Alterations in Sleep Cycle among Nonhospitalized COVID-19-Affected Population during the Pandemic in Karnataka State—A Web-Based Study

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Abstract

Objectives   The psychological and physiological distress and social isolation could adversely affect sleep. As sleep disturbances may persist and deteriorate health, it is important to assess prevalence and related factors of sleep disturbances among the residents of Karnataka state during the coronavirus disease 2019 (COVID-19) infection.

Methods   In this study, 250 responders across the state of Karnataka accessed the survey voluntarily during September 2021 and January 2022. Pittsburgh Sleep Quality Index, Insomnia Severity Index scales, features that are related to sleep quality, and some hypothesized risk factors of sleep disturbances in context of COVID-19 infection are employed to format a self-reported questionnaire.

Results   In this study, females 27(19.1%) experienced more sleep disturbances than males 9 (8.3%). The study revealed the participants who received both the doses of vaccination (126; 54.3%) had better sleep. The participants who reported themselves to be stressed (182; 72.8%) had more disturbances in sleep. A total number of 45 participants (18.4%) experienced difficulty in breathing and out of all the responders 11 (47.8%) were actually worried about their current sleep problem.

Conclusion   COVID-19 infection and changes imposed during the pandemic have led to a surge in individuals reporting sleep problems across the globe. The findings raise the need to screen for worsening sleep patterns to create more awareness about the secondary consequences of COVID-19 infection.

Keywords
► COVID-19
► pandemic
► sleep
► stress
► web-based
► mental health
► anxiety
► insomnia

Introduction

The unprecedented coronavirus disease 2019 (COVID-19) outbreak in December 2019 soon evolved into a global pandemic, affecting governments all over the world, which enforced social isolation measures to halt the disease's spread. Home confinement, combined with the uncertainty of the epidemic, resulted in significant changes in people's lives, impacting social interaction, work, school, physical exercise, and sleep.[1] During a 24-hour cycle, sleep occurs once. Wakefulness develops cyclically to non-rapid eye movement (NREM) sleep and subsequently to REM sleep during this sleep interval that having followed by a REM sleep period, there are brief episodes of arousal or awakening. Over the course of the night, the cycle of NREM to REM sleep typically lasts 80 to 110 minutes. In a typical sleep

cycle, humans will experience four to six of these cycles.[2] Poor sleep quality is associated with cardiovascular and coronary heart disease,[3] obesity,[4] chronic kidney disease, and poor mental health[5] with various sleep disturbances linked to suicidality, independently from the underlying psychiatric morbidities.[6] Stressful life events play a major role in the pathogenesis of sleep disturbances, combined with predisposing factors of personal vulnerability. During times of stress, existing sleep disturbances may be exacerbated and new ones may emerge.[7]

Fear is an adaptive defense mechanism that is essential for survival. It entails many biological processes that prepare the body for a response to potentially dangerous situations. When it is unbalanced, however, it becomes detrimental and can lead to a multitude of psychological illnesses.[8] In the event of a pandemic, fear increases anxiety, stress, and insomnia in healthy people while aggravating the symptoms of those with preceding psychiatric problems.[9] Aside from anxiety, fear, and stress, improvements in our daily activities such as waking up at a definite time, heading to work, eating well, exercising, and engaging in social and leisure activities at significantly regular times are all vital to maintain sleep-wake cycles synchronized with the day (light) and night (dark) cycles. Modifications to those timekeepers, combined with decreased sunshine exposure, which is also required to keep our biological clock synced, are likely to disrupt sleep and circadian cycles.[10]

The COVID-19 pandemic has boundless and far-flung physiological and psychological implications. Considering sleep is linked to improved mood,[11] immune function,[12] and physical health,[13] adequate sleep is expected to be critical during the COVID-19 pandemic. Under these circumstances, public health education is essential to raise public awareness about the importance of sleep and proper sleeping habits to combat the epidemic and avoid or mitigate long-term detrimental repercussions.

Our study focused on the most common sleep disturbances among COVID-19 infected population in Karnataka based on quality or timing of sleep that could be associated with secondary consequences of COVID-19 pandemic.

