Original Article

Sleep quality and mental health in coronavirus disease 2019 patients and general population during the pandemic

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Abstract:

OBJECTIVE: Sleep problems during the coronavirus disease 2019 (COVID-19) pandemic commonly affected general populations. Data on the effect of the COVID-19 pandemic on sleep quality in Saudi Arabia are scarce. Thus, the aim of our study was to evaluate sleep quality and assess the psychological burden of the pandemic in COVID-19 patients and the general population.

METHODS: This was a multicenter, observational, cross-sectional survey. Participants with COVID-19 were recruited from different health-care centers in the western region during the lockdown period from May 13, 2020 to September 2, 2020. All participants completed a validated online survey. The control group comprised individuals from the general public who responded to the online survey through social media. Demographic data, COVID-19 status, and history of chronic diseases were collected. Sleep quality, depression, and insomnia were assessed using validated questionnaires.

RESULTS: In total, 1091 participants were surveyed and 643 (58.9%) were positive for COVID-19. Poor sleep quality was reported in 66.1% of COVID-19 patients (mean score ± standard deviation [SD] 6.9 ± 4.0) and 72.8% of controls (mean score ± SD 7.6 ± 4.3). Insomnia affected 50.5% of COVID-19 patients (mean score ± SD 6.5 ± 5.5) and 58.5% of controls (mean score ± SD 7.6 ± 5.5). Depression was diagnosed in 39.5% of COVID-19 patients (mean score ± SD 4.7 ± 4.6) and 70.1% of controls (mean score ± SD 8.9 ± 6.7).

CONCLUSIONS: The COVID-19 pandemic had a great impact on mental health and sleep quality in both COVID-19 patients and the general population but more pronounced in the general population.

Keywords:

Coronavirus disease 2019, depression, insomnia, sleep quality

At the end of 2019, a surge in atypical pneumonia cases occurred in the City of Wuhan, China. The causative pathogen was acute respiratory syndrome coronavirus 2, which causes coronavirus disease 2019 (COVID-19).[1] The virus spread at an alarming rate, which led the World Health Organization to declare the novel coronavirus outbreak a "Public Health Emergency of International Concern" in January 2020 and a global pandemic in March 2020.[2]

The first case in Saudi Arabia was confirmed by the Ministry of Health (MOH) on the March 02, 2020.[3] In the ensuing months, the Kingdom of Saudi Arabia recorded

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the highest number of active cases among the Gulf Arab states. At the time of this study, 318,319 cases of COVID-19 were confirmed in the Kingdom with 293964 (92.3%) recoveries and 3929 succumbing to the disease (case-fatality rate 1.2%).[4]

The early detection of cases through surveillance and contact tracing helped contain the outbreak.[5] Different control measures to contain the COVID-19 outbreak were implemented in Saudi Arabia. These included enforcement of social distancing rules, case isolation, contact tracing, country-wide lockdowns, and precautionary measures to limit the spread of infection.[6]

Such precautionary measures have had significant economic impacts and caused social disruptions in Saudi Arabia and across the world.[7] The pandemic has resulted in increased rates of mental disorders, including stress, anxiety, and depression.[8] A study conducted by Alkhamees *et al*.[9] showed that one-fourth of the general population in Saudi Arabia experienced moderate-to-severe psychological impact during the early stages of the COVID-19 pandemic.

Clinical studies have shown that anxiety and depression have a detrimental effect on the quality of sleep.[10] Negative emotions may increase the sleep latency of individuals, making it difficult to establish sleep, increase nighttime and early awakenings, and increase dreaming. Thus, poor sleep efficiency and disruption of sleep structure ensues.[10]

Wu *et al*. reported that the COVID-19 pandemic increased mental health problems (depression, anxiety, distress and insomnia) of the global population, particularly health-care workers, noninfectious patients with chronic disease, COVID-19 patients, and quarantined persons.[10] Furthermore, Deng *et al*. conducted a systematic review and random effects meta-analysis to assess the prevalence of depression, anxiety, and sleep disturbances in COVID-19 patients. The present study found that the pooled prevalence of depression, anxiety, and sleep disturbances was 45%, 47%, and 34%, respectively, without significant differences in the prevalence estimates between different genders; however, depression and anxiety prevalence estimates varied based on different screening tools used.[11]

