

# Unveiling Coronasomnia: Pandemic Stress and Sleep Problems During the COVID-19 Outbreak

Si Chen , Cecilia Cheng 

Social and Health Psychology Laboratory, Department of Psychology, The University of Hong Kong, Hong Kong, People's Republic of China

Correspondence: Cecilia Cheng, Social and Health Psychology Laboratory, Department of Psychology, The University of Hong Kong, Pokfulam Road, Hong Kong, People's Republic of China, Email [ceci-cheng@hku.hk](mailto:ceci-cheng@hku.hk)

**Abstract:** The COVID-19 pandemic posed an unprecedented challenge to public well-being, necessitating an examination of its health impact. This review discusses the relationship between pandemic-induced stressors and individual sleep patterns and quality. The pandemic stressors include lockdown or physical distancing measures, direct virus exposure, and the dissemination of misinformation and disinformation. The pandemic led to delayed sleep-wake cycles, except for healthcare professionals, and worsened sleep quality. The prevalence of insomnia was higher for women due to pre-existing conditions and susceptibility stressors such as lockdown stress and family responsibilities. Healthcare professionals, who experienced worsened work conditions during the pandemic, reported higher rates of insomnia and sleep difficulties due to infection anxiety and post-traumatic stress from direct virus exposure. For the general population, stress stemmed from social isolation under lockdown and overwhelming false information available online, resulting in sleep problems. Taken together, the findings highlight the importance of promoting social interactions, providing psychological support services, and caution in navigating health information. In summary, this review underscores the need for individual- and group-centered approaches in ongoing research and interventions to address pandemic-related stress and sleep issues during COVID-19.

**Keywords:** sleep health, sleep disturbance, insomnia, infodemic

## Introduction

The COVID-19 pandemic posed an unprecedented challenge to global well-being.<sup>1–4</sup> A myriad of studies reported the adverse effects of the pandemic on both physical and psychological health outcomes.<sup>5–8</sup> The term “coronasomnia” or “COVID-somnia” emerged to describe the various sleep dysfunctions experienced during the pandemic.<sup>9</sup> The most commonly reported and studied sleep problems include insomnia, circadian rhythm abnormalities, and reduced sleep quality.<sup>9–11</sup> While the overall duration of sleep remained largely unchanged or even increased for a significant portion of the population, this longer sleep duration did not translate into improved sleep quality.<sup>12–15</sup> Ironically, studies consistently showed an increase in cases of insomnia and circadian rhythm sleep disorders.<sup>12,14–17</sup> During the pandemic, the estimated global prevalence of reported sleep problems among the general public was 18%.<sup>18</sup> Previous research has highlighted the role of stressful life events in the development of sleep problems, implying that existing sleep disturbances can be exacerbated during times of stress.<sup>16,19</sup> Indeed, the estimated global prevalence reached 38% for psychological stress and 32% for generalized anxiety.<sup>20</sup> Hence, the documented rise in sleep problems during the COVID-19 pandemic is not surprising, considering the multifaceted nature of the pandemic as a stress-inducing event.

The pandemic-related stress largely stemmed from the unparalleled measures implemented by governments worldwide to contain the novel, highly infectious virus, especially the strict physical distancing orders, such as national lockdowns, home confinement, school and workplace closures, and travel bans.<sup>21–24</sup> While these measures effectively controlled the spread of the virus, they also introduced significant stressors by disrupting essential aspects of public health and individual life.<sup>25–27</sup> The virus itself, combined with the physical distancing measures, elicited pandemic-specific stress and restrictive lifestyle changes,

the latter of which disrupted chronobiological rhythms due to reduced exposure to light, limited social interactions, and decreased physical mobility.<sup>25,26</sup>

Previous reviews on pandemic stress and sleep health during COVID-19 had examined this impact of physical distancing measures on general population's sleep patterns and qualities.<sup>28–30</sup> To gain a more comprehensive understanding of how the pandemic as multifaceted stressor affected sleep, the present review delves deeper into analyzing subgroup differences in susceptibility to various aspects of lockdown stress, highlighting the need for employing more nuanced approaches to sleep health on a population level. In addition to examining the effects of lockdown stress, our review also discusses the impact of the infodemic, which emphasizes the digital aspect of COVID-19 stressors. Specifically, the constant availability of threatening and unfiltered information about COVID-19 through digital media generated ongoing fear and worries, which were also closely related to sleep problems.<sup>27,31–34</sup>

The following sections delve into the findings pertaining to the detrimental impact of pandemic-induced stress and emotional issues on individuals' reported sleep problems during the pandemic.

## Lockdown Stress and Sleep

Amid the implementation of physical distancing measures, national lockdown and home confinement played an influential role in sleep outcomes in residents of the affected regions. A meta-analysis revealed that residents of regions where lockdown was implemented exhibited a higher prevalence of sleep problems than those of regions where containment measures other than lockdown were implemented.<sup>35</sup> Studies conducted during the COVID-19 pandemic examined lockdown as a condition of large-scale, long-term, forced social isolation.<sup>36–38</sup> Indeed, the findings drawn from these studies are largely in line with those of social isolation studies that documented the effects of environmental changes on sleep quality. Specifically, previous laboratory findings have shown that reduced light exposure during social isolation can reduce melatonin production and subsequently disrupt the circadian rhythm.<sup>39</sup> Other factors such as limited physical mobility and diet may also influence sleep pressure, which is the homeostatic drive for sleep, and ultimately influence sleep quality.<sup>40,41</sup> Similarly, the association of reduced light exposure and physical activity with delayed sleep–wake cycles and decreased sleep quality was observed in the general public during COVID-19 lockdowns, with the exception of healthcare professionals, who worked on an extensive and rigid schedule.<sup>9,28,42,43</sup>

In addition to previous social isolation studies that mostly examined the effects of general environmental changes on sleep, the unprecedented scope of COVID-19 lockdown necessitates a greater focus on pandemic-specific factors.<sup>26</sup> In this section, we discuss how pandemic-specific stress caused by the COVID-19 lockdown as a mass-scale social isolation situation was related to sleep outcomes across different demographic groups.

## Teleworking and Changes in Sleep Patterns

One of the most significant changes brought about by the COVID-19 lockdown was the societal shift toward remote working and studying. Earlier survey findings indicated potential benefits of remote working as a result of the flexibility in sleep–wake routines. One large-scale, multi-country study conducted at the early onset of home confinement found a significant increase in residents' sleep hours during workdays and an overall delay in their sleep–wake cycle.<sup>15</sup> The researchers concluded that such a flexible sleep–wake routine reduced “social jetlag” (ie, the discrepancy between sleep duration on workdays and on free days) and could promote well-being by alleviating social time pressure for those previously suffering from sleep deprivation due to occupational and lifestyle commitments. Nonetheless, despite such initial benefits afforded by increased sleep opportunities and flexibility, a growing body of evidence has highlighted the adverse effects of lockdown and the irregular sleep–wake cycle on mental health and sleep.<sup>13,42,44</sup> Taken together, a dichotomy emerged between having more sleep opportunities but poorer sleep quality that characterized the general public's sleep pattern during the pandemic lockdowns.

