptomatology; ESS: Epworth Sleepiness Scale; MCTQ: Munich Chrono-Type Questionnaire.

[a] Baseline data: in-person, Follow-up: phone interview; all other included studies used online surveys.

[b] Used BSMAS for screen time data. All other studies used researcher developed screen time assessments.

[c] Caregivers identified as Mother (71.3%), Father (22.3%), and Grandparent or other (6.4%).

2.3. Data extraction and analysis

The articles included in the final sample were summarized in an evidence table to ensure that all inclusion criteria were met and to organize and synthesize the data thematically based on the results. The sleep variable was the main variable for thematic categorization (e.g., impacts to sleep disturbance; impacts to sleep duration relative to screen time). Strengthening the Reporting of Observational Studies in Epidemiology Checklist (STROBE) was used to assess the included articles.

3. Results

3.1. Study selection

A total of 18 studies were included in the systematic review. Initial searches revealed a total of 2800 articles across the databases of PubMed ($n = 2472$), Nursing & Allied Health ProQuest ($n = 101$), and ScienceDirect Health and Lifescience College Edition ($n = 227$), of which 50 were automatically excluded before screening because they were not in English. The research team initially screened 2750 articles by title and abstract. The full text of 143 articles was retrieved and compiled between the two researchers, and an additional 24 duplicate articles were identified, leaving 119 articles to evaluate for eligibility. In total, 18 studies met the inclusion criteria. Most of the articles were excluded because sleep and screen time were studied separately or because the studies collected only descriptive statistics that did not measure the statistical significance of the study's findings ($n = 90$).

The included articles represented 11 countries worldwide (i.e., Australia, Bangladesh, Brazil, Canada, China, India, Iran, Italy, Pakistan, Singapore, and South Korea). It also sampled various populations, including young adults ($n = 4$); parents of minor-aged children ($n = 3$); and elite/sub-elite athletes ($n = 1$). Of the included articles, ten used established measures to assess sleep-related outcomes (e.g., Pittsburgh Sleep Quality Index [PSQI], Insomnia Severity Index [ISI], Sleep Disturbance Scale for Children, etc.). Only one study used an established measure to assess the impact of screen-based technology (i.e., social media) on sleep *via* the Bergen Social Media Addiction Scale [23]. The demographics reported varied between studies. Table 1 presents details regarding the included studies. The following sections categorize the results of the included studies by the sleep variables measured (i.e., sleep onset latency, delayed bedtime, sleep duration, wake time, sleep quality, sleep disturbance, insomnia). Sleep onset latency refers to the amount of time it takes for a person to fall asleep once sleep is intended. Delayed bedtime indicates the individual went to bed later than usual. Sleep duration describes the amount of time someone slept throughout the night. A person's wake time or rise time signifies the time of day the individual awoke to start his or her day. Sleep quality classifies the degree to which a person slept well over a specified period. Sleep disturbances indicate that someone's sleep was negatively interrupted by something. Insomnia refers to difficulties with falling asleep, staying asleep, or waking too soon and being unable to go back to sleep.

3.2. Screen time and sleep onset latency

Three of the included studies [8,14,36] found that increased screen time was related to an increase in sleep onset latency in adult populations during the COVID-19 pandemic. One study collected data at two separate points (i.e., March 25–28, 2020; April 21–27, 2020) and found that adults who increased their screen usage before bed significantly increased their sleep onset latency (mean change = +4.08 min, standard error = 1.31 min; $p = 0.03$). However, adults who decreased or maintained their amount of screen time before bed did not demonstrate any change to their sleep onset latency between the two time points [36].

Athletes in Australia whose training regimen was impacted by the COVID-19 pandemic also experienced an increased sleep onset latency [14]. Specifically, athletes in the sample who increased their screen time before bed demonstrated a 25% rise in sleep onset latency (Kruskal–Wallis $\chi^2 = 10.4$, $p < 0.01$) [14]. Furthermore, during the pandemic, participants who reported a decrease in their use of screens before bed had an average sleep onset latency of 22 min, compared to those who increased screen use before bed (Sleep onset latency = 37 min, $p = 0.03$) [14]. Additionally, Cellini et al. [8] found that sleep onset latency was mildly but significantly correlated with the increased use of screen-based technology before bed during the pandemic ($r = 0.10$, $p < 0.001$).