It is estimated that sleep disorders during the COVID-19 pandemic affected 40% of the general population. In particular, patients with confirmed COVID-19 and health-care workers had a higher prevalence of sleep disorders.[12,13] Moreover, sleep deprivation has negative consequences on physical and mental health.[14,15]

To our knowledge, data on the effect of the COVID-19 pandemic on sleep quality in Saudi Arabia are scarce. Thus, the objectives of our study were to evaluate sleep quality and assess the psychological burden of the pandemic on patients diagnosed with COVID-19 and the general population.

Methods

Design and setting

This study is an observational, cross-sectional survey conducted by trained physicians at different centers in the western region of Saudi Arabia. Demographic data: Age, gender, employment, COVID-19 diagnosis, and history of chronic disease were collected. Sleep quality, depression, and insomnia were assessed using validated questionnaires.

Participants

The study was carried out over a period of 16 weeks, from May 13, 2020, to September 2, 2020. Patients were diagnosed with COVID-19 if they tested positive on nasopharyngeal swab PCR testing. The COVID-19 group consisted of admitted COVID-19 patients at different hospitals in the Makkah region and patients who were isolated in hotels or at home by an order of the MOH. Both arms consisted of individuals older than 18 years of age who were recruited through an online questionnaire. Confirmed COVID-19 patients who were sedated and intubated in intensive care units were excluded. The other exclusion criterion was a previous diagnosis of sleep or mental disorders.

Sample size

A sample size of 612 was calculated based on these parameters for the comparison of two proportions: P1 = 0.56 (prevalence of poor sleep quality in the general Saudi population during COVID-19 pandemic);[16] P2 = 0.75 (prevalence of poor sleep quality in the COVID-19 patients) (10); ratio = 1; 0.99 confidence interval, and 0.99 power for a two-tailed test. As the study used a convenient sampling strategy, therefore, we recruited slightly higher number of participants in the study.

Instruments

Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) is an instrument used to assess the quality and pattern of sleep. Sleep is characterized as "poor" or "good" by evaluating seven domains: Subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction over the last month. Scoring of the answers is based on a 0–3 scale, with a higher

score indicating worse quality of sleep in that particular domain. An overall score higher than 5 indicates poor sleep quality.[17] The reliability of the PSQI (Cronbach's alpha: 0.76) was adequate in the study sample.

Patient Health Questionnaire 9

The Patient Health Questionnaire (PHQ-9) scale is a tool used to screen for major depressive disorder. It consists of nine questions, each scored from 0 to 3 points. Patients who score <4 points are unlikely to have depression. The lowest possible score is 0, and the highest is 27. Higher scores suggest more severe depression.[18] A total PHQ-9 score ≥5 represents depression; a score of 5–9 represents mild depression, a score of 10–14 represents moderate depressions, a score of 15–19 represents moderately severe depression, and a score of 20–27 represents severe depression. The reliability of the PHQ-9 (Cronbach's alpha: 0.89) was very good in this study sample.

Athens Insomnia Scale

The Athens Insomnia Scale (AIS) is a validated questionnaire that assesses insomnia severity. This eight-item questionnaire evaluates sleep onset, waking at night and early in the morning, sleep time, sleep quality, frequency and duration of complaints, distress caused by the experience of insomnia, and interference with daily functioning.[19] A total AIS score ≥6 represents insomnia. The reliability of the AIS (Cronbach's alpha: 0.88) was very good in this study sample.

Ethical approval

The study was approved by the Institutional Review Board of King Abdulaziz University Hospital. The study objectives and procedures were explained to eligible patients who were then invited to voluntarily participate after providing verbal consent.

