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# Sleep quality, quality of life, fatigue, and mental health in COVID-19 post-pandemic Türkiye: a cross-sectional study

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**Aim:** This study explores the predictors and associated risk factors of sleep quality, quality of life, fatigue, and mental health among the Turkish population during the COVID-19 post-pandemic period.

**Materials and methods:** A cross-sectional survey using multi-stage, stratified random sampling was employed. In total, 3,200 persons were approached. Of these, 2,624 (82%) completed the questionnaire package consisting of socio-demographic information, Pittsburgh Sleep Quality Index (PSQI), the WHO Quality of Life Brief Version (WHOQOL-BREF), Fatigue Assessment Scale (FAS), Patients Health Questionnaire (PHQ-15), GAD-7 anxiety scale, and the 21-item Depression, Anxiety, Stress Scale (DASS-21).

**Results:** Significant differences between genders were found regarding socio-demographic characteristics ( $p < 0.01$ ). Using PHQ-15 for depressive disorders, significant differences were found between normal and high severity scores ( $\geq 10$ ), regarding age group ( $p < 0.001$ ), gender ( $p = 0.049$ ), educational level ( $p < 0.001$ ), occupational status ( $p = 0.019$ ), cigarette smoking ( $p = 0.002$ ), waterpipe-narghile smoking ( $p = 0.039$ ), and co-morbidity ( $p = 0.003$ ). The WHOQOL-BREF indicated strong correlations between public health, physical health, psychological status, social relationships, environmental conditions, and sleep disorders ( $p < 0.01$ ). Furthermore, comparisons of the prevalence of mental health symptoms and sleeping with PHQ-15 scores  $\geq 10$  ( $p = 0.039$ ), fatigue ( $p = 0.012$ ), depression ( $p = 0.009$ ), anxiety ( $p = 0.032$ ), stress ( $p = 0.045$ ), and GAD-7 ( $p < 0.001$ ), were significantly higher among the mental health condition according to sleeping disorder status. Multiple regression analysis revealed that DASS21 stress ( $p < 0.001$ ), DASS21 depression ( $p < 0.001$ ), DASS21 anxiety ( $p = 0.002$ ), physical health (WHOQOL-BREF) ( $p = 0.007$ ), patient health depression-PHQ-15 ( $p = 0.011$ ), psychological health (WHOQOL-BREF) ( $p = 0.012$ ), fatigue ( $p = 0.017$ ), and environmental factors (WHOQOL-BREF) ( $p = 0.041$ ) were the main predictor risk factors associated with sleep when adjusted for gender and age.

**Conclusion:** The current study has shown that sleep quality was associated with the mental health symptoms of depression, anxiety, stress, and fatigue. In addition, insufficient sleep duration and unsatisfactory sleep quality seemed to affect physical and mental health functioning.

## KEYWORDS

COVID-19, sleep quality, quality of life, mental health, depression, anxiety, stress

## Introduction

According to the 2023 report by the WHO, the COVID-19 pandemic, which started in November 2019, produced over 760 million confirmed cases worldwide, and over 6.9 million reported deaths as of August 2023. Since the beginning of the pandemic, significant measures have been taken across the world, such as travel restrictions and home confinements, to control the pandemic. With the progress achieved in the management of the pandemic through the year 2021, the restrictions were gradually lifted. However, more than 3 years since the onset of the COVID-19 pandemic, serious impacts on many aspects of public health are still being observed, including sleep disturbances and mental health symptoms, along with various physiological symptoms (1, 2). Therefore, it is important to explore how the pandemic situation affected public health in order to reduce negative consequences and promote changes in lifestyles and improvements in overall health and life quality among the population. However, pandemic conditions have left an ongoing impact on the physical and mental health of many individuals regardless of whether they had the infection or not. The current research focuses particularly on sleep quality, quality of life, and several mental health symptoms during the aftermath of pandemic restrictions among the Turkish population.

Sleep disturbances, such as difficulty falling asleep or maintaining sleep, are quite common in many countries around the world (3, 4). Since poor sleep quality is linked to many medical and psychological disorders including obesity, cardiovascular diseases, and depression, and has a direct effect on life quality, investigating these effects of sleep quality is important (5–8). Several neurocognitive dysfunctions such as attention deficits and cognitive performance impairment, as well as psychological disorders such as stress, depression, anxiety, and impulse control problems, are related to sleep disturbances (5, 9). If untreated, such sleep-related deficits may lead to further potentially health-threatening consequences such as increased risk of cardiovascular diseases (4). Furthermore, disturbed sleep quality also has important consequences on quality of life, as it can lead to daytime impairments that affect people's performance at work and quality of social life (4, 5).