## Lockdown-Induced Social Isolation, Loneliness, and Sleep Problems

Social isolation causes not only physical but also mental health issues, the latter of which include feelings of loneliness, or subjective distress resulting from a perceived discrepancy between desired and actual social relations.<sup>45</sup> Loneliness can in turn lead to sleep problems.<sup>46,47</sup> Findings revealed a notable societal trend of increased reported feelings of loneliness

during lockdown periods, particularly among older adults, who were typically more vulnerable to loneliness and whose means of social interaction were most disrupted by lockdowns.<sup>48,49</sup> Specifically, the global prevalence of loneliness was at 5% for adolescents, 7% for mid-aged adults, and 12% for older adults.<sup>50</sup> Longitudinal data from older adults in Europe and Israel have revealed positive associations between COVID-19-related loneliness, generalized anxiety, and sleep problems.<sup>48,51</sup> Such positive associations have also been found in various demographic groups such as young adults and employees in collectivist countries (eg, China and Japan).<sup>52,53</sup>

The dichotomy of having more sleep opportunities but poorer sleep quality, thus, may be attributable to the stress of curtailed regular social interactions during lockdowns. A study in China that examined individuals' well-being during and after a 14-day mandatory quarantine identified that increased levels of social capital, which includes social belonging, trust, and engagement, during the isolation period were positively associated with sleep quality and negatively associated with perceived stress.<sup>54</sup> Such findings imply that active social participation despite the external constraints can promote sleep quality and overall well-being during lockdowns. This phenomenon pointed to the beneficial role of digital media during the pandemic, which offered the general public a means to maintain social connectedness, but digital media use during the pandemic can also function as a double-edged sword in relation to sleep quality, as discussed in later sections.<sup>55,56</sup>

## Familial Responsibilities Under Lockdown and Insomnia

The prevalence of sleep problems, especially insomnia, has been found to be higher in women than in men.<sup>32,57,58</sup> A study on the Spanish general population during the national lockdown identified women as one of the most at-risk groups in reporting the poorest sleep quality.<sup>57</sup> Another study with a more representative sample found a significant positive association between anxiety levels and insomnia during home confinement and a disproportionately large proportion of women reporting anxiety directly due to such confinement.<sup>32</sup> Similarly, longitudinal studies during the lockdowns in Italy and the UK revealed worse conditions of insomnia and anxiety in women than in men.<sup>58,59</sup>

Insomnia and anxiety have always been found to exhibit distinct gender dimorphic features.<sup>19,60,61</sup> Pre-pandemic studies provided possible neurobiological explanations, such as a shorter circadian period that could make women more vulnerable to insomnia than men.<sup>62</sup> In addition to these gender differences in biological susceptibility to insomnia and stress, the increase in familial responsibilities due to lockdown may also be more strenuous for women than men, thus contributing to the gender differences in insomnia and anxiety. For instance, school closures shifted the responsibilities of educational institutes to children's primary caregivers, typically mothers. As a result, mothers needed to take care of their children's emotional, physical, and intellectual development for an extended period during school closures.<sup>32</sup> Compared with the pre-pandemic period, there was a significant increase in maternal insomnia during COVID-19 home confinement in multiple countries, including Israel, Italy, and the US.<sup>63–65</sup> These studies also indicated a strong bidirectional association between children's and mothers' sleep patterns and quality, suggesting that the sleep quality of mothers could be influenced by that of their children, and vice versa. Moreover, a later lockdown study on working mothers and fathers showed that the association between the parents' and their children's sleep was stronger for mothers than for fathers, suggesting a possibly closer link between the sleep of mothers and children under lockdown.<sup>66</sup> Similarly, women (vs men) also reported heightened concern over mounting parental or familial responsibilities, which could contribute to increased levels of anxiety and insomnia in women.<sup>32</sup> Collectively, these combined factors of pre-existing susceptibility to stress and insomnia, along with the additional parental and familial responsibilities arising from lockdown measures, may largely contribute to the prevalence of insomnia among women.

## Infection Anxiety, Post-Traumatic Stress, and Sleep

Apart from the heightened stress experienced during social isolation amid the COVID-19 lockdown, the fear of contracting the coronavirus has also been found to influence sleep quality. There has been an escalation in both the fear of COVID-19 infection and sleep problems since the outset of the pandemic; by the end of the first wave of the pandemic, the reported global prevalence of public anxiety and fear of infection reached 19%.<sup>67</sup> Large-sample surveys conducted in Germany and China have documented significant positive associations among public anxiety, fear of COVID-19 infection, and insomnia.<sup>68,69</sup> A nationwide study in Bangladesh further identified fear of COVID-19 infection

and anxiety as key predictive factors of insomnia during the pandemic.<sup>70</sup> It is worth noting that the effects of pandemic-related stress on sleep problems vary among demographic groups.

Consistent with previous research on the impact of lockdown measures, women have shown the highest prevalence of fear of COVID-19 infection and insomnia during the pandemic.<sup>12,71,72</sup> This discrepancy can be attributed to the pre-existing difference in the rate of insomnia between women and men, which is further exacerbated by the increased familial responsibilities experienced during lockdown. Moreover, gender disparities in fear of COVID-19 infection and anxiety may be due to differences in attitudes toward the pandemic between the gender groups. Specifically, women tend to exhibit more favorable attitudes toward and greater adherence to COVID-19 preventive measures than do men, implying a heightened awareness among women regarding the potential risks of viral infection.<sup>73,74</sup>

## Virus Exposure and Insomnia in Healthcare Settings

The association between fear of COVID-19 infection and insomnia was particularly pronounced among healthcare professionals, especially frontline medical staff.<sup>72</sup> During the severe acute respiratory syndrome (SARS) outbreak that occurred approximately a decade ago, studies highlighted the vulnerability of healthcare professionals in terms of their physical and mental well-being.<sup>75</sup> Even in non-pandemic situations, the high demands and irregular work schedules inherent to the medical profession contribute to shorter sleep duration and increased sleep disturbances among healthcare professionals compared with other occupations.<sup>76,77</sup> The COVID-19 pandemic has further exacerbated these challenging work conditions, resulting in a wider disparity in sleep quality between healthcare professionals and the general public.<sup>18,78</sup>

During the COVID-19 pandemic, medical staff similarly faced increasingly irregular and demanding work schedules, including frequent rotational shifts, which contrast sharply with the flexible sleep–wake cycles experienced by the general population during lockdowns. In addition, healthcare professionals were frequently exposed to confirmed and suspected cases of infection, unlike the general public, whose contact with the virus was limited by mandatory physical distancing orders. In Wuhan, China, the epicenter of COVID-19 during the first wave of the outbreak, healthcare workers reported heightened fear of COVID-19 infection and physical exhaustion due to inadequate protection, heavy workloads, and limited contact with their significant others.<sup>79</sup>

