

# Sleep quality and insomnia during the COVID-19 lockdown among the Saudi public

## *A cross-sectional study*

Adel S. Alharbi, MBBS, MD, Sultan M. Alshabrani, MBBS, MD, Muslim M. Alsaadi, MBBS, MD, Hamdan H. AL-Jahdali, MBBS, MD, Siraj O. Wali, MBBS, MD, Ahmed S. BaHammam, MBBS, MD.

### ABSTRACT

**الأهداف:** قياس جودة نوم المواطنين السعوديين أثناء فترة إغلاق جائحة كوفيد-19.

**المنهجية:** أجرينا استبيان عبر الإنترنت أثناء فترة الإغلاق لجائحة COVID-19 بين السكان السعوديين على مدار أسبوعين من 1 أبريل إلى 15 أبريل 2020. استخدمنا تطبيق المراسلة الفورية WhatsApp و Twitter للوصول إلى السكان المستهدفين. وقد اشتملت الدراسة على المواطنين السعوديين والمقيمين غير السعوديين الذين يمكنهم قراءة وفهم الاستبيان. قمنا بتحليل البيانات باستخدام برنامج Stata و SPSS.

**النتائج:** بلغ العدد الإجمالي للردود 790. غالبية المشاركين كانوا من السكان السعوديين (92.9%). بلغ انتشار الأرق وضعف جودة النوم 54.4% و 55.5% على التوالي. ارتبطت الجنسية السعودية بمدّة نوم أطول ( $p=0.031$ ). ارتبط الجنس الأنثوي والزواج بسوء PSQI عالمياً، ونوعية النوم، وتوزيع النوم، وتأخر النوم، والخلل الوظيفي أثناء النهار.

**الخلاصة:** أظهرت النتائج التي توصلنا إليها أنه خلال جائحة COVID-19، كان لدى السكان السعوديين معدل انتشار مرتفع للأرق وضعف جودة النوم. ينبغي النظر في المراقبة الروتينية للتأثير النفسي للفاشيات التي تهدد الحياة واعتماد إجراءات فعالة للصحة العقلية المبكرة.

**Objectives:** To measure the Saudi population's sleep quality during the lockdown of COVID-19.

**Methods:** An internet-based questionnaire that was performed during the lockdown of the COVID-19 pandemic among the Saudi population over 2 weeks from April 1 to April 15, 2020. We used the instant messaging application WhatsApp and Twitter to reach the targeted population. Saudi citizens and non-Saudi residents who can read and understand the questionnaire were recruited. Data were analyzed using Stata and SPSS.

**Results:** A total of 790 responses were included. The majority of participants were the Saudi population 735 (92.9%). The prevalence of insomnia and poor

sleep quality were 54.4% and 55.5%, respectively. Saudi citizenship was associated with longer sleep duration ( $p=0.031$ ). Female gender and being married were associated with worse global PSQI, sleep quality, sleep distribution, sleep latency, and daytime dysfunction.

**Conclusion:** Our findings showed that during the COVID-19 pandemic, the Saudi population had a high prevalence of insomnia and poor sleep quality. Routine monitoring of the psychological impact of life-threatening outbreaks and the adoption of effective early mental health actions should be considered.

**Keywords:** PSQI, ASQ, sleep quality, insomnia, Saudi Arabia, COVID-19, cross-section

*Saudi Med J* 2021; Vol. 42 (4): 384-390  
doi: 10.15537/smj.2021.42.4.20200735

From the Department of Pediatrics (Alharbi), Pediatric Sleep Disorders Center, Prince Sultan Military City, Ministry of Defense; from the Department of Neurosciences (Alshabrani), King Abdullah bin Abdulaziz University Hospital, Princess Nourah bint Abdulrahman University; from the Department of Pediatrics (Alsaadi), from the National Plan for Science and Technology (BaHammam), College of Medicine & King Khalid University Hospital; from the University Sleep Disorders Center (BaHammam), Department of Medicine, College of Medicine, King Saud University; from the Department of Medicine (AL-Jahdali), Sleep Disorder Center, King Saud Bin Abdulaziz for Health Sciences, Riyadh; and from the Sleep Medicine and Research Center (Wali), King Abdulaziz University Hospital, Jeddah, Kingdom of Saudi Arabia.

Received 17th November 2020. Accepted 11th March 2021.