Since the outbreak of the COVID-19 pandemic, multiple studies have shown increased sleep disturbances due to factors related to the pandemic [8, 1, 9, (10)]. A systematic review and meta-analysis investigating changes in the quality of sleep and disturbances of sleep among the general population prior to and during the COVID-19 lockdown has revealed a decline in sleep quality and sleep efficiency, and an increase in sleep disturbances (11). The worldwide pandemic created an unpredictable, stressful, anxiety-provoking environment, with fear of infection and financial concerns added to social isolation and other negative consequences of lockdowns (12–14). Home confinement also resulted in increased screen time as many individuals turned to the media and the internet for information on the pandemic or to distract themselves from the stressful situation. These psychological and physical conditions may have had a negative impact on the quality of sleep experienced by the general population (13, 15–17).

In the initial phases of the pandemic, people with mental health problems in the general population were reported to be struggling with higher levels of depression, anxiety, stress, and fear symptoms (6, 12, 18–24). Indeed, several studies conducted in various countries have reported the negative effects of the COVID-19 pandemic on the mental health of the general population (1, 14). Multiple studies have also shown associations among depression, anxiety, stress, and negative changes in sleep (13, 15, 25, 26).

Although the number of infection cases has dramatically declined and most of the world has lifted restrictions concerning COVID-19, it is still important to assess the long-term health consequences of experiencing the pandemic among the general population.

Accordingly, the objective of this study is to examine the predictors and associated risk factors of sleep quality, quality of life, fatigue, and mental health among the Turkish population during the post-COVID period. For this purpose, several demographic variables, habits, and living conditions were explored as predictor variables of the outcome health variables. In addition, based on the literature reviewed, poor sleep quality is expected to be correlated with negative mental health symptoms, fatigue, and poor quality of life.

## Participants and methods

The research used a cross-sectional multi-center-based survey, conducted among the urban and rural populations of Istanbul, including men and women (aged 20 years and over). The sample size calculations were derived from the following parameters: a margin of error of 2.0% with a confidence level of 99%, and an estimated sample proportion of 25% to be considered. Accordingly, a multi-stage total of 3,200 individuals were approached. A total of 2,624 (82%) participants completed the questionnaire between 1 January and 31 December 2022.

## Measurements

### World health organization quality-of-life assessment

The WHOQOL-BREF (27) has 26 questions consisting of four domains: physical health, psychological status, social relationships, and environmental conditions. The WHOQOL-BREF has been shown to have good reliability and validity in a number of different populations.

### Patients health questionnaire - depression

The PHQ-15 is a screening tool for depressive disorders (28). The validity and reliability of the Turkish version of the PHQ-15 exhibited satisfactory internal consistency (Cronbach's alpha = 0.78). Total scores can range from 0 to 30, resulting in the following categories: 0–4 none, 5–9 mild, 10–14 moderate, and 15–30 severe. The recognized cut-off value is 10.

TABLE 1 Socio-demographic characteristics of participants by gender (N = 2,624).

		Men= 1,420	Women= 1,204	<i>p</i> -value significance
		<i>n</i> (%)	<i>n</i> (%)	
<b>Age group</b>	<30	425 (29.9)	338 (28.1)	0.004
	30–39	312 (22.0)	274 (22.8)	
	40–49	234 (16.5)	264 (21.9)	
	50–59	263 (18.5)	188 (15.6)	
	≥60	186 (13.1)	140 (11.6)	
<b>Educational level</b>				
	Preparatory	115 (8.1)	12 (1.0)	0.001
	Secondary	247 (17.4)	88 (7.4)	
	High school	465 (32.7)	101 (8.4)	
	University / College	420 (29.6)	819 (68.0)	
	Postgraduate M.Sc. / PhD	173 (12.2)	183 (15.2)	
<b>Occupation status</b>				
	Professional/ Sedentary	386 (27.2)	434 (36.0)	0.001
	Administrative/ Clerical	476 (33.5)	344 (28.6)	
	Manual labor	218 (15.4)	31 (2.6)	
	Housewife	0	312 (25.9)	
	Business	340 (23.9)	83 (6.9)	
<b>Income</b>	Low	534 (46.0)	381 (31.6)	0.001
	Medium	415 (30.3)	413 (34.0)	
	High	471 (23.7)	410 (34.4)	
<b>Physical exercise</b>				
	Yes	391 (27.5)	322 (26.7)	0.627
	No	1,029 (72.5)	234 (73.3)	
<b>Number of rooms</b>				
	≤ 3 rooms	783 (55.1)	646 (53.7)	0.103
	> 3 rooms	637 (44.9)	558 (46.3)	
<b>Number of family members</b>				
	≤ 5 people	650 (45.8)	593 (49.3)	0.049
	> 5 people	770 (54.2)	611 (50.7)	
<b>Cigarette smoker</b>				
	Yes	357 (25.1)	239 (19.9)	0.001
	No	1,063 (74.9)	965 (80.1)	
<b>Nargile-waterpipe smoker</b>				
	Yes	278 (19.6)	174 (14.5)	0.001
	No	1,142 (80.4)	1,030 (85.5)	
<b>Co-morbidity</b>				
	None	1,041 (73.3)	998 (82.9)	0.004
	One	308 (21.7)	140 (11.6)	
	Two	71 (5.0)	66 (5.5)	