Statistical analysis

Data entry and analysis were conducted using the Statistical Software Package SPSS version 25.0 (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY, USA. IBM Corp.). Data are presented using the descriptive statistics in the form of frequencies, percentages, means, and standard deviations, as all data were categorized as type and quantitative data. Analytical statistics were performed using the Chi-square tests (χ^2) to test for associations and/or differences between the categorical variables. We used the *t*-test for comparisons between positive and negative COVID-19 quantitative variables. Age was recorded as a continuous variable. It was also classified based on human developmental stages; young: 18–39 years, middle age: 40–64 years, and elderly: 65–88 years for performing multivariate analysis of variance (MANOVA).

A multi-factor MANOVA showing association of factors (all categorical variables: Age, gender (male/female), current employment status (yes/no), health worker (yes/no), and positive for COVID-19 symptoms (yes/no), location of treatment, and presence of chronic conditions) and their second order interaction effects on the combined dependent variable (PSQI score, PHQ-9 score, and AIS score) was performed. COVID-19 diagnosis (yes/no) was not included as an independent variable in the multifactor MANOVA because it was highly correlated to positive for COVID-19 symptoms (yes/no) ($r = 0.87$, $P < 0.01$). $P < 0.05$ was considered statistically significant.

Results

A total of 1091 participants were surveyed; 643 (58.9%) were COVID-19 patients. The mean age of the patients in the COVID-19 arm was 42.8 ± 15.2 years, with a male predominance of 61.1%. Approximately half were employed at the time of the study (53.3%), but only 18% worked in the health-care sector. The majority (58.1%) reported worsened sleep during the COVID-19 pandemic. One-third (30.2%) had a history of chronic disease, and the majority (88.3%) had symptoms related to COVID-19.

The mean age of participants in the control arm was 37.3 ± 11.8 years, with a slight male predominance of 52%. Most of them were employed (64.1%), and only 19.2% worked in the health-care sector. The majority (61.2%) reported worsened sleep during the COVID-19 pandemic. No participants had a history of chronic disease [Table 1].

Poor sleep quality was reported in 66.1% of the patients in the COVID-19 group (mean score of 6.9 ± 4.0) and 72.8% of participants in the control group (mean score 7.6 ± 4.3). Insomnia affected 50.5% of the patients with COVID-19 (mean score of 6.5 ± 5.5) and 58.5% of controls (mean score of 7.6 ± 5.5). Depression was diagnosed in 39.5% of COVID-19 patients (mean score of 4.7 ± 4.6) and 70.1% of controls (mean score of 8.9 ± 6.7). Among the participants diagnosed with depression in both arms, most had mild depression [Table 2].

Multifactor multivariate analysis of variance showing association of factors and their second order interaction effects on the combined dependent variable (Pittsburgh Sleep Quality Index score, Patient Health Questionnaire-9 score, and Athens Insomnia Scale score)

There was a statistically significant independent effect of age on the combined dependent variable (PSQI score, PHQ-9 score, and AIS score: Henceforth referred to

Table 1: Demographic data of the responders

	COVID–, *n* (%)	COVID+, *n* (%)	*t*-test or Chi-square test	
			t or χ^2	*P*
Age, range (mean±SD)	18-71 (37.3±11.8)	18-88 (42.8±15.2)	*t*=−6.4	<0.001*
Gender				
Male	233 (52)	393 (61.1)	χ^2=8.9	0.003*
Female	215 (48)	250 (38.9)		
Current employment	287 (64.1)	343 (53.3)	χ^2=12.4	<0.001*
Health sector employment	86 (19.2)	116 (18.0)	χ^2=0.2	0.6
Chronic diseases	-	194 (30.2)	-	-
Positive symptoms	-	568 (88.3)	-	-

*P-value < 0.05 is considered significant. Chronic diseases included hypertension, diabetes, and congestive heart failure positive symptoms included fever, cough, headache, and shortness of breath. SD=Standard deviation

as mental health), F (6, 1940) = 2.339, P = .03; Wilks' Λ = 0.986 [Table 3]. There was a statistically significant independent effect of place of treatment on the combined dependent variable (PSQI score, PHQ-9 score, and AIS score), F (9, 2360.88) = 3.369, $P \leq 0.001$; Wilks' Λ = 0.963.