Address correspondence and reprint request to: Dr. Adel S. Alharbi, Department of Pediatrics, Pediatric Sleep Disorders Center, Prince Sultan Military City, Ministry of Defense, Riyadh, Kingdom of Saudi Arabia. E-mail: dr.adelalharbi@gmail.com  
ORCID ID: <http://orcid.org/0000-0001-7974-4026>

In December 2019, the world witnessed the first case of Coronavirus disease 2019 (COVID-19), which began to spread rapidly through Wuhan, Hubei Province, and other provinces in China, then the rest of the world.<sup>1-3</sup> Four months later, Saudi Arabia's government had announced the first case of the COVID-19.<sup>4</sup> The Saudi government has undertaken many notable measures to limit the outbreak, including forming a high-level committee incorporating prominent government institutions, the halt of the issuance of tourist visas for all purposes, the immediate suspension of domestic and international air travel.<sup>5</sup> Besides, the government has imposed a 2-week quarantine period for returning travelers from countries with high infection rates, banned mass gatherings for all purposes, enforced complete or partial lockdowns in different areas, closed and disinfected the 2 holy mosques, and increased public awareness and education.<sup>6</sup> These measures are expected to impact the psyche of the Saudi population negatively. Outbreaks are well known to affect human psychological well-being significantly.<sup>7</sup> Therefore, many cases of depression, anxiety, panic attacks, sleep disorders, and posttraumatic stress disorder symptoms have been observed during and after serious outbreaks and pandemics, such as COVID-19.<sup>8</sup>

Sleep disorders or inadequate sleep contribute to epileptic seizures, depression, accidents, heart disease, diabetes, and poor life quality.<sup>9</sup> Therefore, many studies have paid great attention to sleep and sleep disorders during the COVID-19 outbreak.<sup>10-13</sup> Huang and Zhao assessed sleep quality in china (n=603) using the Pittsburgh Sleep Quality Index (PSQI) and showed that during the lockdown, the Chinese population had suffered from poor sleep quality.<sup>14</sup> Furthermore, Yu et al<sup>15</sup> showed that most of the Hong Kong population reported that their sleep had deteriorated following the outbreak of COVID-19. Despite the aforementioned evidence, data regarding the association between the COVID-19 lockdown and the sleep disorders of Middle East countries' general population, especially Saudi Arabia, are scanty. Thus, our study aimed to assess sleep quality among the Saudi population during the COVID-19 pandemic.

**Disclosure.** Authors have no conflict of interests, and the work was not supported or funded by any drug company. Adel S. Alharbi is a member of the Editorial Team, and was therefore excluded from any final editorial decisions regarding this paper.

**Methods.** This was a cross-sectional, internet-based questionnaire that was performed according to the Helsinki Declaration principles and was conducted among the Saudi population during the lockdown of COVID-19. The Strengthening the Reporting of Observational studies in Epidemiology (STROBE) checklist was followed during reporting this study.<sup>16</sup> The survey was carried out in Saudi Arabia over 2 weeks, from April 1, 2020, to April 15, 2020. During the data collection period, the Saudi Government had taken a number of strict measures to overcome the COVID-19 transmission, including imposing a full lockdown.<sup>17-19</sup> Saudi citizens and non-Saudi residents who can read and understand the questionnaire were recruited using convenience sampling. We have used WhatsApp and Twitter instant messaging to reach our target population.

**Sample size calculation.** We have used G\*Power 3.1 software to estimate the sample size based on the estimated insomnia prevalence (17%), and a 3% error margin was applied. In the 95% confidence interval, an estimated sample of 492 was suggested. A total of 790 respondents returned their responses to the internet-based questionnaire over the 2-week period of the study. Before participating in the study, all participants gave their written informed consent.

We collected the following data from the included participants: i) The Pittsburgh Sleep Quality Index (PSQI): The PSQI is an important method for measuring sleep quality and sleep habits in older adults. By measuring 7 domains, it differentiates between "poor" and "good" sleep: daytime dysfunction, sleep medication usage, sleep disturbances, habitual sleep efficiency, sleep duration, sleep latency, and sleep quality over the last month.<sup>20</sup> All 7 domains can range between 0 and 3. The global score can range from 0 to 21, with a cutoff point of 5, which means that a global score of 5 or more indicates poor sleep quality. This study used the validated and translated version (Arabic) developed by Suleiman et al.<sup>21</sup> ii) Athens Sleep Questionnaire (ASQ): We used the Arabic version of ASQ, which was validated previously. The questionnaire consists of 8 questions about the following parameters: 1) Sleepiness during the day; 2) Functioning (physical and mental) during the day; 3) Sense of well-being during the day; 4) Overall quality of sleep; 5) Total sleep duration; 6) Sleep induction; 7) Awakenings during the night; 8) Final awakening earlier than desired. Each question is evaluated with 4 scores from 0 to 3, where 0 means good/satisfactory or no problems, and 3 means serious problem or very unsatisfactory. This score's cutoff point is 6; patients who have more than 6 are considered to have clinical insomnia.