*n* = the number of participants within each subgroup.

TABLE 2 Participants' characteristics, lifestyle behavior, and depression using PHQ-15 tools (N = 2,624).

		N = 1,751; PHQ-15 < 10 none-mild	N = 873; PHQ-15 ≥ 10 moderate-severe	p-value significance
		n (%)	n (%)	
Age group	<30	585 (33.4)	178 (20.4)	0.001
	30–39	349 (19.9)	237 (27.1)	
	40–49	334 (19.1)	164 (18.8)	
	50–59	306 (17.5)	145 (16.6)	
	≥60	177 (10.1)	149 (17.1)	
<b>Gender</b>				
	Men	924 (52.8)	496 (56.8)	0.049
	Women	827 (47.2)	377 (43.2)	
<b>educational level</b>				
	Preparatory	81 (4.6)	46 (5.3)	0.001
	Secondary	223 (12.7)	113 (12.9)	
	High school / College	333 (19.0)	233 (26.7)	
	University	868 (49.6)	371 (42.5)	
	Postgraduate M.Sc. / PhD	246 (14.8)	110 (12.6)	
<b>Occupational status</b>				
	Professional / Sedentary	559 (31.9)	261 (29.9)	0.019
	Administrative / Clerical	537 (30.7)	283 (32.4)	
	Manual Labor	177 (10.1)	72 (8.2)	
	Housewife	220 (12.6)	92 (10.5)	
	Business	258 (14.7)	165 (18.9)	
<b>Physical activity</b>				
	Yes	481 (27.5)	232 (26.6)	0.627
	No	1,270 (72.5)	641 (73.4)	
<b>Number of rooms</b>				
	≤ 3 rooms	934 (53.3)	495 (56.7)	0.103
	> 3 rooms	817 (46.7)	378 (43.3)	
<b>Number of family members</b>				
	≤ 5 people	809 (46.2)	434 (49.7)	0.049
	> 5 people	942 (53.8)	439 (50.3)	
<b>Cigarette smoker</b>				
	Yes	404 (23.1)	155 (17.8)	0.002
	No	1,347 (76.9)	718 (82.2)	
<b>Nargile-waterpipe smoker</b>				
	Yes	349 (19.6)	142 (16.3)	0.039
	No	1,408 (80.4)	731 (83.7)	
<b>Co-morbidity</b>				
	None	1,340 (76.6)	699 (80.1)	0.003
	One	328 (18.7)	120 (13.7)	
	Two	831 (4.7)	54 (6.2)	

TABLE 3 Prevalence of mental health symptoms by gender ( $N = 2,624$ ).