3.3. Screen time and delayed bedtime

Three studies assessed whether screen time impacted bedtime during the COVID-19 pandemic. In adults, the time participants went to bed was mildly influenced by technology use before sleep ($r = 0.09$, $p < 0.001$) [8]. Similarly, during the COVID-19 lockdown in Italy, adolescents with ADHD who went to bed later than usual spent most of their day on electronic devices for leisure activities compared to adolescents who did not change their bedtime [7].

Salfi et al. [36] also discovered that increased screen usage before bed significantly delayed bedtime, with significant changes between the two data collection time points during the lockdown (mean change = +23.08 min; standard error = 3.13 min; $p < 0.001$) in adults. However, a decrease in screen time before bed led to an earlier bedtime (mean change = −23.25 min, standard error = 6.70 min; $p < 0.01$), and those who maintained their screen habits before bed showed no differences in bedtime [36].

3.4. Screen time and sleep duration

Six of the included studies specifically examined the impact screen time may have on sleep duration during the COVID-19 pandemic. For example, Souza et al. [39] found that participants' screen usage during the pandemic predicted that their total amount of sleep per night would be less than or equal to 7 h a night (Odds Ratio [OR] = 1.056; 95% Confidence Interval [CI] = 1.022, 1.090). Similarly, between the two data collections during quarantine in Italy, Salfi et al. [36] found the total time participants spent sleeping decreased significantly (mean change = −16.70 min, standard error = 3.22 min, $p < 0.001$) for those who spent more time on their device before bed. Interestingly, those who reduced or maintained their screen use before bed reported no significant change in their total sleep duration per night ($p = 1.00$) [36]. Furthermore, adolescents who spent most of their day on screen-based devices also experienced a decrease in sleep duration [7].

Non-academic screen-related activities for children aged 3–16 also related to sleep duration during the COVID-19 pandemic ($r^2 = -0.34$; $p < 0.01$), such that an increase in screen use related to a decrease in sleep duration, and vice versa, as reported by their parents [22]. However, this relationship was also present before COVID-19, with a stronger correlation ($r^2 = -0.41$; $p < 0.01$) [22]. An additional study identified that undergraduate and graduate students who used their cellphone more also reported a shorter sleep duration ($r = -0.60$), and for adults working from home, greater use of their computer correlated with a decreased sleep duration ($r = -0.90$) [26]. Alternatively, one study identified a significant relationship between longer sleep periods and increased social media use by way of their electronic devices, during the COVID-19 pandemic [1].

3.5. Screen time and wake time

Two of the included studies explored screen usage effects on wake time during the COVID-19 pandemic. Both studies identified a link between screen-based technology usage and wake time. Specifically, increased technology usage before bedtime was mildly correlated with participants' wake time ($r = 0.13$, $p < 0.001$) (Cellini et al., 2021). Similarly, when two data collection points were compared, participants who increased their screen time before bed also reported a later wake-up time during the COVID-19 pandemic (mean change = +18.92 min, standard error = 2.83 min; $p = 0.03$) [36]. However, participants who decreased or maintained their screen use before bed did not change their wake time in the morning. Therefore, those who increased their screen exposure at bedtime significantly differed from the no change in screen time group and the decreased screen time group and demonstrated a delayed wake time ($p < 0.001$) [36].

3.6. The impact of screen time on sleep quality and sleep disturbance

Five of the included studies examined the impact of screen time on sleep quality. Four studies found that screen time influenced sleep quality [5,12,36,44], and one study found that sleep quality was not affected [8]. Participants assessed at two time points during the COVID-19 pandemic presented with higher scores on the PSQI, signifying a decrease in sleep quality when they simultaneously reported a significant increase in screen usage before bed (mean change = +1.01 min, standard error = 0.15 min; $p < 0.001$) [36]. However, participants that decreased their screen time before bed reported an improved PSQI score (mean change = −1.00, standard error = 0.33; $p < 0.05$), and those who did not change their screen time habits before bed had no significant changes to their PSQI scores [36].