**Statistical analysis.** Responses were collected using an online Google form. To analyze the data, we used the Statistical Package of Social Science (SPSS) for Windows, version 22 (IBM Corp., Armonk, N.Y., USA) and Stata 14.0. To summarize respondents' demographic data, descriptive statistics presented as mean and standard deviation (SD), or number and percentage (%) were used. In accordance with clinically prescribed cutoff points, the respondents' PSQI and ASQ scores were coded into binary data. Mann-Whitney and Kruskal-Wallis tests were used to compare the means of independent groups. In order to examine the relation between PSQI and ASQ scores and demographic features, a Chi-square test was used. Odds ratio (OR) of the binary logistic regression was applied to assess sleep quality correlations with a 95% confidence intervals (95% CI). If less than 0.05, the *p*-value was considered significant.

**Results.** A total of 790 responses were included. The majority of participants were the Saudi population (n=735; 92.9%). Two-thirds of the participants were employed. A total of 27.5% were healthcare workers, 45.1% were enterprise or institution workers, and 27.5% were teachers or students. The characteristics of the included participants are summarized in **Table 1**.

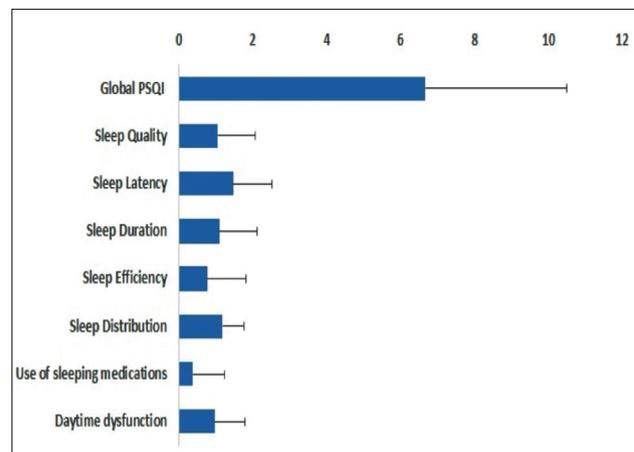
**PSQI.** The overall Global PSQI was 6.67±3.82 for all participants; 350 (44.4%) had good sleep quality, and 438 (55.5%) had poor sleep quality. Two patients were excluded from the analysis of PSQI, as they did not report full information in terms of the sleep parameters. **Figure 1** shows the mean value of sleep parameters, including sleep, latency, duration, efficiency, distribution, use of sleeping medications, and daytime dysfunction.

**Association of demographic characteristics and PSQI.** The association between demographic characteristics and PSQI is shown in **Table 2**. Our analysis demonstrated that female gender was correlated with worse global PSQI (*p*=0.004), sleep quality (*p*=0.004), sleep latency (*p*<0.001), sleep efficiency (*p*=0.012), sleep distribution (*p*<0.001), and daytime dysfunction (*p*<0.001). In terms of sleep duration, the male gender was worse than the female gender (*p*<0.001). Single participants were associated with significant (*p*<0.001) better global PSQI, sleep quality, shorter sleep latency, and less daytime dysfunction than married participants. Saudi participants were associated with better sleep duration compared to the non-Saudi population (*p*=0.031). In terms of employment status, non-employees were associated with worse sleep efficiency (*p*=0.034). Participants with primary

education were associated with worse sleep efficiency compared to secondary education (*p*=0.019) and university education (*p*=0.004). Our analysis showed no significant difference between participants with/without insomnia and PSQI.

**Table 1** - Demographic characteristics.

Demographics	N (%)
<b>Age</b>	
≤40	513 (64.9)
41-60	254 (32.2)
>60	23 (2.9)
<b>Gender</b>	
Male	371 (46.9)
Female	419 (53.1)
<b>Nationality</b>	
Saudi	735 (92.9)
Non-Saudi	55 (7)
<b>Marital status</b>	
Married	512 (64.7)
Single	240 (30.4)
Widow	9 (1.1)
Divorced	29 (3.7)
<b>Education</b>	
Primary	6 (0.8)
Secondary	67 (8.5)
University	717 (90.6)
<b>Employment</b>	
Employee	601 (76)
Non-employee	189 (23.9)
<b>Occupation</b>	
Healthcare workers	165 (20.8)
Enterprise or institution workers	271 (43.3)
Teachers or students	157 (19.8)
Unknown	8 (1.01)



**Figure 1** - Pittsburgh sleep quality index score in Saudi population.

**Logistic regression.** Table 3 presents the main findings of the logistic regression analysis. Marital status can be used as an independent predictor of poor sleep quality.

