Early Online

The European Research Journal 2025 Original Article

DOI: https://doi.org/10.18621/eurj.1653062 *Public Health*

Associations between anxiety, depression, and sleep problems in women during the COVID-19 pandemic: a cross sectional study

Şeyma Çatalgöl[1], Rabia Akgün[2]

[1]Department of Nursing, Uşak University, Faculty of Health Sciences, Uşak, Türkiye; [2]Dokuz Eylul University, Research and Application Hospital, İzmir, Türkiye

ABSTRACT

Objectives: This study was conducted to determine the association between anxiety, depression, and sleep problems in women during the COVID-19 pandemic.

Methods: This cross-sectional study included 686 women via a web survey between February 20, 2021, and April 9, 2021. In this study, participants' anxiety scores were evaluated with the Beck Anxiety Inventory (BAI), depression findings with the Beck Depression Inventory (BDI), and sleep quality scores with the Pittsburgh Sleep Quality Index (PSQI). Cut-off points: PSQI >5 indicates poor sleep quality, BAI 16-25 indicates moderate, and ≥26 indicates severe anxiety; BDI 17-29 indicates moderate, and ≥30 indicates severe depression. Statistical analyses included t-test, ANOVA, Pearson correlation, and multiple linear regression.

Results: The younger age group, students, singles, smokers, and alcohol users were at higher risk for increased anxiety, depression, and poor sleep quality during the COVID-19 pandemic. Participants exhibited high levels of anxiety (moderate anxiety in 20.12%, severe anxiety in 20.70%), depression (moderate depression in 25.22%, severe depression in 12.53%), and poor sleep quality (58.6%). A moderate positive correlation was found between sleep quality and anxiety ($r=0.517$, $P<0.01$) and depression ($r=0.513$, $P< 0.01$). A strong positive correlation was observed between anxiety and depression ($r=0.647$, $P<0.01$). Multiple linear regression analysis revealed that anxiety ($\beta=0.071$, $P<0.001$) and depression ($\beta=0.075$, $P<0.001$) were significant predictors of sleep quality.

Conclusions: The findings show that the COVID-19 pandemic negatively affected women's mental health and sleep quality. Anxiety and depression significantly impact sleep quality, and early intervention, long-term follow-up, and national-level measures are necessary to prevent the complications of psychological issues and sleep disorders.

Keywords: Anxiety, depression, sleep, pandemic, women

The COVID-19 pandemic, which originated in China and spread quickly throughout the world, was announced a "International Public Health Emergency" on January 30, 2020 [1], and a "Global Outbreak (pandemic)" on March 11, 2020 [2]. The COVID-19 virus, which has a very high transmis-

Received: March 7, 2025 **Accepted:** June 1, 2025 **Available Online:** June 4, 2025 **Published:** XX XX, 2025

How to cite this article: Çatalgöl Ş, Akgün R. Associations between anxiety, depression, and sleep problems in women during the COVID-19 pandemic: a cross sectional study. Eur Res J. 2025. doi: 10.18621/eurj.1653062

Corresponding author: Şeyma Çatalgöl, RM, PhD., Phone: +90 276 221 21 21 ext. 3071, E-mail: seyma.catalgol@usak.edu.tr

sion rate, has affected the whole world and caused many people to die [3].

With the spread of the pandemic all over the world, countries have started to take their own measures. To control the spread of the pandemic; many more measures have been taken, such as social isolation, home quarantine, partial or complete lockdown [4].

Some measures have also been taken in Türkiye to prevent and control the spread of the epidemic. Some of these measures: such as closing schools and continuing education online [5], curfews for people under the age of 20 and above the age of 65 [6], travel restrictions, closure of shopping centers, and the public and private sector working from home [7]. With similar measures taken around the world, people began to spend more time at home, and accordingly, a major change in their lifestyle occurred [8, 9].

In addition, these changes have had negative effects on psychological health and sleep/wake patterns [10]. The new lifestyle that emerged in this process and the measures taken to control the pandemic caused an increase in anxiety and depression levels in individuals and led to sleep problems [11]. Maintaining homeostasis and a high standard of living in humans depends heavily on the process of sleep [12].