In Italy, a confinement period started on March 12, 2020 [5]. Forty days into this quarantine, Barrea et al. [5] collected data to assess whether sleep quality was influenced for people smart working, as measured by the PSQI. This data was compared to baseline data that was collected earlier in the year [5]. Smart working typically allows employees to complete their jobs remotely, with a flexible work schedule and location. Both men and women smart working from home reported their sleep quality had declined compared to those not using this work modality, with men demonstrating the biggest reduction in sleep quality ($p < 0.001$) [5]. Furthermore, participants who disclosed frequent television and computer/tablet use experienced a decrease in their sleep quality and demonstrated significantly higher odds that their sleep quality would deteriorate due to this higher rate of screen usage (TV viewing: OR = 1.63, 95% CI = 1.42–1.87; Computer/Tablet Use: OR = 1.91, 95% CI = 1.61–2.27) [44]. One study also found that a greater quality of sleep during a stay-at-home order negatively predicted the overall time spent on the use of electronic devices ($\beta = -0.07$, $p < 0.05$) [12]. However, another study found evidence contrary to these results, finding that increased use of digital electronics before bed did not affect sleep quality ($r = 0.04$, $p = 0.166$) [8].

Furthermore, six studies explored the interchange between screen time and sleep disturbances. Five of those studies revealed significant influences, and one found no association between these variables. Kumar et al. [20] explored whether home confinement impacted sleep for people with Parkinson's Disease from nine different centers across India. Participants indicated whether they had experienced new or worsening sleep disturbances or dissatisfaction (NOWS) during the past three months and were also asked to disclose their daily screen usage for both before and during the quarantine period. Participants who reported NOWS during the past three months also reported that their daily screen time was > 3 hours before the quarantine and during the quarantine. Similarly, it was found that participants who worked from home or were taking online classes demonstrated a 34% higher risk of sleep disturbance (AOR: 1.34, CI: 1.02–1.75), with reports of sleep disturbance highest for participants reporting more than 5 hours of internet use per day [2].

For children aged 7–12, the Sleep Quality and Ritual Survey from the Children's Sleep Habit Questionnaire revealed that tablet time and smartphone time did impact overall sleep problems, but TV, tablet, and smartphone frequency did not relate to overall sleep problems [18]. Comparably, in preschool children, the amount of time they spent using electronic devices positively predicted sleep disturbances [25]. However, when Liu et al. [25] examined the occurrence of sleep disturbances in these children, assessed during the COVID-19 pandemic, and compared it to a comparison sample they collected in December 2018, the children sampled during the COVID-19 pandemic had fewer sleep disturbances overall than the comparison sample from 2018. However, screen time was not measured in their 2018 sample, and the effects it may have had cannot be deduced. Conversely, for adolescents in China, the variance in sleep disturbance did not relate to the amount of time they spent on electronic devices, but it did relate to their sleep impairment score [52]. Finally, for Canadians between the ages of 16 and 95, watching

television for >30 min a week was identified as a factor related to clinically significant sleep difficulties, as measured by selected items from the Quick Inventory of Depressive Symptomatology (OR = 0.713, 95% CI = 0.531–0.956, $p < 0.01$) [33].

3.7. The impact of screen-based technology on insomnia

Two studies measured the impact of screen-based technology usage on insomnia. Lin et al. [23] utilized the Bergen Social Media Addiction Scale (BSMAS) to measure the extent that higher levels of social media use, indicting a greater risk for addiction, was directly and indirectly linked to insomnia [23]. The second study collected data at two sessions and found that those who increased their screen usage before bedtime had a significant increase in their Insomnia Severity Index (ISI) [36]. Furthermore, those who decreased their screen usage before bedtime had a significant decrease in their ISI score [36]. Those who maintained their screen usage habits experienced no significant changes to their ISI score [36].