Variables	Men = 1,420 Yes n (%)	Women = 1,204 Yes n (%)	p-value significance
<b>GHQ-15</b>			
None	528 (37.2)	489 (40.6)	
Mild	396 (27.9)	338 (28.1)	
Moderate	297 (20.9)	219 (18.2)	0.185
Severe	199 (14.0)	158 (13.1)	
<b>Fatigue</b>			
Normal	911 (64.2)	783 (63.4)	0.678
Fatigue	509 (35.8)	441 (38.6)	
<b>Pittsburgh sleep quality index</b>			
Good sleep	507 (35.7)	385 (32.0)	
Average sleep	447 (31.5)	356 (29.6)	0.010
Poor sleep	466 (32.8)	463 (38.5)	
<b>DASS21 depression</b>			
Normal	442 (31.1)	309 (25.7)	
Mild	321 (22.6)	297 (24.7)	
Moderate	298 (21.0)	237 (19.7)	0.001
Severe	243 (17.1)	209 (17.4)	
Very severe	116 (8.2)	152 (12.6)	
<b>DASS21 anxiety</b>			
Normal	528 (37.2)	351 (29.2)	
Mild	430 (30.3)	441 (36.6)	
Moderate	170 (12.0)	177 (14.7)	0.001
Severe	161 (11.3)	117 (9.7)	
Very severe	131 (9.2)	118 (9.8)	
<b>DASS21 stress</b>			
Normal	504 (35.5)	404 (33.6)	
Mild	297 (20.9)	244 (20.3)	
Moderate	262 (18.5)	210 (17.4)	0.031
Severe	213 (15.0)	174 (14.5)	
Very severe	1,443 (10.1)	172 (14.3)	
<b>GAD-7 anxiety</b>			
Minimal	510 (35.9)	417 (34.6)	
Mild	371 (26.1)	267 (22.2)	0.010
Moderate	375 (26.4)	360 (29.9)	
Severe	164 (14.5)	160 (13.3)	

### Depression anxiety stress scale

The 21-item DASS-21 by Lovibond and Lovibond (24) was used to assess depression, anxiety, and stress. Cronbach's alpha internal consistency coefficient was found as  $\alpha = 0.86$  for the depression subscale,  $\alpha = 0.84$  for the anxiety subscale, and  $\alpha = 0.80$  for the stress subscale in the current study. The scale categorizes the participants into five categories: normal, mild, moderate, severe, and very severe.

### Generalized anxiety disorder screener

The GAD-7 is a simple instrument containing seven items that track anxiety symptoms (29). The reliability coefficient of Cronbach's  $\alpha$  for the overall GAD-7 scale is 0.86, which is greater than the recommended value of 0.80, suggesting excellent reliability. The total scores range from 0 to 21 and were categorized as follows: minimal/no anxiety (0–4), mild (7–9, 13, 15), moderate (11, 12, 14, 16, 17), and severe (1, 18–23).

### Pittsburgh sleep quality index

The Pittsburgh Sleep Quality Index (PSQI) was developed by Buysse et al. (30). The reliability and validity of PSQI in the current study population was 0.84. The categorization of the total scores of PSQI is as follows: PSQI  $\leq 5$  = "Good sleep quality," PSQI 6–8 = "Average sleep," and PSQI  $\geq 9$  = "Poor sleep."

### Fatigue assessment scale

The Fatigue Assessment Scale (FAS), developed by Michielsen et al. (31), is a 10-item self-report questionnaire intended to assess general fatigue. The FAS displayed good internal consistency (Cronbach's alpha = 0.91). A total FAS score ranging from 10 to 21 indicates no fatigue (normal) and FAS scores ranging from 22 to 50 indicate fatigue.

### Statistical analyses

SPSS v25 was utilized to analyze the present data, and percentages were computed for each categorical variable. To assess the normal distribution of the data, the Kolmogorov-Smirnov test and normality plots were utilized. Student's  $t$ -test was used to ascertain the significance of differences between mean values. The chi-square test was used to determine significant differences between categorical variables. A multivariate stepwise regression analysis was performed to predict potential risk factors (determinants) for sleep and mental health. Furthermore, the multiple stepwise regression analysis was used to control for the effects of gender and age. All statistical tests were two-tailed, and  $p < 0.01$  was considered significant.

## Results

A significant difference was found between men and women in educational level, occupational status, monthly income, place of residence as urban or rural, number of rooms, and number of family members ( $p < 0.01$ ) (Table 1). The educational status ranged from primary school to university degree and postgraduate levels. In terms of occupational status, the majority were in professional/sedentary and clerical occupation categories.

Table 2 provides participants' characteristics, lifestyle behavior, and level of depression using PHQ-15, and the results indicate significant differences between normal and high severity regarding age group ( $p < 0.001$ ), gender ( $p = 0.049$ ), educational level ( $p < 0.001$ ), occupational status ( $p = 0.019$ ), smoking cigarettes

TABLE 4 Quality of life descriptive statistics with the test for normality of distribution and reliability of the domains.