The incidence of disorders such as anxiety, depression, and stress is higher in individuals with sleep disorders. Especially in women, poor sleep is associated with some adverse health outcomes [13]. These are related to increases in comorbid conditions such as vasomotor symptoms, hormonal changes, age-related changes, and depression [14].

The likelihood of experiencing depression is also approximately twice as high in women as in men. This difference starts from adolescence and continues until the mid-50s. Therefore, women appear to be at greater risk of depression during their reproductive years [15].

During the COVID-19 pandemic, there was an increase in anxiety, depression, and stress levels due to the impact of lifestyle changes [3]. It is essential to recognize the psychological disorders and factors causing insomnia during the pandemic phase to prevent these problems. The purpose of this study was to evaluate the association between anxiety, depression, and sleep problems among women during the COVID-19 pandemic. To address the gaps mentioned above, this study has been conducted in line with the following research questions.

Research question 1: How has the COVID-19 pandemic affected women's anxiety, depression, and sleep quality levels?

Research question 2: Is there a statistically significant relationship between women's anxiety and depression levels and sleep problems?

Research question 3: How do demographic factors affect women's anxiety, depression, and sleep quality?

METHODS

Study Design

The data of this cross-sectional descriptive study was gathered from women who volunteered to participate in the research using the snowball sampling method across Türkiye between February 20, 2021 and April 9, 2021. Study questions were sent to women via Google Forms.

Inclusion Criteria

All women aged 18-65 years who gave electronic informed consent to participate in the study were included.

Exclusion Criteria

Women who had mental or sleep-related illnesses and were taking medication for these disorders and who gave logically incorrect answers to the study questions were excluded from the study.

Sample and Data Collection

The research universe is made up of 27974887 women between the ages of 18 and 65 in Türkiye [16]. The sample of the study was 686 women between the ages of 18 and 65 who voluntarily participated in the study from various parts of Türkiye. Introductory Features Information Form, Beck Anxiety Inventory (BAI), Beck Depression Inventory (BDI), and Pittsburgh Sleep Quality Index (PSQI) were used as measurement tools in the study.

The OpenEpi program Version 3 was used to determine the sample size. To determine the sample size, the following formula for descriptive research was used: Sample size (n)=[DEFF×Np(1-p)] / [(d2/Z21-α/2×(N-1)+p×(1-p)]. The minimum number of samples to be taken was calculated as 385 with 0.95 confidence and 0.05 margin of error with the sample

formula. To increase the efficiency of the study and the reliability of its results, 686 volunteer women were reached, and research data were collected. Answering every question was mandatory, and in the electronic form, unanswered questions could not be skipped. Therefore, there was no missing data. However, thirty participants were excluded from the analysis due to inconsistent responses.

Questionnaires

The Pittsburgh Sleep Quality Index, Beck Anxiety Inventory, and Beck Depression Inventory are the scales used in the study, and the information form created for the study was used to collect research data.

Information Form

The researchers developed 20 questions for the data collection form utilized in the study to assess the sociodemographic characteristics and sleep issues of women.

Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) was developed by Buysse *et al*. [17] and adapted into Turkish by Ağargün *et al*. [18]. The total score is between 0 and 21. PSQI score >5 indicates poor sleep quality, while a PSQI score ≤ of 5 indicates good sleep quality. In this study, the coefficient of the scale in Cronbach's α was determined as 0.807.

Beck Anxiety Inventory

The Beck Anxiety Inventory (BAI), developed by Beck *et al*. [19], is a 21-item self-report inventory designed to assess the severity of anxiety symptoms using a 4-point Likert scale (0 = none/minimal, 1=mild, 2=moderate, 3=severe). The Turkish validity and reliability of the inventory were established by Ulusoy *et al*. [20]. Total scores range from 0 to 63, with 0-7 indicating minimal anxiety, 8-15 mild anxiety, 16-25 moderate anxiety, and 26-63 severe anxiety symptoms. In the current study, the Cronbach's alpha for the BAI was found to be 0.941.