As discussed previously, the COVID-19 pandemic has resulted in an increased prevalence of sleep problems, including insomnia and sleep deprivation, particularly among healthcare professionals compared with the general public.<sup>18,72</sup> A thorough review focusing on the well-being of nurses during the pandemic revealed that at least one third of nurses experienced increased levels of sleep disturbances and anxiety.<sup>33</sup> Furthermore, the percentage of nurses experiencing insomnia nearly doubled in comparison with the general public, surpassing the rates observed during previous outbreaks of SARS and Middle East respiratory syndrome.<sup>33</sup> It is also important to note the regional differences in the prevalence of experienced distress and sleep outcomes among healthcare professionals. Nurses from developing countries such as Iran and Ethiopia reported a poorer sleep quality in comparison to those from European countries.<sup>80,81</sup>

One possible explanation for the higher occurrence of insomnia among healthcare professionals, especially those in regions with scarcer medical resources, is the increased fear of COVID-19 infection resulting from direct contact with the atypical coronavirus. Studies conducted on US physicians and Chinese nurses during the COVID-19 outbreak similarly showed an association between direct exposure to infected patients and insomnia.<sup>17,82</sup> Specifically, stress related to both contagion and the potential infection of family members was found to largely explain the impact of the outbreak on frontline medical professionals' sleep difficulties.<sup>17</sup>

When comparing nurses from European countries with those from developing countries, similar patterns of findings emerged. Specifically, nurses from Iran reported higher levels of psychological distress, greater fear of viral contraction, and consequently poorer sleep quality due to the lack of access to proper vaccines.<sup>80</sup> Another study conducted during the pandemic with Turkish healthcare workers revealed that general coronavirus anxiety, fear of COVID-19 infection, and perceived burnout collectively predicted the severity of insomnia symptoms.<sup>78</sup> In summary, these findings on infection anxiety across nations suggest that direct exposure to COVID-19 tends to significantly contribute to an elevated fear of COVID-19 infection, which in turn leads to an increased prevalence of insomnia among healthcare professionals during the pandemic.

## Pandemic as a Potentially Traumatic Event and Sleep Disruptions

The COVID-19 pandemic has elicited an increase in post-traumatic stress, particularly among healthcare professionals, who have been exposed to a large number of traumatic and unexpected deaths.<sup>83</sup> Research has shown that repeated exposure to distressing aspects of traumatic events contributes to the development of traumatic stress, which in turn negatively affects sleep quality.<sup>84,85</sup> In the context of the COVID-19 emergency, healthcare workers have reported a high prevalence of post-traumatic stress, which is positively associated with the occurrence of sleep disorders such as insomnia and poor sleep quality.<sup>34,83</sup> Similarly, the general public, who have been exposed to risk factors such as social discrimination, fear of uncontrolled contagion, and financial burden, have also reported an increase in sleep problems induced by post-traumatic stress, although with lower prevalence than that in healthcare workers.<sup>86</sup> Overall, these findings reveal that post-traumatic stress resulting from the COVID-19 pandemic, similar to the fear of COVID-19 infection, significantly impacts sleep quality, particularly among healthcare professionals. Post-COVID-19 studies have also indicated that post-traumatic stress and stress-induced sleep problems may persist into the post-pandemic era, especially among individuals who perceive COVID-19 as a highly threatening event.<sup>87,88</sup>

## Infodemic and Sleep

During the COVID-19 pandemic, online social media platforms played a crucial role in overcoming physical constraints by providing users with up-to-date information on virus prevention and facilitating regular interactions in the digital space.<sup>89,90</sup> For instance, a review conducted in India indicated a three-fold increase in social media usage during the lockdown period, highlighting a significant shift toward digital interactions and communication.<sup>91</sup> However, this surge in social media use has also emphasized the importance of distinguishing responsible use from problematic use.<sup>92</sup>

One direct consequence of physical distancing measures has been an increase in screen time as individuals strive to stay informed about COVID-19-related information and maintain online connections. Studies have identified that increased screen time is related to both shortened sleep duration and reduced sleep efficiency.<sup>28,93,94</sup> Further examination of the increased smartphone use during the pandemic revealed an association between problematic social media use, characterized by compulsive engagement with online platforms, and sleep problems.<sup>95</sup> Therefore, while social media can serve as a valuable tool for staying connected and informed in times of pandemic, it is crucial to exercise caution regarding its use due to the potential adverse impact on users' physical and psychological well-being.

Since the beginning of the COVID-19 pandemic, individuals have been exposed to a constant stream of alarming pandemic-related information, including daily updates on COVID-19 infection and mortality rates, through news outlets and social media platform.<sup>27,31</sup> This continuous exposure to pandemic-related information online has contributed to the development of what is commonly referred to as "pandemic fear".<sup>96</sup> Alongside the portrayal of the pandemic as a menacing threat through traditional news sources, the spread of false COVID-19 information—including misinformation and disinformation—on social media has emerged as a significant public health concern. Recognizing the potential harmful effects of online misinformation and disinformation on the well-being of the general public, Tedros Adhanom Ghebreyesus, the Director-General of the World Health Organization, coined the term "infodemic" in July 2020, underscoring the need to combat not only the epidemic but also this widespread dissemination of false information.<sup>97</sup>

## Media Exposure and Anxiety in the General Public

Similar to previous outbreaks such as Ebola in Africa and Zika in Brazil, the COVID-19 pandemic led to the emergence of a digital infodemic, which has shown a bidirectional interaction with social media. This interaction has been found to directly impact the public's emotional and behavioral responses to both of these public health crises.<sup>98,99</sup> As mentioned above, alongside the overall increase in social media use, there has been a well-documented rise in problematic social media use, which has been positively associated with insomnia.<sup>95</sup> Importantly, this association between problematic social media use and insomnia can be attributed to the fear of contracting COVID-19. Population surveys revealed that approximately half of the general population reported experiencing concerning levels of information anxiety due to frequent exposure to pandemic-related information online.<sup>100</sup> Collectively, these findings imply that social media,



particularly when used in an unhealthy or irresponsible manner, can potentially act as a risk factor for sleep disturbances in the general population during the pandemic.

Studies in India and China that compared residents' sleep before and during the pandemic reported an increase in sleep problems linked to heightened social media use, exposure to COVID-19 information, and general anxiety.<sup>27,31</sup> In addition, another study on Chinese participants identified media vicarious traumatization as a potential mechanism that explains the significant association between media exposure and sleep problems.<sup>31</sup> This finding suggests that the infodemic can function as a traumatic event resulting from Internet users' exposure to negative online media portrayals of the pandemic, which can in turn impact their sleep quality. The study also revealed a moderating effect of geographic location, with residents in regions highly reliant on social media for their perception of the pandemic being more susceptible to pandemic-related stress and insomnia due to vicarious traumatization.<sup>31</sup> It is worth noting that with the implementation of physical distancing measures globally, the majority of the general public heavily relied on media sources to shape their understanding of the pandemic threat, as evidenced by the increase in screen time and digital media use worldwide.<sup>28,93,94</sup> Therefore, the adverse impact of media vicarious traumatization on sleep and mental well-being may explain the association between the infodemic and sleep problems on a global scale.