Domain	Mean	Median	Standard deviation	Minimum	Maximum	P-value	Cronbach alpha
Physical health	13.46	14.00	2.75	4.85	19.72	<0.001	0.797
Psychological health	13.95	14.00	2.91	4.34	20.00	<0.001	0.840
Social relationships	14.87	14.67	3.16	4.06	20.00	<0.001	0.818
Environment	15.28	15.00	3.04	5.18	21.54	<0.001	0.805
Rate your quality of life	3.99	4.00	0.93	1.00	5.00	<0.001	0.826
How satisfied are you with your health?	3.77	4.00	0.87	1.00	5.00	<0.001	0.826

( $p = 0.002$ ), waterpipe-narghile smoking ( $p = 0.039$ ), and comorbidity ( $p = 0.003$ ). Smoking cigarettes was reported by 25% of the participants, and narghile waterpipe use was reported by 20%.

Table 3 shows the prevalence of mental health symptoms by gender. The prevalence of depression was 30% among women and 20% among men. The prevalence of mental health symptoms is significantly higher among women than men regarding depression ( $p < 0.001$ ), anxiety ( $p < 0.001$ ), stress ( $p = 0.031$ ), GAD-7 ( $p = 0.030$ ), and PSQI ( $p = 0.010$ ).

Table 4 presents the quality of life descriptive with the test for normality of distribution and reliability of the domains. The WHOQOL-BREF domains were all normally distributed. Furthermore, Table 5 reveals higher statistically significant positive correlations between WHOQOL-BREF public health, physical health, psychological status, social relationships, environmental conditions, and sleeping disorders ( $p < 0.01$ ). The correlation between WHOQOL-BREF physical health and sleeping disorders was  $r = 0.40$ ,  $p < 0.01$ .

Table 6 shows the prevalence of mental health symptoms and sleeping disorders. The prevalence of PHQ-15 scores  $\geq 10$  was 10% among people with sleeping disorders and 5% among people without sleeping disorders. The prevalence of PHQ-15 scores  $\geq 10$  was 10% among people with sleeping disorders and 5% among people without sleeping disorders. As can be seen, the prevalence of PHQ-15  $\geq 10$  scores ( $p = 0.039$ ), fatigue ( $p = 0.012$ ), depression ( $p = 0.009$ ), anxiety ( $p = 0.032$ ), stress ( $p = 0.045$ ), and GAD-7 ( $p < 0.001$ ) were significantly higher among the mental health condition compared to sleeping disorder status.

Table 7 shows the relationships between sleeping disorders and mental health using multivariate stepwise regression analysis. It can be seen from this table that DASS21 stress ( $p < 0.001$ ), DASS21 depression ( $p < 0.001$ ), DASS21 anxiety ( $p = 0.002$ ), physical health (WHOQOL-BREF) ( $p = 0.007$ ), patient health depression-PHQ-15 ( $p = 0.011$ ), psychological health (WHOQOL-BREF) ( $p = 0.012$ ), fatigue ( $p = 0.017$ ), and environmental factors (WHOQOL-BREF) ( $p = 0.041$ ) were considered as the main predictor risk factors associated with sleep quality after adjusting for age and gender.

TABLE 5 Pearson's Correlation between sleeping disturbances and mental health parameters ( $N = 2,624$ ).

Variables	Sleeping disturbances correlations coefficient (r)	P-value *significance
GHQ-15 general health questionnaire	$r = 0.335$	0.001
Fear	$r = 0.594$	0.001
Fatigue	$r = 0.486$	0.001
DASS21 depression symptoms	$r = 0.304$	0.001
DASS21 anxiety symptoms	$r = 0.178$	0.050
DASS21 stress symptoms	$r = 0.164$	0.001
GAD-7 anxiety	$r = 0.311$	0.001
<b>A WHOQOL-BREF quality of life assessment:</b>		
Public health	$r = 0.260$	0.005
Physical health (WHOQOL-BREF)	$r = 0.273$	0.005
Psychological health (WHOQOL-BREF)	$r = 0.829$	0.001
Social relationships	$r = 0.246$	0.005
Environmental factors (WHOQOL-BREF)	$r = 0.494$	0.001

## Discussion

Since the outbreak of COVID-19, the management and prevention of the negative health consequences of the pandemic have become a major concern. Globally, a significant emphasis has been placed on addressing and preventing the adverse effects of the COVID-19 pandemic on health since its onset, and this has emerged as a significant public health priority. Further research into the ongoing effects of COVID-19 is still needed to provide better insight into COVID-19-related physical and mental symptoms, and for the development of preventive measures and programs to promote healthy living (12, 18, 19, 23, 24). The findings of the current study contribute to this process by showing that

TABLE 6 Prevalence of mental health symptoms and sleeping disorders (N = 2,624).