Beck Depression Inventory

The Beck Depression Inventory (BDI) was developed by Beck *et al*. [21] to assess the risk and severity of depressive symptoms. The Turkish adaptation and validation were conducted by Hisli [22]. The scale's total score ranges from 0-63. In line with the corresponding score ranges, the scale includes 0-9 minimal, 10-16 mild mood disorders, 17-29 moderate depression, and between 30-63, which is considered severe depression. In this study, the Cronbach's α coefficient of the scale was determined as 0.922.

Statistical Analysis

The data obtained in the study were analyzed using the SPSS (Statistical Package for Social Sciences) for Windows 25.0 program. The assumption of normality was assessed statistically using the Kolmogorov-Smirnov test, and visually and descriptively through Q-Q plots and skewness-kurtosis values. The results of the Kolmogorov-Smirnov test indicated no significant deviation from normality. The difference between the two independent groups was assessed using an independent t-test. One-way analysis of Variance (ANOVA) was utilized to compare more than

Table 1. Socio-demographic characteristics of participants (n=686)

	n	%
Age		
18-25	444	64.7
26-35	137	20.0
36-45	52	7.6
46 and above	53	7.7
Marital Status		
Unmarried	480	70.0
Married	206	30.0
Education Level		
High college and lower	162	23.6
University	489	71.3
Post Graduate	35	5.1
Employment Status		
Student	171	24.9
Employed	281	41.0
Unemployed	234	34.1
Smoker		
Yes	189	27.6
No	497	72.4
Alcohol Consumption		
Yes	551	19.7
No	135	80.3

two independent groups, and the Bonferroni test was employed to identify the group from which the difference originated. To examine the relationships between the variables, Pearson correlation coefficients were calculated. This analysis was used to evaluate the linear associations between PSQI, BAI, and BDI scores.

To identify the factors affecting sleep quality among participants, a multiple linear regression analysis was conducted. In this analysis, the dependent variable was the PSQI score, and the independent variables were the BAI and BDI scores. This model was used to evaluate the predictive effects of anxiety and depression levels on sleep quality. $P<0.05$ was deemed to be statistically significant.

RESULTS

Information on the descriptive characteristics of the participants is provided in Table 1. In this study, 64.7% of the participants were between the ages of 18-25, 70.0% were single, 71.3% were university graduates,

Table 2. Sleep characteristics of participants during the pandemic period

	n	%
Have you had any changes in your waking hours during the pandemic?		
No change	280	40.8
I started waking up later than usual.	341	49.7
I'm waking up earlier than usual	65	9.5
Has there been a change in your sleep time compared to the pre-pandemic period?		
No change	287	41.8
I sleep less than before the pandemic	121	17.6
I sleep a lot compared to the pre-pandemic period.	278	40.5
How was your sleep quality during the pandemic period?		
Very good	40	5.8
Good	205	29.9
Middle	291	42.4
Bad	119	17.3
Very bad	31	4.5
How long are you exposed to sunlight during the day?		
None	103	15.0
1 hour or less	313	45.6
1-2 hours	147	21.4
2-3 hours	57	8.3
3-4 hours	32	4.7
4 hours or more	34	5.0
How much screens are you exposed to during the day compared to the pre-pandemic period?		
1 hour or less	64	9.3
1-2 hours	49	7.1
2-3 hours	84	12.2
3-4 hours	113	16.5
4 hours or more	376	54.8

Table 3. Sleep quality, anxiety and depression scores according to the characteristics of the participants