Methods

Study Design and Participants
A self-reported web survey was employed to obtain the data. The objective of this web-based poll was to get as many people to participate as possible. Thus, rather than using formal psychological tools to respond to inquiries concerning sleep disorders or anxiety, we developed a self-reporting questionnaire to keep the questionnaire simple and clear for the respondents, as well as to shorten the interview period. The questionnaire covered parameters that have been relevant to sleep quality in prior studies.[14–16] The questionnaire also included several suspected risk factors for sleep disruptions in the context of COVID-19 infection and a revised normal life of the society. Pittsburgh Sleep Quality Index and Insomnia Severity Index

scales are used to measure the quality of sleep among the population.

1. The survey questionnaire was sent throughout the Internet, accompanied with an informed consent form, across multiple social networking and messaging sites including WhatsApp, Facebook, email, and SMS. People who intended to participate answered the questionnaire by clicking on the appropriate link. From September 2021 to January 2022, participants submitted the questionnaire over the Internet. Non-hospitalized COVID-19-affected patients over the last 5 months aged between 21 and 50 years were, both male and female, were included. Both vaccinated and nonvaccinated COVID-19-affected patients were also included. Patients with any systemic disease, known case of any sleep disorders like obstructive sleep apnea/insomnia or under sleep medication, known cases of psychological disorders or under any psychotropic drugs, and pregnant and lactating mothers were excluded.

Data Collection
Participants submitted online questionnaire from September 2021 to January 2022. All participants provided demographic information, COVID-19 information, and sleep quality queries. A total of 250 participants responded to the survey.

Variables were assessed and measured.

Demographic and Other Personal Information
Demographic variables included name, age, gender, occupation, medical history along with history of sleep disorders and medications, and vaccination history.

Information Regarding COVID-19 Infection Period
Individuals were questioned regarding array of aspects during their COVID-19 infection period that included their psychological status on the day they were tested positive, whether they were stressed about the situation in the country, sun exposure, oxygen levels during the infected period.

Information Regarding Sleep
The questionnaire included information regarding their usual bed time during the period of infection; whether there was any change in the time taken to fall asleep after going to bed during that period and if so whether the problem resolved after recovery; how they managed to sleep if they had trouble sleeping, whether the disturbance in sleep interfered with their daily functioning, whether they had perspirations, difficulty in breathing, increased heart rate; and finally how worried they were in regard to this disturbance in sleeping.

Statistical Analysis
The distribution of the population's demographic features was assessed using descriptive statistical methods. The chi-square test was then performed to discover connections between independent variables and sleep disruption. At 95% confidence level and 85% power, sample size comes
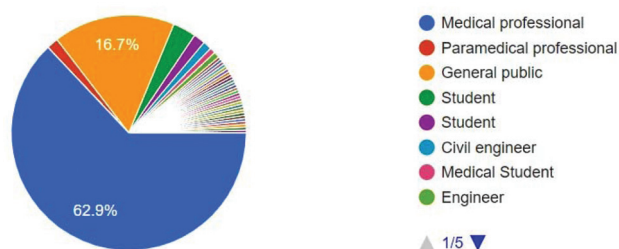
was calculated to be a minimum of 250. A statistical package SPSS version 23.0 was used to do the analysis. $p < 0.05$; was considered to be statistically significant.

Results

In the present survey of 250 participants, 152 (60.8%) were under the mean age group of 21 to 25 years, 141 (56.4%) were females and 109 (43.6%) were males. A majority of 162 participants (64.8%) were medical and paramedical professionals with 42 (16.7%) general public and 9 (3.6%) engineers (►Fig. 1).

In relation to the demographic characteristics like age, there were no statistically significant results observed in relation to sleep disturbances; whereas the study reported females experiencing more sleep disturbances with 27 participants (19.1%) reporting fairly bad and 11 (7.8%) reporting very bad sleep during the COVID-19 infection. On the other hand, only 9 (8.3%) and 5 (4.6%) males reported fairly bad and very bad sleep, respectively, which is statistically significant ($p = 0.03$; ►Table 1).

The study also included the history regarding vaccination that reported out of 232 participants who received both the doses of vaccination, 126 (54.3%) had fairly good and 60 (25.9%) had very good sleep even during the infection stage, while 8 (57.1%) and 2 (14.3%) of participants who received only the first dose reported fairly good and very good sleep respectively. Out of the total participants, there were only four participants who did not receive vaccination in which two (50.0%) participants had very bad, one (25%) had fairly good, and one (25%) had very good sleep patterns during the COVID-19 infection, which is statistically significant ($p = 0.024$; ►Table 2, ►Fig. 2).