## Variations in Sleep Outcomes When Coping with the Infodemic

The uncertainty theory of anxiety offers a framework for comprehending public anxiety in the face of an unknown disease.<sup>101</sup> According to this theory, individuals are driven to deploy diverse coping strategies as an attempt to mitigate their perceived uncertainty and anxiety. Active information-seeking through digital media is one such strategy commonly utilized by the residents of COVID-19-affected regions.<sup>10,102</sup> People in these regions have reported dedicating more effort and time to searching for disease prevention information than usual, a trend further accentuated by the implementation of physical distancing and lockdown measures.<sup>103</sup>

Notably, this active information-seeking strategy has been found to be negatively associated with emotional well-being and sleep quality. A pronounced characteristic of the infodemic is the overwhelming abundance of misinformation and disinformation constantly accessible online. Studies conducted in Italy and the UK on major social media platforms such as Twitter and Facebook have highlighted the increased prevalence of misleading information related to the pandemic.<sup>104</sup> As a result, the active information-seeking strategy may not always yield desirable outcomes due to the excessive amount of false information encountered.

Some studies have demonstrated that seeking COVID-19 information can elicit higher levels of anxiety, COVID-19 misunderstanding, physical fatigue, and sleep problems.<sup>95,105</sup> One possible explanation for these undesirable outcomes of information-seeking during the infodemic is the goodness-of-fit hypothesis, which proposes that the effectiveness of coping strategies largely depends on the match between individuals' coping style and their response to a particular situation.<sup>106,107</sup> In line with this framework, a study found that the frequency of COVID-19 information searches online had a moderated mediating effect on sleep quality.<sup>10</sup> Specifically, the findings indicated that frequent online searches for COVID-related information increased infection anxiety in individuals with a blunting coping style, and this heightened anxiety, in turn, disrupted their sleep quality. In contrast, insufficient offline COVID-19 information searches tended to increase infection anxiety and disrupt sleep quality in individuals with a monitoring coping style. These findings collectively emphasize the heightened risk posed by frequent exposure to COVID-19 information for particular groups over others, underscoring the need for more nuanced, individual-centered approaches to promote effective coping strategies in navigating the infodemic.

## Practical Implications and Future Directions

As discussed in this review, the COVID-19 pandemic significantly disrupted sleep patterns and sleep quality of residents of the affected regions.<sup>5–8</sup> While the overall duration of sleep remained relatively unchanged or increased in some populations, sleep-related issues such as insomnia, circadian rhythm sleep disorders, and reduced sleep quality affected the general population.<sup>12,14–17</sup> Specifically, the implementation of physical distancing measures, which enforced social isolation, resulted in individuals experiencing delays in their sleep–wake cycle and poorer sleep quality, despite initial reports of some benefits from a flexible circadian rhythm.<sup>15</sup> The loneliness stemming from physical lockdowns has been strongly associated with a decline in sleep quality, while social capital has been shown to promote better sleep quality and overall well-being.<sup>48,51–54</sup>

Therefore, alongside efforts to contain the spread of the virus, it is also important to emphasize the significance of regular social interactions that are crucial for bolstering mental wellness during periods of physical distancing.

In addition to the stress caused by loneliness, it is crucial to address the disruption caused by widespread lockdowns and its impact on sleep quality across different demographic groups. For instance, women, particularly working mothers, have faced heightened stress due to remote work and schooling, as well as the fear of contracting the virus. Consequently, there has been a higher prevalence of insomnia in this gender group.<sup>63–65,68,73,74</sup> These findings highlight the need for gender-specific measures to mitigate the impact of the pandemic on sleep quality. Similarly, it is important to adopt more targeted approaches to address the effects of the pandemic on sleep and overall well-being for individuals from diverse backgrounds, including those facing financial instability or belonging to specific age groups.<sup>108</sup>

Apart from the heightened stress experienced during social isolation, the fear and anxiety surrounding COVID-19 infection have also been found to exert a major impact on sleep quality, particularly among healthcare professionals. Healthcare professionals have endured irregular work schedules and constant exposure to the virus, resulting in higher levels of anxiety and concerns about infecting their significant others. This, in turn, contributes to the development of insomnia and poor sleep quality.<sup>17,33,78</sup> Furthermore, repeated encounters with COVID-19 fatalities have been shown to increase the risk of post-traumatic stress disorder and insomnia, especially in frontline workers.<sup>83</sup> To address the vulnerability of healthcare professionals and mitigate the potential long-term adverse effects of the pandemic on their sleep and mental health, it is recommended to implement appropriate strategies such as professional training to specifically address the expected action-plan and management of medical emergencies. These strategies can help healthcare professionals effectively cope with urgent and demanding circumstances in the future, such as those presented by COVID-19. Such practices that strengthen the resilience of healthcare professionals against pandemic-induced stress and the resulting sleep problems may play a crucial role in enhancing their psychological well-being.<sup>17</sup>

In the general public, sleep dysfunctions related to COVID-19 primarily stemmed from infection anxiety and the information technological aspects of the pandemic. The presence of an infodemic, characterized by an overwhelming amount of pandemic-related misinformation and disinformation, resulted in increased confusion and anxiety among the public, leading to a decline in sleep quality.<sup>27,31,95</sup> Therefore, it is crucial to exercise caution when engaging with information on digital media platforms.

At the societal level, efforts should be focused on correcting misinformation and disinformation, addressing the associated public confusion and anxiety, and ultimately improving public sleep quality and psychological well-being.<sup>109,110</sup> This can be achieved through initiatives aimed at correcting false information and promoting accurate information dissemination. For example, during the pandemic, major social media platforms, such as Facebook, Instagram, X (formerly known as Twitter), and YouTube, practiced a set of regulatory policies regarding the spread of COVID-19 information online. However, due to the lack of enforcement and the encrypted nature of information disseminated on other messaging platforms (eg, WhatsApp and Messenger), these strategies failed to effectively curb the infodemic.<sup>111</sup> Thus, to promote future informational and digital well-being, there is a need for social media platforms to improve their policies and regulatory measures to tackle the spread of misinformation and disinformation more effectively.

At the individual level, it is important to tailor strategies to one's own coping style in order to effectively navigate excessive information related to uncertain and threatening situations.<sup>10</sup> Considering the prevalence of misinformation and disinformation on social media, interventions should also take into account the role of news and media literacy, as well as individual resilience, to better cope with similar infodemics in the future. Interventions that promote critical thinking and enhance individuals' ability to discern reliable information can contribute to improved sleep and mental health.<sup>112</sup>

## Conclusion

The COVID-19 pandemic had a profound and wide-ranging impact on sleep, giving rise to a multitude of sleep problems including insomnia, disturbances in the circadian rhythm, and diminished sleep quality. The imposition of lockdown measures, combined with the distress stemming from direct exposure to the virus and the spread of false information, has contributed to the intricate and stress-laden nature of this global health crisis. The present review delves into the detrimental effects of these factors on sleep in diverse demographic groups, highlighting the heightened vulnerability experienced by specific populations such as women and healthcare professionals. These compelling findings emphasize the critical

importance of fostering regular social interactions, providing timely and robust psychological support services, and exercising discernment in the consumption of health-related information. Prioritizing these measures will help to actively promote enhanced sleep quality and overall well-being during these unprecedented times of public health upheaval.

## Data Sharing Statement

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

## Acknowledgments

This study was funded by Hong Kong Research Grants Council's General Research Fund (17601420), and the University of Hong Kong's Seed Fund for Basic Research (202011159134).