	PSQI	F[a]/t[b]	P value	BAI	F[a]/t[b]	P value	BDI	F[a]/t[b]	P value
Age									
18-25	6.61±2.86	2.606	0.051	15.80±13.13	1.304	0.272	16.76±12.26	9.452	**<0.001***
26-35	5.95±2.53			13.52±12.18			12.81±10.33		
36-45	5.98±3.26			14.18 ±11.59			11.27±9.44		
46 and above	6.02±3.14			14.22±13.16			10.62±9.65		
Marital Status									
Unmarried	6.59±2.91	2.892	**0.004***	15.73±13.13	1.997	**0.046***	16.41±12.27	4.606	**<0.001***
Married	5.90±2.71			13.60±12.05			11.97±9.71		
Education Level									
High college and lower	5.90±2.95	4.441	**0.012***	14.20±11.98	1.013	0.364	14.41±11.47	0.363	0.695
University	6.48±2.83			15.23±13.17			15.31±11.97		
Post graduate	7.31±2.72			17.45±12.22			14.83±9.54		
Employment Status									
Student	6.46±2.99	1.236	0.296	16.72±14.02	3.310	**0.037***	15.84±11.80	0.939	0.421
Employed	6.16±2.79			13.67±12.41			14.43±11.41		
Unemployed	6.58±2.85			15.62±12.85			15.24±12.07		
Smoker									
Yes	6.86±2.83	2.712	**0.007***	17.40±13.25	2.910	**0.004***	17.65±12.08	3.576	**<0.001***
No	6.20±2.86			14.22±12.60			14.10±11.46		
Alcohol Consumption									
Yes	7.50±2.74	-5.127	**<0.001***	19.71±13.63	-4.724	**<0.001***	18.03±12.60	-3.282	**0.001***
No	6.11±2.83			13.97±12.40			14.35±11.41		
Mean PSQI, BAI, BDI Scores	6.38±2.87			15.08±11.73			15.10±12.85		

Data are shown as mean±standard deviation. BAI=Beck Anxiety Inventory, BDI=Beck Depression Inventory, PSQI=Pittsburgh Sleep Quality Index.
[a]Tested by one-way ANOVA with post-hoc Bonferroni test. [b]Independent sample t-test *P<0.05

41.0% were employed, 27.6% smoked, and 19.7% drank alcohol.

The distribution of the participants according to their sleep characteristics during the pandemic period is presented in (Table 2). In our study, 49.7% of the participants reported waking up later than before the pandemic, 40.5% reported an increase in their sleep duration during the pandemic, 21.8% reported poor sleep quality, 45.6% reported being exposed to sunlight for one hour or less during the day compared to before the pandemic, and 54.8% reported being exposed to screens for four hours or more during the day. When examining the differences in sleep quality, anxiety, and depression scores (Table 3), significant differences were found between sleep quality and marital status, education, smoking, and alcohol consumption. The sleep quality of single individuals was worse than that of married individuals (P<0.05), and the sleep quality of postgraduate students was worse than that of individuals with a high school education or lower (P<0.05). Smokers and alcohol users had worse sleep quality compared to non-smokers and non-drinkers (P<0.05).

Significant differences were found in anxiety scores based on marital status, employment status, and tobacco and alcohol use. The anxiety scores of single individuals were higher than those of married individuals (P<0.05), and students had higher anxiety scores than working individuals (P<0.05). Smokers and alcohol users had higher anxiety scores compared to non-smokers and non-drinkers (P<0.05). Significant differences in depression scores were found based on age, marital status, smoking, and alcohol use. The depression scores of individuals in the 18-25 age group were higher than those in other age groups (P<0.05). Additionally, singles had higher depression scores compared to married individuals (P<0.05). Smokers and alcohol users also had higher depression scores compared to non-smokers and non-drinkers (P<0.05). The mean scores of the PSQI, BAI, and BDI scales used in the study were as follows: PSQI: 6.38±2.87, BAI: 15.08±11.73, and BDI: 15.10±12.85.

The relationship between sleep quality and anxiety and depression scores was found to be statistically significant (Table 4). As a result of the Bonferroni test, it was determined that the group with severe anxiety and depression had worse sleep quality than the other groups (P<0.05).

The results showing the relationship between the PSQI, BAI, and BDI scales used in the study are presented in (Table 5). The results show a moderate positive and significant relationship between sleep quality and anxiety (r=0.517; P<0.01), a moderate positive and significant relationship between sleep quality and depression (r=0.513; P<0.01), and a strong positive and significant relationship between anxiety and de-

Tablo 4. Sleep quality scores by anxiety and depression scores of the participants

	n	%	Mean±SD	F[a]	P value
Anxiety					
Minimal	250	36.44	4.73±2.12	78.274	**<0.001***
Mild	156	22.74	6.31±2.75		
Moderate	138	20.12	7.26±2.65		
Severe	142	20.70	8.52±2.58		
Total	686	100			
Depression					
Minimal	268	39.07	4.90±2.40	70.926	**<0.001***
Mild	159	23.18	6.40±2.58		
Moderate	173	25.22	7.40±2.60		
Severe	86	12.53	8.97±2.51		
Total	686	100			