**Athens sleep questionnaire (ASQ).** The prevalence of insomnia was 430 (54.4%). Compared to non-Saudi participants, Saudi participants were linked to a greater prevalence of insomnia (45.5% versus 55%), with no significant difference ( $p=0.172$ ). There was no considerable relationship between insomnia and participants' age ( $p=0.800$ ), gender ( $p=0.947$ ), education ( $p=0.827$ ), and employment ( $p=0.692$ ). Regarding marital status, the prevalence of insomnia was 61.3% in the single participants and 50.4% in the married participants. Moreover, our analysis failed to find any significant correlation between insomnia and the parameters of PSQI, as presented in Table 4.

**Discussion.** Our study investigated the association between the COVID-19 lockdown and the sleep quality of the Saudi population. Our findings showed that about 55.5% of the included participants had poor sleep quality. Moreover, we observed that females and married participants were associated with worse global PSQI, daytime dysfunction, sleep quality, sleep distribution, and sleep latency. However, the prevalence of overall poor sleep and insomnia was lower in married participants compared to others, indicating that they have less prevalence with worse scores. Furthermore, employment status and education level were linked with poor sleep quality.

Huang and Zhao reported a much lower prevalence of poor sleep quality (18.2%) in 7,236 self-selected Chinese volunteers.<sup>14</sup> They assessed the sleep quality

**Table 2 -** Association of demographic, clinical characteristics, insomnia (ASQ), and Pittsburgh Sleep Quality Index (PSQI).