## Disclosure

The authors declare no conflict of interest in this work.

## References

1. Bueno-Notivol J, Gracia-García P, Olaya B, Lasheras I, López-Antón R, Santabábara J. Prevalence of depression during the COVID-19 outbreak: a meta-analysis of community-based studies. *Int J Psychol*. 2021;21(1):100196. doi:10.1016/j.ijchp.2020.07.007
2. Cheng C, Wang H-Y, Chan L. Multiple forms of mass anxiety in Coronavirus Disease-2019 pandemic. *J Affect Disord*. 2021;291:338–343. doi:10.1016/j.jad.2021.05.034
3. Fountoulakis KN, Apostolidou MK, Atsiova MB, et al. Self-reported changes in anxiety, depression and suicidality during the COVID-19 lockdown in Greece. *J Affect Disord*. 2021;279:624–629. doi:10.1016/j.jad.2020.10.061
4. Gasteiger N, Vedhara K, Massey A, et al. Depression, anxiety and stress during the COVID-19 pandemic: results from a New Zealand cohort study on mental well-being. *Bri Med J*. 2021;11(5):e045325. doi:10.1136/bmjopen-2020-045325
5. Cheng C, Ying W, Ebrahimi OV, Wong KFE. Coping style and mental health amid the first wave of the COVID-19 pandemic: a culture-moderated meta-analysis of 44 nations. *Health Psychol Rev*. 2023;18(1):141–164. doi:10.1080/17437199.2023.2175015
6. Cullen W, Gulati G, Kelly BD. Mental health in the COVID-19 pandemic. *Int J Med*. 2020;113(5):311–312.
7. O'Connor RC, Wetherall K, Cleare S, et al. Mental health and well-being during the COVID-19 pandemic: longitudinal analyses of adults in the UK COVID-19 Mental Health & Wellbeing study. *Br J Psychiatry*. 2021;218(6):326–333. doi:10.1192/bjp.2020.212
8. Pollard CA, Morran MP, Nestor-Kalinoski AL. The COVID-19 pandemic: a global health crisis. In: *Physiol Genomics*. American Physiological Society Bethesda; 2020.
9. Gupta R, Pandi-Perumal SR. COVID-somnia: how the pandemic affects sleep/wake regulation and how to deal with it? *Sleep Vigil*. 2020;4(2):51–53. doi:10.1007/s41782-020-00118-0
10. Cheng C, Ebrahimi OV, Lau Y. Maladaptive coping with the infodemic and sleep disturbance in the COVID-19 pandemic. *J Sleep Res*. 2021;30(4):e13235. doi:10.1111/jsr.13235
11. Bhat S, Chokroverty S. Sleep disorders and COVID-19. *Sleep Med*. 2022;91:253–261. doi:10.1016/j.sleep.2021.07.021
12. Yuan RK, Zitting K-M, Maskati L, Huang J. Increased sleep duration and delayed sleep timing during the COVID-19 pandemic. *Sci Rep*. 2022;12(1):10937. doi:10.1038/s41598-022-14782-x
13. Wright KP, Linton SK, Withrow D, et al. Sleep in university students prior to and during COVID-19 Stay-at-Home orders. *Curr Biol*. 2020;30(14):R797–R798. doi:10.1016/j.cub.2020.06.022
14. Leone MJ, Sigman M, Golombek DA. Effects of lockdown on human sleep and chronotype during the COVID-19 pandemic. *Curr Biol*. 2020;30(16):R930–R931. doi:10.1016/j.cub.2020.07.015
15. Korman M, Tkachev V, Reis C, et al. COVID-19-mandated social restrictions unveil the impact of social time pressure on sleep and body clock. *Sci Rep*. 2020;10(1):22225. doi:10.1038/s41598-020-79299-7
16. Mandelkorn U, Genzer S, Choshen-Hillel S, et al. Escalation of sleep disturbances amid the COVID-19 pandemic: a cross-sectional international study. *J Clin Sleep Med*. 2021;17(1):45–53. doi:10.5664/jcsm.8800
17. Abdulah DM, Musa DH. Insomnia and stress of physicians during COVID-19 outbreak. *Sleep Med*. 2020;2:100017.
18. Alimoradi Z, Broström A, Tsang HW, et al. Sleep problems during COVID-19 pandemic and its' association to psychological distress: a systematic review and meta-analysis. *EClinicalMedicine*. 2021;36:100916. doi:10.1016/j.eclim.2021.100916
19. Morin CM, Drake CL, Harvey AG, et al. Insomnia disorder. *Nat Rev Dis*. 2015;1(1):1–18.
20. Necho M, Tsehay M, Birkie M, Biset G, Tadesse E. Prevalence of anxiety, depression, and psychological distress among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. *Int J Ment Health*. 2021;67(7):892–906.
21. Sen-Crowe B, McKenney M, Elkbali A. Social distancing during the COVID-19 pandemic: staying home save lives. *Am J Emerg Med*. 2020;38(7):1519. doi:10.1016/j.ajem.2020.03.063
22. Gostin LO, Wiley LF. Governmental public health powers during the COVID-19 pandemic: stay-at-home orders, business closures, and travel restrictions. *JAMA*. 2020;323(21):2137–2138. doi:10.1001/jama.2020.5460
23. Tang S, Xiang M, Cheung T, Xiang Y-T. Mental health and its correlates among children and adolescents during COVID-19 school closure: the importance of parent-child discussion. *J Affect Disord*. 2021;279:353–360. doi:10.1016/j.jad.2020.10.016
24. Cheng C, Wang H-Y, Ebrahimi OV. Adjustment to a "new normal": coping flexibility and mental health issues during the COVID-19 pandemic. *Front Psychiatry*. 2021;12:353. doi:10.3389/fpsy.2021.626197