SD=standard deviation. [a]Tested by one-way ANOVA with post-hoc Bonferroni test. *P<0.05

Table 5. Correlations between pittsburgh sleep quality index, beck anxiety inventory and beck depression inventory scores

Variables	PSQI	BAI	BDI
PSQI	-		
BAI	0.517**	-	
BDI	0.513**	0.647**	-

BAI=Beck Anxiety Inventory, BDI=Beck Depression Inventory, PSQI=Pittsburgh Sleep Quality Index
**P<0.01

pression (r=0.647; P<0.01).

The results of the multiple linear regression analysis show that anxiety (ß=0.071) and depression (ß=0.075) have a significant effect on sleep quality (P<0.05) (Table 6). With these effects, it is observed that 32% of the change in sleep quality is explained by anxiety and depression (Adjusted R^2=0.320). Additionally, the effect of anxiety on sleep quality was found to be higher than that of depression (Beta=0.318).

DISCUSSION

This study examined the anxiety, depression, and sleep problems experienced by women during the COVID-19 pandemic and the relationships between these problems. It was found that high anxiety and depression during the pandemic were significantly associated with poor sleep quality. Mandatory changes such as home quarantine, restriction of recreational activities, and transition to working from home led to significant changes in participants' mental health and sleep patterns [23]. In our study, various factors that may affect sleep quality were investigated and participants' responses to these factors were evaluated. It was determined that 49.7% of the participants woke up later during the pandemic compared to before the pandemic, 40.5% of them reported that their sleep duration increased compared to before the pandemic, and 45% were exposed to less than one hour of sunlight per day. Similarly, Raman and Coogan [24] reported that the participants in their study woke up later during the pandemic, and Rezaei and Grandner [25] reported that participants' sleep duration increased during COVID-19. Low exposure to sunlight can affect sleep quality by causing circadian rhythm disorders [26]. In our study, it was determined that 54.8% of the participants spent more than four hours in front of a screen. Majumdar *et al*. [27] also found that screen exposure increased during the pandemic. According to our study results, it is seen that women's sleep problems increased during the pandemic period.

In our study, it was found that 58.6% of women had poor sleep quality. Similar findings were obtained in other studies. Especially during the COVID-19 pandemic, women's PSQI scores were found to be high and their sleep quality was reported to be low [28-30]. It is seen that women have higher PSQI scores compared to men and sleep problems are more common [30-32].

Table 6. Multiple linear regression analysis of variables affecting participants' Pittsburgh Sleep Quality Index values

Dependent Variable	Independent Variables	ß	t	P value	VIF	Beta	F	Model (P)	Adjusted R^2
PSQI	**Constant**	4.181	27.416	**<0.001***					
	BAI	0.071	7.683	**<0.001***	1.721	0.318	162.298	**<0.001***	0.320
	BDI	0.075	7.446	**<0.001***	1.721	0.308			

BAI=Beck Anxiety Inventory, BDI=Beck Depression Inventory, PSQI=Pittsburgh Sleep Quality Index
Durbin Watson=1.869 *P<0.05

The mean BAI score of the participants was determined as 15.08±11.73. Smith *et al*. [34] found the mean BAI score of women as 14.1 ± 12.2. Massad *et al*. [35] reported that the mean BAI score of women in Jordan was 9.67. The high anxiety scores obtained in our study are not directly comparable because there are several differences between different populations. The mean BDI score of the participants in the current study was determined as 15.10 ± 12.85. Guadagni *et al*. [36] reported that the mean BDI score in women was 14.0 ± 9.9. Cellini *et al*. [10] reported that the mean BDI score in women students in their study in Italy was 9.93 ± 8.36. These differences may be due to differences in the age groups and sample size of the participants.