Tests of between-subject's effects showed that age was significantly associated with the AIS score (F [2, 972] = 2.966; $P < 0.05$; partial $\eta 2 = 0.01$). Tests of between-subject's effects showed that female gender was significantly associated with the AIS score (F [1, 972] = 5.125; $P < 0.02$; partial $\eta 2 = 0.01$). Similarly, follow-up univariate ANOVA revealed that place of treatment was significantly associated with the PHQ-9 score (F [3, 972] = 6.551; $P < 0.001$; partial $\eta 2 = 0.02$). There was a statistically significant interaction effect between being a health worker and place of treatment with the PHQ-9 score, F (3, 972) = 2.651, $P < 0.05$; partial $\eta 2 = 0.01$.

Table 2: Prevalence of poor sleep quality, depression and insomnia in confirmed coronavirus disease-2019 patients and the control group

	COVID–, *n* (%)	COVID+, *n* (%)	*t*-test	
			t	*P*
PSQI				
Positive	326 (72.8)	425 (66.1)	2.8	0.005*
Mean±SD	7.6±4.3	6.9±4.0		
AIS				
Positive	262 (58.5)	325 (50.5)	3.4	0.001*
Mean±SD	7.6±5.5	6.5±5.5		
PHQ-9				
Positive	314 (70.1)	254 (39.5)	12.4	<0.001*
Mild	147 (46.8)	163 (64.2)		
Moderate	78 (24.8)	64 (25.2)		
Moderately severe	49 (15.6)	23 (9.1)		
Severe	40 (12.7)	4 (1.6)		
Mean±SD	8.9±6.7	4.7±4.6		

*P-value < 0.05 is considered significant.A global PSQI score ≥5 represents poor sleep quality, A total AIS score ≥6 represents insomnia, A total PHQ-9 ≥5 represents depression; a score of 5-9 represents mild depression, a score of 10-14 represents moderate depression, a score of 15-19 represents moderately severe depression, and a score of 20-27 represents severe depression. PSQI=Pittsburgh Sleep Quality Index, PHQ-9=Patient Health Questionnaire-9, AIS=Athens Insomnia Scale, SD=Standard deviation

Discussion

The COVID-19 outbreak has caused a global socioeconomic crisis and profound psychological distress.[8] At time of this study, more than 120 million cases had been registered, and more than 2.6 million patients had succumbed to the disease.[20] During the pandemic, sleep and mental disorders, including insomnia, stress, anxiety and depression, increased in the population.[12] In this prospective, cross-sectional study, the prevalence rates of poor sleep quality, insomnia, and depression were high among the study population (68.8%, 53.8%, and 52.1%, respectively). Interestingly, poor sleep quality, insomnia, and depression were significantly higher in the control group than in the COVID-19 group (72.8% vs. 66.1%, 58.5% vs. 50.5% and 70.1% vs. 39.5%, respectively).

Sleep quality in the general population during the pandemic may be compromised due to anxiety about becoming ill, and anxiety may be worsened by social isolation and fear of financial loss.[21] Our study concurs with this expectation and revealed high prevalence rates of poor sleep quality among COVID-19 patients (66.1%) and participants in the control group (72.8%). A study conducted on 7236 participants in China during the pandemic concluded that 18% of the general population experienced poor sleep quality.[22] In addition, patients with COVID-19 are expected to have reduced sleep quality due to symptoms associated with contracting the disease.[22] The reported poor sleep quality in our study was higher than that reported in China, which could be related to the time the study was conducted during the pandemic. Our study was conducted in the second half of 2020, while the Chinese study was carried out in early 2020 at the onset of the pandemic. Other reasons could be cultural differences in perceiving and coping with stress and measures adopted by governments to contain the pandemic. In another study in China, Zhao *et al*. concluded that anxiety associated with the COVID-19 pandemic deteriorated

Table 3: Multi-factor multivariate analysis of variance showing association of factors and their second order interaction effects on the combined dependent variable