Variables	Global PSQI	Quality	Latency	Duration	Efficiency	Distribution	Sleeping medications	Daytime dysfunction
<b>Age</b>								
≤40	6.57±3.84 <sup>a</sup>	1.04±0.99 <sup>a</sup>	1.47±1.05 <sup>a</sup>	1.10±1.02 <sup>a</sup>	0.74±1.02 <sup>a</sup>	1.18±0.57 <sup>a</sup>	0.36±0.84 <sup>a</sup>	0.94±0.84 <sup>a</sup>
41-60	6.78±3.74 <sup>a</sup>	1.11±1.07 <sup>a</sup>	1.47±1.04 <sup>a</sup>	1.07±1.01 <sup>a</sup>	0.81±1.08 <sup>a</sup>	1.23±0.60 <sup>a</sup>	0.38±0.84 <sup>a</sup>	1.01±0.81 <sup>a</sup>
>60	7.60±4.20 <sup>a</sup>	1.00±1.00 <sup>a</sup>	1.65±1.15 <sup>a</sup>	1.47±0.99 <sup>a</sup>	0.84±1.06 <sup>a</sup>	1.08±0.42 <sup>a</sup>	0.74±1.29 <sup>a</sup>	0.96±0.88 <sup>a</sup>
<b>Marital status</b>								
Single	6.28±3.70 <sup>a</sup>	0.96±0.95 <sup>a</sup>	1.32±1.03 <sup>a</sup>	1.19±0.98 <sup>a,c</sup>	0.75±1.04 <sup>a</sup>	1.15±0.58 <sup>a</sup>	0.37±0.87 <sup>a</sup>	0.79±0.76 <sup>a</sup>
Married	7.50±3.83 <sup>b</sup>	1.26±1.09 <sup>b</sup>	1.77±1.04 <sup>b</sup>	0.92±1.05 <sup>b</sup>	0.78±1.01 <sup>a</sup>	1.29±0.55 <sup>b</sup>	0.40±0.85 <sup>a</sup>	1.34±0.83 <sup>b</sup>
Widow	7.33±4.36 <sup>ab</sup>	1.11±1.27 <sup>a,b</sup>	1.78±1.09 <sup>ab</sup>	2.00±1.07 <sup>a,c</sup>	2.75±0.50 <sup>b</sup>	1.11±0.93 <sup>ab</sup>	-	0.67±0.71 <sup>ab</sup>
Divorced	6.44±4.64 <sup>ab</sup>	1.17±1.18 <sup>a,b</sup>	1.48±1.02 <sup>ab</sup>	0.89±1.05 <sup>b</sup>	0.70±1.12 <sup>a</sup>	1.13±0.63 <sup>ab</sup>	0.40±0.84 <sup>a</sup>	1.00±0.95 <sup>ab</sup>
<b>Gender</b>								
Male	6.24±3.50 <sup>a</sup>	0.95±0.94 <sup>a</sup>	1.30±1.01 <sup>a</sup>	1.26±0.93 <sup>a</sup>	0.65±0.99 <sup>a</sup>	1.10±0.56 <sup>a</sup>	0.38±0.86 <sup>a</sup>	0.85±0.75 <sup>a</sup>
Female	7.04±4.05 <sup>b</sup>	1.157±1.07 <sup>b</sup>	1.62±1.06 <sup>b</sup>	0.97±1.07 <sup>b</sup>	0.87±1.07 <sup>b</sup>	1.28±0.58 <sup>b</sup>	0.38±0.85 <sup>a</sup>	1.07±0.88 <sup>b</sup>
<b>Nationality</b>								
Saudi	6.65±3.77 <sup>a</sup>	1.04±1.02 <sup>a</sup>	1.49±1.05 <sup>a</sup>	1.08±1.02 <sup>a</sup>	0.78±1.06 <sup>a</sup>	1.20±0.58 <sup>a</sup>	0.37±0.85 <sup>a</sup>	0.97±0.81 <sup>a</sup>
Non-Saudi	6.89±4.40 <sup>a</sup>	1.28±0.92 <sup>a</sup>	1.27±1.11 <sup>a</sup>	1.39±0.97 <sup>b</sup>	0.54±0.76 <sup>a</sup>	1.18±0.58 <sup>a</sup>	0.51±0.97 <sup>a</sup>	0.96±1.00 <sup>a</sup>
<b>Education</b>								
Primary	7.60±6.50 <sup>a</sup>	1.20±1.09 <sup>a</sup>	0.80±0.84 <sup>a</sup>	1.75±1.50 <sup>a</sup>	2.67±0.58 <sup>a</sup>	1.40±1.14 <sup>a</sup>	0.60±1.34 <sup>a</sup>	0.60±0.89 <sup>a</sup>
Secondary	6.71±3.95 <sup>a</sup>	0.98±0.97 <sup>a</sup>	1.52±1.00 <sup>a</sup>	1.17±1.12 <sup>a</sup>	1.00±1.20 <sup>b</sup>	1.18±0.58 <sup>a</sup>	0.46±1.03 <sup>a</sup>	0.84±0.83 <sup>a</sup>
University	6.66±3.79 <sup>a</sup>	1.07±1.02 <sup>a</sup>	1.47±1.06 <sup>a</sup>	1.10±1.00 <sup>a</sup>	0.74±1.02 <sup>b</sup>	1.19±0.57 <sup>a</sup>	0.37±0.84 <sup>a</sup>	0.98±0.83 <sup>a</sup>
<b>Employment</b>								
Employee	6.62±3.80 <sup>a</sup>	1.05±1.02 <sup>a</sup>	1.46±1.04 <sup>a</sup>	1.13±1.01 <sup>a</sup>	0.72±1.01 <sup>a</sup>	1.19±0.58 <sup>a</sup>	0.37±0.83 <sup>a</sup>	0.96±0.83 <sup>a</sup>
Non-employees	6.84±3.88 <sup>a</sup>	1.09±1.03 <sup>a</sup>	1.50±1.08 <sup>a</sup>	1.01±1.03 <sup>a</sup>	0.94±1.11 <sup>b</sup>	1.19±0.56 <sup>a</sup>	0.42±0.94 <sup>a</sup>	0.99±0.83 <sup>a</sup>
<b>Occupation</b>								
Healthcare workers	6.72±3.72 <sup>a</sup>	1.09±1.03 <sup>a</sup>	1.52±1.01 <sup>a</sup>	1.16±0.99 <sup>a</sup>	0.84±1.08 <sup>a</sup>	1.15±0.60 <sup>a</sup>	0.43±0.89 <sup>a</sup>	0.99±0.83 <sup>a</sup>
Enterprise or institution workers	6.55±3.83 <sup>a</sup>	1.03±1.00 <sup>a</sup>	1.44±1.06 <sup>a</sup>	1.15±1.00 <sup>a</sup>	0.72±1.03 <sup>a</sup>	1.21±0.53 <sup>a</sup>	0.31±0.77 <sup>a</sup>	0.99±0.83 <sup>a</sup>
Teachers or students	6.63±3.87 <sup>a</sup>	1.10±1.02 <sup>a</sup>	1.44±1.05 <sup>a</sup>	1.08±1.06 <sup>a</sup>	0.61±0.90 <sup>a</sup>	1.21±0.64 <sup>a</sup>	0.41±0.87 <sup>a</sup>	0.99±0.83 <sup>a</sup>
<b>Insomnia (ASQ)</b>								
No	6.47±3.69 <sup>a</sup>	1.03±0.98 <sup>a</sup>	1.49±1.08 <sup>a</sup>	1.11±1.00 <sup>a</sup>	0.72±1.02 <sup>a</sup>	1.16±0.55 <sup>a</sup>	0.32±0.77 <sup>a</sup>	0.92±0.83 <sup>a</sup>
Yes	6.84±3.92 <sup>a</sup>	1.08±1.05 <sup>a</sup>	1.45±1.03 <sup>a</sup>	1.10±1.03 <sup>a</sup>	0.80±1.06 <sup>a</sup>	1.22±0.60 <sup>a</sup>	0.43±0.92 <sup>a</sup>	1.01±0.83 <sup>a</sup>

Data are presented as mean± SD. Means within the same column carrying different superscripts are significantly different at ( $p<0.05$ ).