The study revealed that 182 participants (72.8%) were stressed about the pandemic situation in the country in which 14 (7.7%) participants had very bad and 30 (16.5%) had fairly bad sleep, which is statistically highly significant ($p < 0.001$; ►Table 3).

A total number of 45 participants (18.4%) experienced difficulty in breathing ($p = 0.02$; ►Fig. 3) and 43 participants (17.2%) had perspirations and tachycardia while sleeping. A majority of 112 (44.8%) participants reported their usual bed time at night around 10 pm to 12am. Fortunately, 154 (61.6%) had 6 to 8 hours of minimum sleep, although a small number of 19 participants (7.6%) had 1 to 3 hours and 10 participants (4.0%) reported less than 1 hour of sleep (►Fig. 4).

When the participants were asked how worried were they about their current sleep problem, 11 (47.8%) participants who had very bad sleep and 4 (17.4%) who had fairly bad sleep during the COVID-19 infection phase reported that they were very much worried about it which is statistically very highly significant ($p < 0.0014$; ►Table 4, ►Fig. 5).

Discussion

To the authors' knowledge, this is the first study to explore the prevalence and characteristics of sleep disorders in the residents of Karnataka who were infected during the outbreak of COVID-19.

Our findings did not support the notion that certain age groups are more susceptible to sleep disorders, which contradicts the findings of Cardinali et al,[17] but direct comparison is difficult due

Fig. 1 Pie chart showing population of different occupations participated in the survey.

Table 1 Crosstabulation between how would you personally rate your sleep quality since the COVID-19 pandemic versus gender

|		Female	Male	Total
Very bad	Count	11	5	16
	%	7.80%	4.60%	6.40%
Fairly bad	Count	27	9	36
	%	19.10%	8.30%	14.40%
Fairly good	Count	74	61	135
	%	52.50%	56.00%	54.00%
Very good	Count	29	34	63
	%	20.60%	31.20%	25.20%
Total	Count	141	109	250
	%	100%	100%	100%

Abbreviation: COVID-19, coronavirus disease 2019.
$X2 = 8.949$, $p = 0.03$ sig.

Table 2 Crosstabulation between questions how would you personally rate your sleep quality since the COVID-19 pandemic versus have you been vaccinated?

		Have you been vaccinated?			Total
		No	Yes, but just the 1st dose	Yes, completely vaccinated	
Very bad	Count	2	1	13	16
	%	50.00%	7.10%	5.60%	6.40%
Fairly bad	Count	0	3	33	36
	%	0.00%	21.40%	14.20%	14.40%
Fairly good	Count	1	8	126	135
	%	25.00%	57.10%	54.30%	54.00%
Very good	Count	1	2	60	63
	%	25.00%	14.30%	25.90%	25.20%
Total	Count	4	14	232	250
	%	100%	100%	100%	100%

Abbreviation: COVID-19, coronavirus disease 2019.
$X^2 = 14.539$, $p = 0.024$ sig.
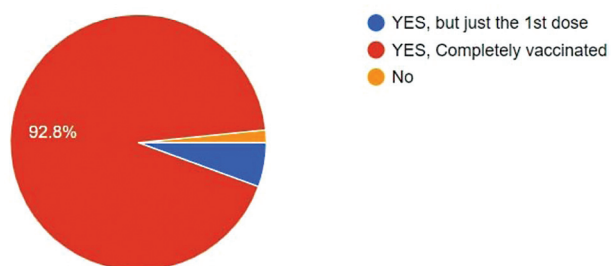
Fig. 2 Pie chart showing population vaccinated against coronavirus disease 2019 infection.

to changes in the research population. The study discovered that females were more likely to suffer from sleep disorders, which is consistent with the findings of Gualano et al.[18] The triple burden of women is reflected in the basic sectors of production, reproductive, and community service.[19] Women's workload and capacity to balance their time are mostly affected by disease crisis, disasters, and outbreaks.[20] The significant presence of anxiety and a heavier burden in the household enhance female stress, which may result in a higher incidence of sleep disturbance.

According to the findings of this study, the sleeping schedule had a statistically significant impact on the prevalence of sleep disturbances in favor of participants who

Table 3 Crosstabulation between how would you personally rate your sleep quality since the COVID-19 pandemic versus were you stressed about the situation in the country?