Effect	Wilks' Λ value	*F* (exact statistics)	df effect	df error	Significant	Partial η^2
Age	0.986	2.339	6.000	1940.000	0.030	0.007
Gender	0.993	2.381	3.000	970.000	0.068	0.007
Presence of chronic diseases	0.998	0.759	3.000	970.000	0.517	0.002
Current employment status	0.998	0.400	6.000	1940.000	0.880	0.001
Health worker	1.000	0.152	3.000	970.000	0.929	0.000
Place of treatment	0.963	4.121	9.000	2360.876	<0.001	0.013
Positive symptoms	0.996	1.419	3.000	970.000	0.236	0.004
Health worker × place of treatment	0.979	2.331	9.000	2360.876	0.013	0.007

Only factors and significant second order interaction effects of factors are shown. PSQI=Pittsburgh Sleep Quality Index, PHQ-9=Patient Health Questionnaire-9, AIS=Athens Insomnia Scale, df=Degree of freedom

sleep quality among the general population and health-care workers.[23]

Although we found that the prevalence of insomnia was higher in the general population, it was generally high in both groups. In a cross-sectional study conducted on 2,427 participants in Greece during the pandemic, 37.6% of the general population surveyed reported insomnia, which was lower than that in our study (58.5%).[24] Taken together, these results indicate that the prevalence of insomnia seems to have increased considerably from prepandemic worldwide estimates that ranged from 3.9% to 22%;[25] this may be attributed to the persistent fear of contracting the virus, self-isolation, and unemployment.

In addition, more control participants (70.1%) than COVID-19 patients (39.5%) ($P < 0.05$) were found to have depression, and most had mild depression. Chronic stress could explain the higher prevalence of depression in the control group due to the upregulation of the sympathetic nervous system that occurs under conditions that induce chronic stress.[26] In a similar study conducted by Alamri *et al*. in Saudi Arabia during the pandemic, 1597 participants in the general population were surveyed using the Depression, Anxiety, and Stress Scale-21. They concluded that 17.1% of respondents reported moderate-to-severe depressive symptoms, 10% reported moderate-to-severe anxiety symptoms, and 12% reported moderate-to-severe stress levels.[27] Both our study and that published by Alamri *et al*.,[27] however, revealed a higher prevalence of depression than that published in the Saudi National Mental Health Survey (SNMHS) covering the 12 months before the pandemic (3.8%).[28]

Furthermore, an international study across 18 countries found that during the peak of the pandemic, the prevalence of symptoms of depression was high. Among almost 10,000 participants surveyed in the multination study, 25% of the sample reported that they did not enjoy doing certain things anymore, 33% reported boredom and nearly 50% reported that their time was being wasted. Interestingly, not all participants were affected, as 40% felt their mental state had improved. The authors concluded that this could be due to the collective feeling that "everybody is in it together."[29]

In our study, multi-factor MANOVA showed a statistically significant independent effect of age, and place of treatment on the combined dependent variable (PSQI score, PHQ-9 score, and AIS score). Age and female gender were significantly associated with insomnia based on AIS score. In addition, there was a statistically significant interaction effect between being a health worker and location of treatment with combined dependent variable (PSQI score, PHQ-9 score, and AIS score). Most patients in the COVID-19 group were young and middle aged (mean age ± standard deviation [SD] 42.8 ± 15.2) with a male predominance (61.2%). According to the SNMHS, young age along with female gender were the risk factors for developing anxiety and mood disorders.[28] This is similar to evidence from the United Kingdom Household Longitudinal Study, which concluded that the intersection of young age and female gender increased anxiety, depression, and sleep problems.[30]

A recently published meta-analysis during the COVID-19 pandemic found that approximately 40% of the general and health-care populations experienced sleep problems (insomnia, anxiety, stress, depression, and poor sleep quality). The present study found that patients with COVID-19 appeared to be the most affected group, with a pooled rate of sleep disorders of 74.8% (95% confidence interval [CI], 28.7%–95.6%).[12] They also concluded that the prevalence of sleep problems among the general population, comprising a total of 54,231 participants from 13 countries, was 32.3% (95% CI, 25.3%–40.2%), which is twice as high as the previously reported prevalence in the general population in China before the pandemic (15.0%, 95% CI, 12.1%–18.5%).[12,31]

Interestingly, we found that the location where COVID-19 patients received care was significantly correlated with poor sleep quality, depression and insomnia. This was illustrated by the significant positive relationship between the location of treatment and the

combined dependent variable. These findings could be related to pharmacotherapy and psychotherapy support available in hospitals, consistent wake/sleep schedules, and feeling less vulnerable having been cared for by medical personnel. The observed trend of poor mental health among patients isolating in hotels was pronounced because of increased poor sleep quality and insomnia symptoms. Although our results do not prove causation, they indicate that for better management of mental health, isolation in hotels may better be reconsidered by health-care authorities.