**Table 3** - Logistic regression of poor sleep quality.

Independent variables	Poor sleep quality OR (95% CI)	P-value
<b>Age</b>		
≤40	Ref	
41-60	1.18 (0.87, 1.59)	0.287
>60	1.09 (0.47, 2.55)	0.828
<b>Gender</b>		
Male	Ref	
Female	1.25 (0.95, 1.67)	0.111
<b>Nationality</b>		
Saudi	1.04 (0.60, 1.81)	0.872
Non-Saudi	Ref	
<b>Marital status</b>		
Married	1.15 (0.54, 2.44)	0.70
Single	1.88 (0.86, 4.08)	0.109
Widow	3.74 (0.66, 21.19)	0.135
Divorced	Ref	
<b>Education</b>		
Primary	Ref	
Secondary	1.85 (0.29, 11.7)	0.515
University	1.88 (0.31, 11.4)	0.488
<b>Employment</b>		
Employee	0.93 (0.68, 1.27)	0.682
Non-employee	Ref	

using the same questionnaire used in this study (PSQI); however, they used a higher cutoff point (>7), leading to underestimation of the sleep quality of their population. This study used (>5) as a cutoff point to differentiate between poor and good sleep quality. This cutoff point (>5) was tested by Buysse et al,<sup>22</sup> who developed the PSQI questionnaire, and it showed 89.6% sensitivity and 86.5% specificity in differentiation between good and poor sleepers. Huang and Zhao had no substantial connection between the quality of sleep and the participants' age ( $p=0.446$ ), which was confirmed by our findings.<sup>14</sup> On the other hand, they found that the Healthcare workers are the only group who had a significant positive regression (OR 1.48, 95% CI: 1.15, 1.95) with sleep quality. They estimated that in healthcare workers, the prevalence of sleep problems was about 25%, which could be attributed to the longer working period, making them more vulnerable to psychological distress. This difference between our and their findings can be attributed to the study time;

**Table 4** - Association between demographic and clinical characteristics and Insomnia (ASQ).

Demographic characteristics	Insomnia (ASQ)		P-value
	Non insomnia	Insomnia	
<b>Age</b>			
<41	233 (45.4)	280 (54.6)	0.817
41-60	116 (45.7)	138 (54.3)	
>60	12 (52.2)	11 (47.8)	
<b>Nationality</b>			
Non-Saudi	30 (54.5)	25 (45.5)	0.172
Saudi	331 (45.0)	404 (55.0)	
<b>Marital status</b>			
Single	93 (38.8)	147 (61.3)	0.028
Married	254 (49.6)	258 (50.4)	
Widow	3 (33.3)	6 (66.7)	
Divorced	11 (37.9)	18 (62.1)	
<b>Gender</b>			
Male	170 (45.8)	201 (54.2)	0.947
Female	191 (45.6)	228 (54.4)	
<b>Education</b>			
Primary	2 (33.3)	4 (66.7)	0.827
Secondary	31 (46.3)	36 (53.7)	
University	328 (45.7)	389 (54.3)	
<b>Employment</b>			
Non-employee	84 (44.4)	105 (55.6)	0.692
Employee	277 (46.1)	324 (53.9)	
<b>Occupation</b>			
Healthcare workers	93 (56.4)	72 (43.6)	0.001
Enterprise or institution workers	124 (45.8)	147 (54.2)	
Teacher and student	60 (36.4)	105 (63.6)	
<b>Global sleep score</b>			
Good sleep	168 (48.0)	182 (52.0)	0.258
Poor sleep	193 (44.0)	246 (56.0)	

Values are presented as number and percentage (%)

their study was performed in early February, where the COVID-19 was at the peak in China, leading to a substantial burden on the healthcare workers.

In Italy, Marelli et al<sup>23</sup> conducted a cross-sectional study to determine the COVID-19 lockdown effect on university students and administration staff. They demonstrated that 73.3% and 60.2% of the university students and administration staff had poor sleep quality, respectively. In agreement with our study, they showed that the impact was greater in females than in males ( $p=0.001$ ). Therefore, they recommended that health authorities should offer psychological supports to females and students. It was reported that sleep habits