		Were you stressed about the situation in the country?		
		Yes	No	Total
Very bad	Count	14	2	16
	%	7.70%	2.90%	6.40%
Fairly bad	Count	30	6	36
	%	16.50%	8.80%	14.40%
Fairly good	Count	107	28	135
	%	58.80%	41.20%	54.00%
Very good	Count	31	32	63
	%	17.00%	47.10%	25.20%
Total	Count	182	68	250
	%	100%	100%	100%

Abbreviation: COVID-19, coronavirus disease 2019.
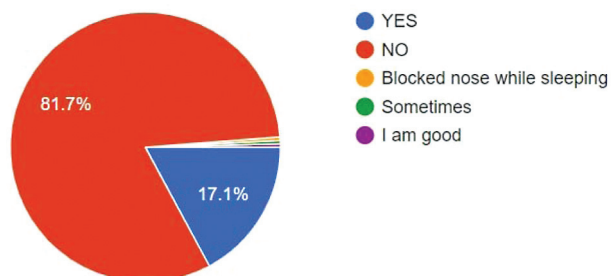$X^2 = 24.318$, $p < 0.001$, vhs: very highly significant.

slept less than 3 hours per night, which is consistent with the findings of studies conducted by Cao et al[21] and Wang et al.[22] Our study found a statistically significant relation between observed apnea during sleeping in COVID-19-infected population that is in accordance with Partinen et al. They conducted an international COVID-19 sleep study, which was undertaken to analyze issues such as REM sleep, sleep apnea, exhaustion, insomnia, nightmares

Fig. 3 Pie chart showing population who experienced difficulty in breathing during sleeping in coronavirus disease 2019 infection.

Fig. 4 Pie chart showing number of hours of sleep the participants had during their coronavirus disease 2019 infection period. OSA, obstructive sleep apnea.

and discovered a link between COVID-19 infection and psychiatric and other physiological distress.[23]
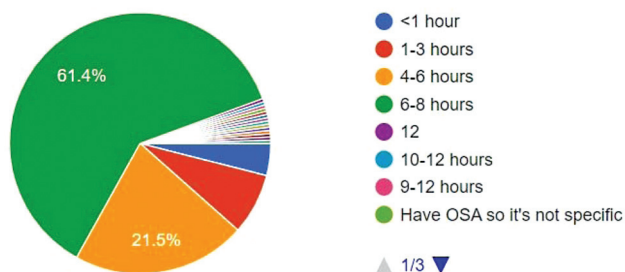
Furthermore, this study demonstrated that the participants' awareness of the severity of the pandemic resulted in stress and anxiety, affecting sleep quality, which is in accordance with the findings of Moldofsky and Patcai,[24] Morin and Carrier,[1] Proserpio et al.[25] The participants who received immunizations also slept better, according to the study. Despite the fact that the results of several studies were inconsistent, they were consistent with the findings of Nguyen, who found that vaccination had a positive influence on an individual's psychological well-being, which may be responsible for favorable sleep patterns.[26]

Insomnia complaints included difficulty falling asleep and waking up during the night. Circadian rhythm-related complaints included falling asleep at a later-than usual time and working up earlier or later than usual time and waking up earlier or later than the desired time. Daytime dysfunction complaints included feeling unrefreshed in the morning, needing to take a nap, or feeling tired during the day.[27] We found that in those reporting worsened sleep, 16.7% had trouble sleep when they were isolated, 19.5% participants reported that it took more than 30 minutes to fall asleep after going to bed during the isolation period, 17.1% participants reported waking up between the sleep due to many reasons like difficulty in sleeping, 16.7% reported sweats and increased heart rate, and 21.1% of participants reported interference in the daily functioning due to this sleep problems. But as the survey dealt with acute changes following the pandemic, the complaints did not fulfil the 3-month chronicity criterion for classification as a disorder.

Perceived sleep quality, which constitutes an important dimension of a healthy sleep, can be influenced by anxiety, stress, and hyperarousal[28] all of which were prevalent in the current crisis. In our study, 21.5% felt anxious, 20.7% felt nervous, and 12.4% were depressed on the day they were tested COVID-19 positive and 20.3% of the participants were

Table 4 Crosstabulation between questions how would you personally rate your sleep quality since the COVID-19 pandemic versus how worried are you about this current sleep problem?