The strength of this study is that it is one of the first to assess sleep quality and mental health among patients with COVID-19 in the region and to our knowledge, the first to perform a head-to-head comparison between COVID-19 patients and the general population during the lockdown period. It would be interesting to conduct similar studies in the era of vaccination and after the pandemic period to determine the effect of preventive programs on sleep and mental health.

The limitations of the current study include its cross-sectional nature. Consequently, general inferences at a certain point in time can be made, although causation cannot be established. In addition, the data of health-care workers did not differentiate the nature of employment (frontline vs. nonfrontline health-care workers), and as such, the study did not investigate the effect of occupation on sleep and mental health. Additional studies are needed to determine which professions are most vulnerable.

Conclusions

The study findings have important clinical implications, as they indicate that both the general population and COVID-19 patients are affected and need psychosocial support. The general population had more depression and insomnia and poorer sleep quality than COVID-19 patients. Patients who isolated in hotels had worse sleep health than those isolating at home or in hospitals, and hence, isolation in hotels should be reconsidered by health-care authorities.

Further studies are required to identify the subpopulations most vulnerable to the effects of stress during the COVID-19 pandemic, and awareness of available psychological services to improve coping during this difficult time should be increased.

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Conflicts of interest
There are no conflicts of interest.

References

1. Zhu H, Wei L, Niu P. The novel coronavirus outbreak in Wuhan, China. Glob Health Res Policy 2020;5:6.
2. World Health Organization. Listings of WHO's Response to COVID-19. Report Coronavirus Disease (COVID-2019) Situation Reports [Internet]. WHO. 2020.
3. Ministry of Health (MOH) March 2, 2020. Saudi Arabia. MOH reports first case of coronavirus infection.https://www.moh.gov.sa/en/Ministry/MediaCenter/News/Pages/News-2020-03-02-002.aspx.
4. Ministry of Health. Sehaty. Available online: https://apps.apple.com/sa/app/%D8%B5%D8%AD%D8%AA%D9%8A-sehhaty/id1459266578?l=ar . [Last accessed on 2021 Aug 10].
5. Lee VJ, Chiew CJ, Khong WX. Interrupting transmission of COVID-19: Lessons from containment efforts in Singapore. J Travel Med 2020;27:taaa039.
6. Chen W, Wang Q, Li YQ, Yu HL, Xia YY, Zhang ML, *et al*. Early containment strategies and core measures for prevention and control of novel coronavirus pneumonia in China. Zhonghua Yu Fang Yi Xue Za Zhi 2020;54:239-44.
7. Shigemura J, Ursano RJ, Morganstein JC, Kurosawa M, Benedek DM. Public responses to the novel 2019 coronavirus (2019-nCoV) in Japan: Mental health consequences and target populations. Psychiatry Clin Neurosci 2020;74:281-2.
8. Serafini G, Parmigiani B, Amerio A, Aguglia A, Sher L, Amore M. The psychological impact of COVID-19 on the mental health in the general population. QJM: An International Journal of Medicine. 2020 Aug 1;113(8):531-7.
9. Alkhamees AA, Alrashed SA, Alzunaydi AA, Almohimeed AS, Aljohani MS. The psychological impact of COVID-19 pandemic on the general population of Saudi Arabia. Comprehensive psychiatry. 2020 Oct 1;102:152192.
10. Wu K, Wei X. Analysis of psychological and sleep status and exercise rehabilitation of front-line clinical staff in the fight against COVID-19 in China. Med Sci Monit Basic Res 2020;26:e924085.
11. Deng J, Zhou F, Hou W, Silver Z, Wong CY, Chang O, *et al*. The prevalence of depression, anxiety, and sleep disturbances in COVID-19 patients: A meta-analysis. Ann N Y Acad Sci 2021;1486:90-111.
12. 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;17:299-313.
13. Jahrami H, BaHammam AS, AlGahtani H, Ebrahim A, Faris M, AlEid K, *et al*. The examination of sleep quality for frontline healthcare workers during the outbreak of COVID-19. Sleep Breath 2021;25:503-11.
14. Grandner MA, Jackson NJ, Pak VM, Gehrman PR. Sleep disturbance is associated with cardiovascular and metabolic disorders. J Sleep Res 2012;21:427-33.
15. Mullington JM, Haack M, Toth M, Serrador JM, Meier-Ewert HK. Cardiovascular, inflammatory, and metabolic consequences of sleep deprivation. Prog Cardiovasc Dis 2009;51:294-302.
16. Alharbi AS, Alshahrani SM, Alsaadi MM, Al-Jahdali HH, Wali SO, BaHammam AS. Sleep quality and insomnia during the COVID-19 lockdown among the Saudi public: A cross-sectional study. Saudi Med J 2021;42:384-90.
17. Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The pittsburgh sleep quality index: A new instrument for psychiatric practice and research. Psychiatry Res 1989;28:193-213.
18. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: Validity of a brief depression severity measure. J Gen Intern Med 2001;16:606-13.
19. Soldatos CR, Dikeos DG, Paparrigopoulos TJ. The diagnostic validity of the Athens Insomnia Scale. J Psychosom Res 2003;55:263-7.