have changed during lockdowns because of social isolation and changes in social rhythms such as work and daily work.<sup>24</sup> In young people (namely, students), social isolation can lead to a growing number of anxious and depressing symptoms in the presence of loneliness, vulnerability, and emergency worry. According to Huang and Zhao, these issues' potential cause might be related to the "hypochondriac concerns." They feared the outbreak would be difficult to contain.<sup>14</sup> A recent systematic review showed that healthcare workers and female gender were at an elevated risk of depression, anxiety, poor sleep quality, and psychological distress.<sup>25</sup> Regarding insomnia, our study demonstrated an increased prevalence of insomnia (54.4%) among the general Saudi population. However, we could not identify the associations of this high prevalence. In China, Li et al,<sup>26</sup> reported an increased prevalence of insomnia 33.7%. They suggested that insomnia may be associated with economic-related stress, social distance restrictions, travel restrictions, daily life changes, mental illness, and female gender. In our study, we could not find any significant difference between both genders in terms of insomnia. In the Greek population, Voitsidis et al reported a 37.6% prevalence of insomnia, assessed by the AIS. Moreover, they showed that insomnia was more prominent in females and people in urban areas.<sup>27</sup> Similar to our findings, Idrissi et al<sup>28</sup> demonstrated that the Moroccan population was associated with a high prevalence of daytime sleepiness (9.9%) and insomnia (56%). The COVID-19 pandemic was accompanied by a high risk of infection, fears of infection, insufficient supplies, financial loss, inadequate information, excess information from mass media, negative emotional patients, and lack of communication with their families.<sup>29,30</sup> They also supported the findings of Voitsidis et al regarding the increased prevalence of insomnia in females and people in urban areas.<sup>27</sup>

In Bahrain, Jahrami et al<sup>31</sup> reported that 75% of the frontline healthcare workers were poor sleepers. In non-frontline healthcare workers, 76% were also poor sleepers. They also found that the female gender is an independent predictor of poor sleep quality. A recent study in Saudi Arabia by Al-Musharaf<sup>32</sup> aimed to assess the pandemic's impact on a group of healthy young Saudi females. She reported different parameters such as emotional eating scale, anxiety, depression, and preserved stress scale. She also reported that the overall PSQI score for the entire population was significantly impacted by stress, anxiety, and depression; however, she did not report the mean value of the score or the prevalence of sleep quality.<sup>32</sup> Alnafaiey et al<sup>33</sup> highlighted that the prevalence of sleep disorders in Saudi doctors

was 43.9%, with a higher prevalence in doctors with 31-40 years.

*The current study has some weaknesses.* First, the cross-sectional design hindered our ability to create any causal inferences. Second, we could not perform an interview-based questionnaire that reduces the over or under-estimation resulting from self-reporting; however, we used an internet-based questionnaire approach to prevent potential infections due to the outbreak. Third, we could not assess participants' sleep quality before the disease due to the outbreak's unanticipated occurrence.

In conclusion, we highlighted the substantial deterioration in the Saudis' sleep health during the COVID-19 outbreak. The prevalence of insomnia and overall poor sleep was lower in married participants, compared to others. However, the PSQI score showed that, despite the lower prevalence, they have the worse scores in terms of global PSQI, sleep quality, sleep distribution, sleep latency, and daytime dysfunction. Any change in sleep quality may affect individuals' mood and productivity; consequently, contentious monitoring of the psychological effects of life-threatening outbreaks and the implementation of appropriate early mental health measures should become routine. Future research should focus on the direct causal relationship between the COVID-19 pandemic and sleep disorders after considering the independent predictors that may influence this relationship.

**Acknowledgment.** Authors would like to thank SevoClin CRO ([www.sevoclin.com](http://www.sevoclin.com)) for English language editing.

## References

1. Velavan TP, Meyer CG. The COVID-19 epidemic. *Trop Med Int Health* 2020; 25: 278-280.
2. Wu YC, Chen CS, Chan YJ. The outbreak of COVID-19: An overview. *J Chin Med Assoc* 2020; 83: 217-220.
3. Bahbah EI, Negida A, Nabet MS. Purposing Saikosaponins for the treatment of COVID-19. *Med Hypotheses* 2020; 140: 109782.
4. Ministry of Health. COVID 19 Dashboard: Saudi Arabia [Internet]. [cited 2020]. Available from: <https://covid19.moh.gov.sa/>
5. Ebrahim SH, Memish ZA. Saudi Arabia's drastic measures to curb the COVID-19 outbreak: temporary suspension of the Umrah pilgrimage. *J Travel Med* 2020; 27: taaa029.
6. Al-Tawfiq JA, Memish ZA. COVID-19 in the Eastern Mediterranean Region and Saudi Arabia: prevention and therapeutic strategies. *Int J Antimicrob Agents* 2020; 55: 105968.
7. Dubey S, Biswas P, Ghosh R, Chatterjee S, Dubey MJ, Chatterjee S, et al. Psychosocial impact of COVID-19. *Diabetes Metab Syndr* 2020; 14: 779-788.