Additionally, between surveys 1 and 2, the number of people with moderate to severe insomnia (+3.6%) and identified as poor sleepers (+11.4%) increased for those who increased their screen usage before bed [36]. Conversely, the number of participants identified as poor sleepers (−10.7%) and those with moderate to severe insomnia (−7.3%) significantly decreased for those who reduced their screen time before bed [36]. Participants who maintained their screen usage habits before bed also exhibited a decrease in clinical insomnia prevalence [36].

4. Discussion

This systematic review explored literature databases to formulate an answer as to whether increased screen time during the COVID-19 pandemic impacted sleep-related variables, such as sleep quality or sleep quantity. The articles identified through this process varied in methodology and outcome measures. However, the studies overall identified effects to sleep onset latency, bedtime, wake time, sleep duration, sleep quality, and sleep disturbance. In summary, sleep onset latency tended to be increased, with later bedtime and wake time when people reported greater screen time. In addition, sleep duration tended to decrease with increased screen time, with findings of decreased sleep quality and increased reports of sleep disturbances. However, several of the studies countered this generalization. Cellini et al. [8] and Ali et al. [1] suggested that changes to daily routines, such as school closures [1] and altered job schedules, [8] relegated the need for early morning arousals, which allowed for shifts in sleep habits and routines as participants lived in drastically different circumstances. Rather, adolescents with extensive screen use may have had trouble falling asleep, thus delaying their bedtime, and instead, slept later and longer in the morning [1].

The overarching view of the findings implies that screen time influenced aspects of sleep. Furthermore, findings of the systematic review highlight whether the pandemic will have additional impacts on sleep, such as altered sleep-wake rhythms. For example, two of the articles included found that participants who increased their screen time delayed their bedtime [8,36]; however, these same studies also revealed that the sample delayed their wake-up time, as well. Specifically, the correlation between screen time and a later wake time was slightly stronger than the correlation between screen time and a delayed bedtime [8]. A loss of approximately four minutes of sleep existed for those who delayed their bedtime by approximately 24 minutes and those who delayed their wake time by approximately 19 minutes [36]. This apparent alteration to sleep-wake rhythms may partly explain findings countering the argument that screen time influences sleep. Rather, people may have had the opportunity to align with a preferred sleep schedule during quarantine. During the COVID-19 pandemic, people's self-selected sleep-wake routines differed from their typical schedule dictated by social conventions [34]. Future research could explore whether changes to sleep-wake rhythm mediate effects of screen time on sleep, particularly during the COVID19 pandemic.

Although most of the included articles identified that sleep was affected when there was an increase in screen time, results that indicated otherwise cannot be ignored. The varied results suggest additional factors may be involved and should be considered in synthesizing an answer to the research question.

4.1. Comparison of pre-COVID-19 and during COVID-19 findings

The 2005–2006 US National Health and Nutrition Examination Survey found that adults with higher levels of screen time (more than 6 hours/day) had a greater likelihood of reporting trouble with sleep onset latency [42]. Three of the included studies also identified that higher levels of screen time related to an increase in sleep onset latency during the COVID-19 pandemic for adults [8,14,36].

Before COVID-19, children who used a smartphone and/or tablet every day had increased odds for a longer sleep onset latency and a decrease in sleep duration [9]. Furthermore, in childhood through adolescence, greater screen time related to more sleep disturbances, which further predicted mental health concerns indirectly connected to screen time [30]. Results of the current systematic review revealed similar findings. Children aged 3–16 who engaged in non-academic screen time [22] and adolescents who spent most of their day on screen-related activities [7] experienced a decrease in their sleep duration during the COVID-19 pandemic. However, Liu et al. [25] discovered that children experienced fewer sleep disturbances overall when compared to their sample from 2018; nonetheless, it must be considered that screen usage was not studied in their 2018 sample. Although the samples cannot be compared equally for impacts, it cannot be ignored that children's screen use positively predicted sleep disturbances during the COVID-19 pandemic [25]. The findings of Kumar et al. [20] also question if changes in sleep variables during the COVID-19 epidemic relate to screen-based technology use, or to something else. The new or worsening sleep problems assessed were more recent; however, they occurred in those whose reported their daily screen time was >3 before the pandemic as well [20].