20. John Hopkins University of Medicine. Corona Virus Resource Center. John Hopkins University of Medicine; 2021.
21. Florea C, Topalidis P, Hauser T, Angerer M, Kurapov A, Beltran Leon CA, *et al.* Sleep during COVID-19 lockdown: A cross-cultural study investigating job system relevance. Biochem Pharmacol 2021;191:114463.
22. Huang Y, Zhao N. Mental health burden for the public affected by the COVID-19 outbreak in China: Who will be the high-risk group? Psychol Health Med 2021;26:23-34.
23. Zhao X, Lan M, Li H, Yang J. Perceived stress and sleep quality among the non-diseased general public in China during the 2019 coronavirus disease: A moderated mediation model. Sleep Med 2021;77:339-45.
24. Voitsidis P, Gliatas I, Bairachtari V, Papadopoulou K, Papageorgiou G, Parlapani E, *et al.* Insomnia during the COVID-19 pandemic in a Greek population. Psychiatry Res 2020;289:113076.
25. Kay-Stacey M, Attarian H. Advances in the management of chronic insomnia. BMJ 2016;354:i2123.
26. Won E, Kim YK. Stress, the autonomic nervous system, and the immune-kynurenine pathway in the etiology of depression. Curr Neuropharmacol 2016;14:665-73.
27. Alamri HS, Algarni A, Shehata SF, Al Bshabshe A, Alshehri NN, ALAsiri AM, *et al.* Prevalence of depression, anxiety, and stress among the general population in Saudi Arabia during Covid-19 pandemic. Int J Environ Res Public Health 2020;17:E9183.
28. Altwaijri YA, Al-Habeeb A, Al-Subaie AS, Bilal L, Al-Desouki M, Shahab MK, *et al.* Twelve-month prevalence and severity of mental disorders in the Saudi National Mental Health Survey. Int J Methods Psychiatr Res 2020;29:e1831.
29. Gloster AT, Lamnisos D, Lubenko J, Presti G, Squatrito V, Constantinou M, *et al.* Impact of COVID-19 pandemic on mental health: An international study. PLoS One 2020;15:e0244809.
30. Daly M, Sutin AR, Robinson E. Longitudinal changes in mental health and the COVID-19 pandemic: Evidence from the UK Household Longitudinal Study. Psychological medicine. 2020 Nov 13:1-0.
31. Cao XL, Wang SB, Zhong BL, Zhang L, Ungvari GS, Ng CH, *et al.* The prevalence of insomnia in the general population in China: A meta-analysis. PLoS One 2017;12:e0170772.