		How worried are you about this current sleep problem?				
		Not at all worried	A little	Somewhat	Very much worried	Total
Very bad	Count	2	2	1	11	16
	%	1.90%	2.90%	1.90%	47.80%	6.40%
Fairly bad	Count	2	17	13	4	36
	%	1.90%	24.30%	24.10%	17.40%	14.40%
Fairly good	Count	53	40	35	7	135
	%	51.50%	57.10%	64.80%	30.40%	54.00%
Very good	Count	46	11	5	1	63
	%	44.70%	15.70%	9.30%	4.30%	25.20%
Total	Count	103	70	54	23	250
	%	100%	100%	100%	100%	100%

Abbreviation: COVID-19, coronavirus disease 2019.
$X^2 = 118.673$, $p < 0.0014$ vhs.
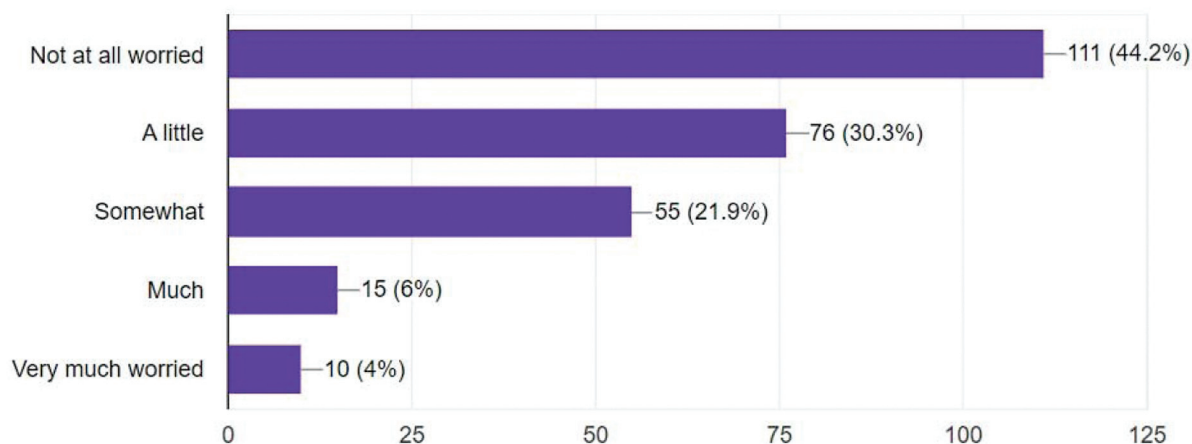
Fig. 5 Bar graph showing how much the participants were worried about their sleep problem.

stressed about the situation in the country. But our findings underscore the fact that adequate sleep duration does not guarantee healthy sleep. We did not collect much data on psychological distress and thus cannot link sleep quality to anxiety directly in our study.

Limitations and Strengths of the Study

The findings of the study should be interpreted in perspective of the study's design and restrictions. Since considering personal interviews was not possible due to COVID-19 confinement constraints, the study relied on a web-based nonprobabilistic convenience sampling method. Establishing a nationwide representative sample using a web-based poll, on the other hand, is always tricky. The study can only point to associations because it is cross-sectional. A more reliable design, such as case–control or cohort, is advised to confirm causation and generality.

The study was simple, with strictly delineated divisions and no official psychiatric inquiry, allowing respondents to finish the survey swiftly. People were approached using a range of digital media, making the survey more accessible. Despite its flaws, the study focuses at a crucial topic of mental health and related diseases such as sleeping disorders, which have been highlighted as one of the pandemic's secondary consequences. To the best of researcher's knowledge, this is the earliest study in Karnataka state that examines the relationship between sleep disorders and characteristics linked with COVID-19-induced isolation.

Conclusion

Fortunately, the government has implemented several comprehensive national measures to prevent the COVID-19 outbreak from spreading further. The public's psychological issues during the COVID-19 pandemic, on the other hand, are still being disregarded. This study examines the prevalence of sleep disturbance as a critical manifestation of major depression to fill this research deficit. We hope that this paradigm will assist policymakers in establishing government programs to diagnose and treat mental health illnesses as a result of the

pandemic's secondary effects. This study could be exploited to continue researching the influence of the pandemic on mental health and sleep quality in the future.

Conflict of Interest
None declared.

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