4.2. Is it screen time's fault, or is it something else?

Although these results imply that higher levels of screen time during the pandemic impacted sleep-related variables, other factors may be involved. Mood state (i.e., anger and confusion) and poor sleep quality predicted smartphone use in young adults before the COVID-19 pandemic [16]. Furthermore, in children and adolescents from the Brazilian High-Risk Cohort for Psychiatry Disorders, more baseline psychological symptoms predicted the highest levels of screen time at follow-up; however, screen time did not predict psychopathology [4]. Future research may examine whether an underlying variable, such as mood state or a psychological condition, functioned as an explanatory factor for the varied findings in the current systematic review. For instance, did people who reported higher levels of sleep difficulties and screen time have an underlying psychological factor that was not explored? The potential of this relationship is important to consider, as high levels of screen time were found to relate to anxiety, depression, psychopathology, and poor-quality sleep [46]. However, future research must consider the type of screen in relation to these variables. For example, in adults, television use related to increased levels of depression, but computer and mobile devices related to a decrease in depression symptoms [49]. In children and adolescents, smaller screens or smartphones did not relate to signs of psychopathology, but greater computer usage related to psychopathology in an age-dependent manner [37].

4.2. Clinical implications

Pandemic-related effects on sleep have influenced health and well-being. For example, Kilgore et al. [17] found evidence that individuals who experienced insomnia during the epidemic were at an increased risk for suicide ideation; specifically, the link between COVID-19-related concerns and suicide ideation was explained by self-reports of insomnia, which was found to be greater than previous reports in the general population. These findings present a potential grave consequence; as the world continues to experience increased tension due to the unknown nature of the COVID-19 pandemic, leading to greater levels of sleep disturbances such as insomnia, higher levels of completed suicide may be seen. Thus, clinical strategies to improve sleep, such as training in diaphragmatic breathing for relaxation [24], routine sleep assessment and intervention by health providers [15], and initiatives to address sleep hygiene and consistent sleep schedules [17], are essential. Furthermore, empowering individuals to develop healthy habits regarding technology use may prevent negative physical and mental health problems that are associated with higher levels of screen time [58]. Researchers also discovered that appropriate levels of sleep and less passive time spent on screen-based devices decreased psychopathology in youth during the COVID-19 pandemic [35].

Community leaders must consider the potential long-term health implications that may arise, such as increased levels of emotional distress and psychological illness, as the world continues to adjust to the ebb and flow nature of this global pandemic [32]. Therefore, it is vital researchers and healthcare professionals consider the whole person in their endeavors to identify the underlying causes of sleep challenges as the world adapts to a new normal; sleep is essential to life, and negative impacts to sleep may increase the lives lost during this unprecedented situation [17].

4.3. Limitations

Limitations of the current systematic review must be taken into consideration. The articles included is limited to the timeframe determined by the inclusion criteria. Additionally, the publications reviewed had diverse samples (i.e., from children, to athletes, to adults), which restricts our ability to make a universal conclusion. Furthermore, the methodologies and outcome measures varied between the included articles. Only ten of the included studies used an established outcome measure to address sleep-related factors (e.g., PSQI), and only one study used an established outcome measure for the screen-related variable. Therefore, the instruments used to assess screen time were also heterogenous in nature across the included studies. The other studies used researcher-developed outcome measures which had no psychometric property validation. Thus, there is a limited ability to draw stronger conclusions due to the varied nature of the studies.

5. Conclusion

Although the number of articles included in this systematic review is limited, the overall synthesis of findings suggests that COVID-19 related lifestyle changes, such as increased screen time, may negatively affect sleep health. However, whether there is a direct relationship between screen time and sleep needs further consideration; other unidentified factors may play a role and warrant additional exploration. Nonetheless, the clinical implications demonstrate community leaders must consider the potential long-term consequences that may arise due to the pandemic and implement initiatives to identify and address sleep challenges, as sleep and well-being are intricately interconnected.

Declaration of Competing Interest

Authors declare that they have no conflict of interest.

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