8. Torales J, O'Higgins M, Castaldelli-Maia JM, Ventriglio A. The outbreak of COVID-19 coronavirus and its impact on global mental health. *Int J Soc Psychiatry* 2020; 66: 317-320.
9. Stores G. Clinical diagnosis and misdiagnosis of sleep disorders. *J Neurol Neurosurg Psychiatry [Internet]* 2007; 78: 1293-1297.
10. 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; 12; 26.
11. Xiao H, Zhang Y, Kong D, Li S, Yang N. The effects of social support on sleep quality of medical staff treating patients with coronavirus disease 2019 (COVID-19) in January and February 2020 in China. *Med Sci Monit* 2020; 26: e923549.
12. Belingheri M, Paladino ME, Riva MA. Working schedule, sleep quality and susceptibility to COVID-19 in healthcare workers. *Clin Infect Dis* 2020; 27: ciaa499.
13. Stojanov J, Malobabic M, Stanojevic G, Stevic M, Milosevic V, Stojanov A. Quality of sleep and health-related quality of life among health care professionals treating patients with coronavirus disease-19. *Int J Soc Psychiatry* 2020; 16: 002076402094280.
14. Huang Y, Zhao N. Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. *Psychiatry Res* 2020; 288: 112954.
15. Yu BYM, Yeung WF, Lam JCS, Yuen SCS, Lam SC, Chung VCH, et al. Prevalence of sleep disturbances during COVID-19 outbreak in an urban Chinese population: a cross-sectional study. *Sleep Med* 2020; 74: 18-24.
16. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *J Clin Epidemiol* 2008; 61: 344-349.
17. Al-Tawfiq JA, Memish ZA. COVID-19 in the Eastern Mediterranean Region and Saudi Arabia: prevention and therapeutic strategies. *Int J Antimicrob Agents* 2020; 55: 105968.
18. Algaissi AA, Alharbi NK, Hassanain M, Hashem AM. Preparedness and response to COVID-19 in Saudi Arabia: Building on MERS experience. *J Infect Public Health* 2020; 13: 834-838.
19. KPMG. Kingdom of Saudi Arabia: Government and institution measures in response to COVID-19. [Updated 2020 November 18]. Available from: <https://home.kpmg/xx/en/home/insights/2020/04/saudi-arabia-government-and-institution-measures-in-response-to-covid.html>
20. Smyth C. The Pittsburgh Sleep Quality Index (PSQI). *Insight* 2000; 25: 97-98.
21. Suleiman KH, Yates BC, Berger AM, Pozehl B, Meza J. Translating the Pittsburgh Sleep Quality Index into Arabic. *West J Nurs Res* 2010; 32: 250-268.
22. Buysse DJ, Reynolds CF, 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.
23. Marelli S, Castelnovo A, Somma A, Castronovo V, Mombelli S, Bottoni D, et al. Impact of COVID-19 lockdown on sleep quality in university students and administration staff. *J Neurol* 2021; 268: 8-15.
24. Altena E, Baglioni C, Espie CA, Ellis J, Gavriloff D, Holzinger B, 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: e13052.
25. Vindegaard N, Benros ME. COVID-19 pandemic and mental health consequences: Systematic review of the current evidence. *Brain Behav Immun* 2020; 89: 531-542.
26. Li Y, Qin Q, Sun Q, Sanford LD, Vgontzas AN, Tang X. Insomnia and psychological reactions during the COVID-19 outbreak in China. *J Clin Sleep Med* 2020; 16: 1417-1418.
27. 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.
28. Janati Idrissi A, Lamkaddem A, Benouajjit A, Ben El Bouazzaoui M, El Houari F, Alami M, et al. Sleep quality and mental health in the context of COVID-19 pandemic and lockdown in Morocco. *Sleep Med* 2020; 74: 248-253.
29. Ahmed H, Sayed A, Munir M, Elberry MH, Sayed IM, Kamal MA, et al. A Clinical Review of COVID-19; Pathogenesis, Diagnosis, and Management. *Curr Pharm Des* 2020; 22: 26.
30. Ebada MA, Wadaa-Allah A, Bahbah E, Negida A. An Updated Review on COVID-19. *Infect Disord Drug Targets* 2020; 16.
31. Jahrami H, BaHamam 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* 2020: 1-9.
32. Al-Musharaf S. Prevalence and Predictors of Emotional Eating among Healthy Young Saudi Women during the COVID-19 Pandemic. *Nutrients* 2020; 12: 2923.
33. Alnofaiey YH, Alshehri HA, Alosaimi MM, Alswat SH, Alswat RH, Alhulayfi RM, et al. Sleep disturbances among physicians during COVID-19 pandemic. *BMC Res Notes* 2020; 13: 493.