According to the findings obtained from our study, a significant relationship was found between sleep quality and some sociodemographic characteristics such as marital status, education level, smoking and alcohol use. It was observed that single participants had worse sleep quality than married participants. The results of the study by Deo *et al*. [37] are also consistent with these findings. It was observed that individuals who smoke and drink alcohol had higher sleep quality scores and that individuals in this group had poor sleep quality. These findings, in line with previous epidemiological studies, show that smoking and alcohol use have negative effects on sleep quality [38-40]. In our study, a significant relationship was found between the sociodemographic variables of age, marital status, smoking and alcohol use and the mean BDI scores. Similarly, a significant relationship was found between the sociodemographic variables of marital status, employment status, smoking and alcohol use and the mean BAI scores. When looking at age categories, it was found that women between the ages of 18-25 had higher depression scores than other age groups. Solomou and Constantinidou [41] stated that depression scores were higher in young individuals. It has been reported that young adults have poor sleep quality and high anxiety and depression risk [42]. In our study, it was determined that anxiety scores were higher in students. Wang *et al*. [43] found that students' anxiety levels were higher than other professional groups. Distance education in universities in Türkiye is thought to increase anxiety [44].

In our study, anxiety and depression scores were found to be higher in single participants than in married participants. Similarly, Gualano *et al*. [45] reported that anxiety and depression scores were higher in single participants in their study. Anxiety and depression scores were found to be higher in participants who smoked and drank alcohol. This finding is consistent with previous studies showing that individuals who smoked and drank alcohol are at higher risk for anxiety and depression [40, 46]. The pandemic period may pose potential risks for smoking and alcohol abuse and requires public health measures to protect vulnerable individuals. In this study, it was found that participants with severe depression and anxiety had higher sleep quality scores than other groups and that there was a significant relationship between sleep quality and anxiety and depression. In addition, it was found that the effect of anxiety on sleep quality was more pronounced than depression. Decreased sleep quality is strongly associated with poor mood [26]. Sleep problems are an important factor that can negatively affect psychological health [23].

Limitations

Among the limitations of the study, the sample size being restricted to a specific geographical area and the participants consisting solely of women can be mentioned. These limitations should be taken into account as they may restrict the generalizability of the findings. In future research, it is thought that studies conducted with large-scale and more heterogeneous samples, including individuals from different age groups as well as male participants, may provide more comprehensive results. Additionally, it would be beneficial to conduct studies that track the long-term psychological effects post-COVID-19 and evaluate the effectiveness of intervention strategies.

The study focused only on women, so the findings may not be generalizable to other populations. Future research should consider longitudinal studies and more diverse participant samples to understand these relationships in more depth.

CONCLUSION

This study reveals that the increased levels of anxiety and depression during the COVID-19 pandemic are significantly associated with poor sleep quality. The younger age group, students, singles, smokers, and al-

cohol users were at higher risk of increased anxiety, depression, and poor sleep quality during the pandemic.

According to our results, it is important to develop more targeted strategies for women, young people, and other vulnerable groups when creating health policies, to minimize the impacts of the pandemic. These strategies may include interventions such as ensuring easy access to psychological support services, increasing online therapy and support groups. Additionally, it is emphasized that early interventions and long-term monitoring for sleep disorders and psychological issues should be implemented. In this process, the adoption of community-based solutions through the collaboration of mental health professionals and healthcare institutions can alleviate the long-term psychological burden of the pandemic.

Ethical Statement

This study was approved by the Ethics Committee of Clinical Research, Faculty of Medicine, Uşak University (Date: 03.02.2021, Number: 35-35-11). We conducted this research in accordance with the guidelines in the Declaration of Helsinki. Informed consent was obtained from all participants.

Authors' Contribution

Study Conception: ŞÇ, RA; Study Design: ŞÇ, RA; Supervision: ŞÇ, RA; Funding: ŞÇ; Materials: ŞÇ, RA; Data Collection and/or Processing: ŞÇ, RA; Statistical Analysis and/or Data Interpretation: ŞÇ; Literature Review: ŞÇ, RA; Manuscript Preparation: ŞÇ, RA; and Critical Review: ŞÇ, RA.

Conflict of interest

The author disclosed no conflict of interest during the preparation or publication of this manuscript.

Financing

The author disclosed that they did not receive any grant during the conduction or writing of this study.

Editor's note

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