25. Galli F, Reglero G, Bartolini D, Visioli F. Better prepare for the next one. Lifestyle lessons from the COVID-19 pandemic. *PharmaNutrition*. 2020;12:100193. doi:10.1016/j.phanu.2020.100193
26. Altena E, Baglioni C, Espie CA, et al. Dealing with sleep problems during home confinement due to the COVID-19 outbreak: practical recommendations from a task force of the European CBT-I Academy. *J Sleep Res*. 2020;29(4):e13052. doi:10.1111/jsr.13052
27. Roy D, Tripathy S, Kar SK, Sharma N, Verma SK, Kaushal V. Study of knowledge, attitude, anxiety & perceived mental healthcare need in Indian population during COVID-19 pandemic. *Asian J Psychiatr*. 2020;51:102083. doi:10.1016/j.ajp.2020.102083
28. Gupta R, Grover S, Basu A, et al. Changes in sleep pattern and sleep quality during COVID-19 lockdown. *Indian J Psychiatry*. 2020;62(4):370. doi:10.4103/psychiatry.IndianJPsychiatry\_523\_20
29. Limongi F, Siviero P, Trevisan C, et al. Changes in sleep quality and sleep disturbances in the general population from before to during the COVID-19 lockdown: a systematic review and meta-analysis. *Front Psychiatry*. 2023;14:1166815. doi:10.3389/fpsy.2023.1166815
30. Doraiswamy S, Cheema S, Al Mulla A, Mamtani R. COVID-19 lockdown and lifestyles: a narrative review. *F1000Res*. 2021;10:363. doi:10.12688/f1000research.52535.1
31. Liu C, Liu Y. Media exposure and anxiety during COVID-19: the mediation effect of media vicarious traumatization. *Int J Environ Res Public Health*. 2020;17(13):4720. doi:10.3390/ijerph17134720
32. Bigalke JA, Greenlund IM, Carter JR. Sex differences in self-report anxiety and sleep quality during COVID-19 stay-at-home orders. *Biol Sex Differ*. 2020;11(1):1–11. doi:10.1186/s13293-020-00333-4
33. Al Maqbali M, Al Sinani M, Al-Lenjawi B. Prevalence of stress, depression, anxiety and sleep disturbance among nurses during the COVID-19 pandemic: a systematic review and meta-analysis. *J Psychosom Res*. 2021;141:110343. doi:10.1016/j.jpsychores.2020.110343
34. Marvaldi M, Mallet J, Dubertret C, Moro MR, Guessoum SB. Anxiety, depression, trauma-related, and sleep disorders among healthcare workers during the COVID-19 pandemic: a systematic review and meta-analysis. *Neurosci Biobehav Rev*. 2021;126:252–264. doi:10.1016/j.neubiorev.2021.03.024
35. Alimoradi Z, Gozal D, Tsang HW, et al. Gender-specific estimates of sleep problems during the COVID-19 pandemic: systematic review and meta-analysis. *J Sleep Res*. 2022;31(1):e13432. doi:10.1111/jsr.13432
36. Pancani L, Marinucci M, Aureli N, Riva P. Forced social isolation and mental health: a study on 1006 Italians under COVID-19 lockdown. *Front Psychol*. 2021;12:663799. doi:10.3389/fpsyg.2021.663799
37. Mckeown B, Poirer GL, Strawson WH, et al. The impact of social isolation and changes in work patterns on ongoing thought during the first COVID-19 lockdown in the United Kingdom. *Proc Natl Acad Sci*. 2021;118(40):e2102565118. doi:10.1073/pnas.2102565118
38. Kasar KS, Karaman E. Life in lockdown: social isolation, loneliness and quality of life in the elderly during the COVID-19 pandemic: a scoping review. *Geriatr Nurs*. 2021;42(5):1222–1229. doi:10.1016/j.gerinurse.2021.03.010
39. Potter GD, Skene DJ, Arendt J, Cade JE, Grant PJ, Hardie LJ. Circadian rhythm and sleep disruption: causes, metabolic consequences, and countermeasures. *Endocr Rev*. 2016;37(6):584–608. doi:10.1210/er.2016-1083
40. Driver HS, Taylor SR. Exercise and sleep. *Sleep Med Rev*. 2000;4(4):387–402. doi:10.1053/smr.2000.0110
41. Kelley GA, Kelley KS. Exercise and sleep: a systematic review of previous meta-analyses. *Evid Based Med*. 2017;10(1):26–36. doi:10.1111/jebm.12236
42. Bertrand L, Schröder C, Bourgin P, et al. Sleep and circadian rhythm characteristics in individuals from the general population during the French COVID-19 full lockdown. *J Sleep Res*. 2022;31(2):e13480. doi:10.1111/jsr.13480
43. Morin CM, Carrier J, Bastien C, Godbout R, Sleep C, Network C. Sleep and circadian rhythm in response to the COVID-19 pandemic. *Can J Public Health*. 2020;111(5):654–657. doi:10.17269/s41997-020-00382-7
44. Jahrami H, BaHammam AS, Bragazzi NL, Saif Z, Faris M, Vitiello MV. Sleep problems during the COVID-19 pandemic by population: a systematic review and meta-analysis. *J Clin Sleep Med*. 2021;17(2):299–313. doi:10.5664/jcsm.8930
45. Perlman D, Peplau LA. Toward a social psychology of loneliness. *Pers Relatsh*. 1981;3:31–56.
46. Wakefield JR, Bowe M, Kellezi B, Butcher A, Groeger JA. Longitudinal associations between family identification, loneliness, depression, and sleep quality. *Br J Health Psychol*. 2020;25(1):1–16. doi:10.1111/bjhp.12391
47. McHugh JE, Lawlor BA. Perceived stress mediates the relationship between emotional loneliness and sleep quality over time in older adults. *Br J Health Psychol*. 2013;18(3):546–555. doi:10.1111/j.2044-8287.2012.02101.x
48. Santini ZI, Koyanagi A. Loneliness and its association with depressed mood, anxiety symptoms, and sleep problems in Europe during the COVID-19 pandemic. *Acta Neuropsychiatr*. 2021;33(3):160–163. doi:10.1017/neu.2020.48
49. Pai N, Vella S-L. The physical and mental health consequences of social isolation and loneliness in the context of COVID-19. *Curr Opin Psychiatry*. 2022;35(5):305–310. doi:10.1097/YCO.0000000000000806
50. Surkalim DL, Luo M, Eres R, et al. The prevalence of loneliness across 113 countries: systematic review and meta-analysis. *Br Med J*. 2022;376:e067068.
51. Grossman ES, Hoffman YS, Palgi Y, Shira A. COVID-19 related loneliness and sleep problems in older adults: worries and resilience as potential moderators. *Pers Individ Differ*. 2021;168:110371. doi:10.1016/j.paid.2020.110371
52. Grey I, Arora T, Sanah A. Generalized anxiety mediates the relationship between loneliness and sleep quality amongst young adults during the COVID-19 pandemic. *Psychol Rep*. 2023;126(5):2141–2157. doi:10.1177/00332941221079723
53. Tesen H, Konno Y, Tateishi S, et al. Association Between loneliness and sleep-related problems among Japanese workers during the COVID-19 Pandemic. *Front Public Health*. 2022;10:828650. doi:10.3389/fpubh.2022.828650
54. Xiao H, Zhang Y, Kong D, Li S, Yang N. Social capital and sleep quality in individuals who self-isolated for 14 days during the coronavirus disease 2019 (COVID-19) outbreak in January 2020 in China. *Med Sci Monit*. 2020;26:e923921. doi:10.12659/MSM.923921
55. Cheng C, Lau Y. Social media addiction during COVID-19-mandated physical distancing: relatedness needs as motives. *Int J Environ Res Public Health*. 2022;19(8):4621. doi:10.3390/ijerph19084621
56. Cheng C, Lau Y, Luk JW. Social capital–accrual, escape-from-self, and time-displacement effects of internet use during the COVID-19 stay-at-home period: prospective, quantitative survey study. *J Med Internet Res*. 2020;22(12):e22740. doi:10.2196/22740
57. Maestro-Gonzalez A, Sánchez-Zaballos M, Mosteiro-Díaz MP, Zuazua-Rico D. Quality of sleep among social media users during the lockdown period due to COVID-19 in Spain. *Sleep Med*. 2021;80:210–215. doi:10.1016/j.sleep.2021.01.050

58. Salfi F, Lauriola M, Amicucci G, Corigliano D, Viselli L, Tempesta D. Gender-related time course of sleep disturbances and psychological symptoms during the COVID-19 lockdown: a longitudinal study on the Italian population. *Neurobiol Stress*. 2020;13:100259. doi:10.1016/j.ynstr.2020.100259
59. Falkingham J, Evandrou M, Qin M, Vlachantoni A. "Sleepless in Lockdown": unpacking differences in sleep loss during the coronavirus pandemic in the UK. *MedRxiv*. 2020;2020:20157255.
60. Kocavska D, Blanken TF, Van Someren EJ, Rösler L. Sleep quality during the COVID-19 pandemic: not one size fits all. *Sleep Med*. 2020;76:86–88. doi:10.1016/j.sleep.2020.09.029
61. Silva-Costa A, Rotenberg L, Nobre AA, et al. Sex differences in the association between self-reported sleep duration, insomnia symptoms and cardiometabolic risk factors: cross-sectional findings from Brazilian longitudinal study of adult health. *Arch Public Health*. 2020;78(1):1–13. doi:10.1186/s13690-020-00429-8
62. Eastman CI, Tomaka VA, Crowley SJ. Sex and ancestry determine the free-running circadian period. *J Sleep Res*. 2017;26(5):547–550. doi:10.1111/jsr.12521
63. Zreik G, Asraf K, Haimov I, Tikotzky L. Maternal perceptions of sleep problems among children and mothers during the coronavirus disease 2019 (COVID-19) pandemic in Israel. *J Sleep Res*. 2021;30(1):e13201. doi:10.1111/jsr.13201
64. Cellini N, Di Giorgio E, Mioni G, Di Riso D. Sleep and psychological difficulties in Italian school-age children during COVID-19 lockdown. *J Pediatr Psychol*. 2021;46(2):153–167. doi:10.1093/jpepsy/jsab003
65. Ruppanner L, Tan X, Scarborough W, Landivar LC, Collins C. Shifting inequalities? Parents' sleep, anxiety, and calm during the COVID-19 pandemic in Australia and the United States. *Men Masc*. 2021;24(1):181–188. doi:10.1177/1097184X21990737
66. Aishworiya R, Lim MTC, Ramamurthy MB, Tran AP, Rajgor DD, Goh DYT. Impact of work routines on parents' and children's sleep during the COVID-19 pandemic lockdown. *Sleep Med*. 2021;88:61–67. doi:10.1016/j.sleep.2021.10.005
67. Luo F, Ghanei Gheshlagh R, Dalvand S, Saedmoucheshi S, Li Q. Systematic review and meta-analysis of fear of COVID-19. *Front Psychol*. 2021;12:661078. doi:10.3389/fpsyg.2021.661078
68. Hetkamp M, Schweda A, Bäuerle A, et al. Sleep disturbances, fear, and generalized anxiety during the COVID-19 shut down phase in Germany: relation to infection rates, deaths, and German stock index DAX. *Sleep Med*. 2020;75:350–353. doi:10.1016/j.sleep.2020.08.033
69. Fu W, Wang C, Zou L, et al. Psychological health, sleep quality, and coping styles to stress facing the COVID-19 in Wuhan, China. *Transl Psychiatry*. 2020;10(1):225. doi:10.1038/s41398-020-00913-3
70. Al Mamun F, Gozal D, Hosen I, Misti JM, Mamun MA. Predictive factors of insomnia during the COVID-19 pandemic in Bangladesh: a GIS-based nationwide distribution. *Sleep Med*. 2022;91:219–225. doi:10.1016/j.sleep.2021.04.025
71. Quadros S, Garg S, Ranjan R, Vijayasarithi G, Mamun MA. Fear of COVID 19 infection across different cohorts: a scoping review. *Front Psychiatry*. 2021;12:708430. doi:10.3389/fpsyg.2021.708430
72. Yuan K, Zheng Y-B, Wang Y-J, et al. A systematic review and meta-analysis on prevalence of and risk factors associated with depression, anxiety and insomnia in infectious diseases, including COVID-19: a call to action. *Mol Psychiatry*. 2022;27(8):3214–3222. doi:10.1038/s41380-022-01638-z
73. Islam SD-U, Safiq MB, Bodrud-Doza M, Mamun MA. Perception and attitudes toward PPE-related waste disposal amid COVID-19 in Bangladesh: an exploratory study. *Front Public Health*. 2020;8:592345. doi:10.3389/fpubh.2020.592345
74. Hosen I, Pakpour AH, Sakib N, Hussain N, Al Mamun F, Mamun MA. Knowledge and preventive behaviors regarding COVID-19 in Bangladesh: a nationwide distribution. *PLoS One*. 2021;16(5):e0251151. doi:10.1371/journal.pone.0251151
75. Liu X, Kakade M, Fuller CJ, et al. Depression after exposure to stressful events: lessons learned from the severe acute respiratory syndrome epidemic. *Compr Psychiatry*. 2012;53(1):15–23. doi:10.1016/j.comppsy.2011.02.003
76. Caruso CC. Negative impacts of shiftwork and long work hours. *Rehabilitat Nurs*. 2014;39(1):16–25. doi:10.1002/rnj.107
77. Koinis A, Giannou V, Drantaki V, Angelaina S, Stratou E, Saridi M. The impact of healthcare workers job environment on their mental-emotional health. Coping strategies: the case of a local general hospital. *Health Psychol Res*. 2015;3(1). doi:10.4081/hpr.2015.1984
78. Yilmaz Y, Erdogan A, Bahadır E. Fear, anxiety, burnout, and insomnia levels of healthcare workers during COVID-19 pandemic in Turkey. *Psychiatry Danub*. 2021;33(suppl 13):350–356.
79. Fiorillo A, Gorwood P. The consequences of the COVID-19 pandemic on mental health and implications for clinical practice. *Eur Psychiatry*. 2020;63(1):e32. doi:10.1192/j.eurpsy.2020.35
80. Zangeneh Soroush M, Tahvilian P, Koohestani S, et al. Effects of COVID-19-related psychological distress and anxiety on quality of sleep and life in healthcare workers in Iran and three European countries. *Public Health Front*. 2022;10:997626. doi:10.3389/fpubh.2022.997626
81. Hasen AA, Seid AA, Mohammed AA. Anxiety and stress among healthcare professionals during COVID-19 in Ethiopia: systematic review and meta-analysis. *Br Med J*. 2023;13(2):e070367.
82. Zhan Y, Liu Y, Liu H, et al. Factors associated with insomnia among Chinese front-line nurses fighting against COVID-19 in Wuhan: a cross-sectional survey. *J Nurs Manag*. 2020;28(7):1525–1535. doi:10.1111/jonm.13094
83. Lu MY, Ahorsu DK, Kukreti S, et al. The prevalence of post-traumatic stress disorder symptoms, sleep problems, and psychological distress among COVID-19 frontline healthcare workers in Taiwan. *Front Psychiatry*. 2021;12:705657. doi:10.3389/fpsyg.2021.705657
84. Maher MJ, Rego SA, Asnis GM. Sleep disturbances in patients with post-traumatic stress disorder: epidemiology, impact and approaches to management. *CNS Drugs*. 2006;20(7):567–590. doi:10.2165/00023210-200620070-00003
85. Husain AM, Miller PP, Carwile ST. REM sleep behavior disorder: potential relationship to post-traumatic stress disorder. *J Clin Neurophysiol*. 2001;18(2):148–157. doi:10.1097/00004691-200103000-00005
86. Hong S, Kim H, Park MK. Impact of COVID-19 on post-traumatic stress symptoms in the general population: an integrative review. *Int J Ment Health Nurs*. 2021;30(4):834–846. doi:10.1111/inm.12875
87. Li W, Zhao Y-J, Zhang S-F, et al. Mapping post-traumatic stress disorder symptoms and quality of life among residents of Wuhan, China after the COVID-19 outbreak: a network perspective. *J Affect Disord*. 2022;318:80–87. doi:10.1016/j.jad.2022.08.074
88. Straus LD, Dolsen EA, Nishimi K, Neylan TC, O'Donovan A. Worse sleep, worsening post-traumatic stress disorder (PTSD): poor sleep quality associated with increases in PTSD symptoms amongst those experiencing high threat of the COVID-19 pandemic. *J Sleep Res*. 2022;31(5):e13568. doi:10.1111/jsr.13568

89. Cheng C. Time-series associations between public interest in COVID-19 variants and national vaccination rate: a Google Trends analysis. *Behav Sci.* **2022**;12(7):223. doi:10.3390/bs12070223
90. Orzech KM, Grandner MA, Roane BM, Carskadon MA. Digital media use in the 2 h before bedtime is associated with sleep variables in university students. *Comput Hum Behav.* **2016**;55:43–50. doi:10.1016/j.chb.2015.08.049
91. Kadam AB, Atre SR. Negative impact of social media panic during the COVID-19 outbreak in India. *J Travel Med.* **2020**;27(3):taaa057. doi:10.1093/jtm/taaa057
92. Cheng C, Ebrahimi OV, Luk JW. Heterogeneity of prevalence of social media addiction across multiple classification schemes: latent profile analysis. *J Med Internet Res.* **2022**;24(1):e27000. doi:10.2196/27000
93. Sultana A, Tasnim S, Hossain MM, Bhattacharya S, Purohit N. Digital screen time during the COVID-19 pandemic: a public health concern. *F1000Res.* **2021**;10:81. doi:10.12688/f1000research.50880.1
94. Smith L, Jacob L, Trott M, et al. The association between screen time and mental health during COVID-19: a cross sectional study. *Psychiatry Res.* **2020**;292:113333. doi:10.1016/j.psychres.2020.113333
95. Lin C-Y, Broström A, Griffiths MD, Pakpour AH. Investigating mediated effects of fear of COVID-19 and COVID-19 misunderstanding in the association between problematic social media use, psychological distress, and insomnia. *Internet Interv.* **2020**;21:100345. doi:10.1016/j.invent.2020.100345
96. Ornell F, Schuch JB, Sordi AO, Kessler FHP. “Pandemic fear” and COVID-19: mental health burden and strategies. *Bras J Psychiatry.* **2020**;42(3):232–235. doi:10.1590/1516-4446-2020-0008
97. Zarocostas J. How to fight an infodemic. *Lancet.* **2020**;395(10225):676. doi:10.1016/S0140-6736(20)30461-X
98. Sharma M, Yadav K, Yadav N, Ferdinand KC. Zika virus pandemic—analysis of Facebook as a social media health information platform. *Am J Infect Control.* **2017**;45(3):301–302. doi:10.1016/j.ajic.2016.08.022
99. Househ M. Communicating Ebola through social media and electronic news media outlets: a cross-sectional study. *J Health Inform.* **2016**;22(3):470–478. doi:10.1177/1460458214568037
100. Mohammed M, Sha’aban A, Jatau AI, et al. Assessment of COVID-19 information overload among the general public. *J Racial Ethn Health Disparities.* **2021**;8(1):1–9. doi:10.1007/s40615-020-00905-5
101. Miceli M, Castelfranchi C. Anxiety as an “epistemic” emotion: an uncertainty theory of anxiety. *Anxiety Stress Coping.* **2005**;18(4):291–319. doi:10.1080/10615800500209324
102. Ying W, Cheng C. Public emotional and coping responses to the COVID-19 infodemic: a review and recommendations. *Front Psychiatry.* **2021**;2319:755938. doi:10.3389/fpsy.2021.755938
103. Thomas J, Kulkarni P, Kumar D, Prakash B, Murthy M. COVID-19 infodemic: unveiling the root causes through public perspectives. *Int J Health Allied Sci.* **2020**;9(5):31. doi:10.4103/ijhas.IJHAS\_94\_20
104. Naeem SB, Bhatti R. The Covid-19 “infodemic”: a new front for information professionals. *Health Info Libr J.* **2020**;37(3):233–239. doi:10.1111/hir.12311
105. Geldsetzer P. Knowledge and perceptions of COVID-19 among the general public in the United States and the United Kingdom: a cross-sectional online survey. *Ann Intern Med.* **2020**;173(2):157–160. doi:10.7326/M20-0912
106. Cheng C, Lau H-PB, Chan M-PS. Coping flexibility and psychological adjustment to stressful life changes: a meta-analytic review. *Psychol Bull.* **2014**;140(6):1582. doi:10.1037/a0037913
107. Miller SM. Monitoring and blunting of threatening information: cognitive interference and facilitation in the coping process. In: *Cognitive Interference*. Routledge; **2014**:175–190.
108. O’reagan D, Jackson ML, Young AH, Rosenzweig I. Understanding the impact of the COVID-19 pandemic, lockdowns and social isolation on sleep quality. *Nat Sci Sleep.* **2021**;Volume 13:2053–2064. doi:10.2147/NSS.S266240
109. Ganie AUR, Mukhter I. Misinformation induced anxieties and fear affecting vaccination programs: challenge for COVID-19 vaccination program. *J Family Med Prim Care.* **2022**;11(1):405. doi:10.4103/jfmpe.jfmpe\_1520\_21
110. Banerjee D, Rao TS. Psychology of misinformation and the media: insights from the COVID-19 pandemic. *Indian J Soc Psychiatry.* **2020**;36(Suppl 1):S131–S137. doi:10.4103/ijsp.ijsp\_112\_20
111. Krishnan N, Gu J, Tromble R, Abroms LC. Research note: examining how various social media platforms have responded to COVID-19 misinformation. *HKS Misinf Rev.* **2021**;2(6):1–25.
112. Livingstone S, Burton P, Cabello P, et al. Media and information literacy among children on three continents: insights into the measurement and mediation of well-being. In: Grizzle A, Jaakkola M, Durán-Becerra T, editors. *MIL Cities and MIL Citizens: Informed, Engaged, Empowered by Media and Information Literacy (MIL)*. Minuto de Dios University Corporation; **2021**:90–103.

## Nature and Science of Sleep

Dovepress

## Publish your work in this journal

Nature and Science of Sleep is an international, peer-reviewed, open access journal covering all aspects of sleep science and sleep medicine, including the neurophysiology and functions of sleep, the genetics of sleep, sleep and society, biological rhythms, dreaming, sleep disorders and therapy, and strategies to optimize healthy sleep. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <https://www.dovepress.com/nature-and-science-of-sleep-journal>