Variables and scores	Sleep quality			p-value Significance
	Good sleep = 892 (PSQI score < 5) Yes n (%)	Average sleep = 830 (PSQI score 6–8) Yes n (%)	Poor sleep = 902 (PSQI score > 8) Yes n (%)	
<b>GHQ-15</b>				
None	372 (41.7)	290 (34.9)	355 (39.4)	
Mild	235 (26.3)	254 (30.6)	245 (27.2)	0.026
Moderate	183 (20.5)	167 (20.1)	166 (18.4)	
Severe	102 (11.4)	119 (14.3)	136 (15.1)	
<b>Fatigue</b>				
Normal	549 (61.5)	504 (62.0)	621 (67.6)	0.012
Fatigue	343 (68.5)	309 (38.0)	298 (32.4)	
<b>DASS21 depression</b>				
Normal	268 (30.0)	229 (27.6)	254 (28.2)	
Mild	222 (24.9)	198 (23.9)	198 (24.1)	
Moderate	200 (24.4)	151 (18.2)	184 (22.0)	0.009
Severe	121 (13.6)	159 (19.2)	172 (19.1)	
Very severe	81 (9.1)	93 (10.2)	94 (10.4)	
<b>DASS21 anxiety</b>				
Normal	314 (35.2)	288 (35.9)	277 (30.5)	
Mild	285 (32.0)	261 (32.5)	325 (35.0)	
Moderate	107 (12.0)	114 (14.2)	126 (13.6)	0.032
Severe	101 (11.3)	81 (10.1)	96 (10.3)	
Very severe	85 (9.5)	59 (7.3)	105 (11.3)	
<b>DASS21 stress</b>				
Normal	292 (32.7)	282 (34.0)	334 (37.0)	
Mild	174 (19.5)	181 (21.8)	186 (20.6)	
Moderate	170 (19.1)	141 (17.0)	161 (17.8)	0.045
Severe	153 (17.2)	130 (15.7)	104 (11.5)	
Very severe	103 (11.5)	96 (11.6)	117 (13.0)	
<b>GAD-7 anxiety</b>				
Minimal	331 (37.1)	271 (32.7)	325 (36.0)	
Mild	238 (26.7)	174 (21.0)	239 (26.5)	0.001
Moderate	227 (25.4)	259 (31.2)	236 (26.2)	
Severe	96 (10.8)	126 (13.2)	102 (11.3)	

negative health consequences of COVID-19 are still present in major populations.

The current research focused particularly on sleep quality, quality of life, fatigue, and mental health during the post-COVID-19 period. The findings indicated the prevalence of mental health symptoms and sleeping disorders among the Turkish population during the aftermath period of the pandemic. In addition, depression, stress, anxiety, physical and psychological health, fatigue, and environmental factors are shown as the main predictors of sleep quality in the current findings. The current

findings concur with previous multinational research showing that people who experience increased symptoms of depression were more vulnerable to experiencing psychological burdens because of the COVID-19 pandemic (32). Furthermore, studies have reported increased depression, anxiety, and stress, and poor sleep quality (16, 33, 34), as well as increased mental and physical health conditions related to COVID-19 exposure among Chinese populations (13, 17).

COVID-19 has created considerable amounts of fear, fatigue, depression, anxiety, and stress in many communities, and is

TABLE 7 The relationships between sleeping disorders and mental health using multivariate stepwise regression analysis ( $N = 2,624$ ).

Variables	Regression coefficient	Standard error	t-test value	p-value significance
DASS-21 stress symptoms	0.226	0.069	3.255	0.001
DASS-21 depression symptoms	0.980	0.221	4.518	0.001
DASS-21 anxiety symptoms	0.950	0.289	3.328	0.002
Physical health (WHOQOL-BREF)	0.620	0.230	2.709	0.007
Patient Health depression-PHQ-15	0.267	0.105	2.541	0.011
Psychological health (WHOQOL-BREF)	0.579	0.218	2.643	0.012
Fatigue	0.900	0.380	2.389	0.017
Environmental factors (WHOQOL-BREF)	0.169	0.083	2.043	0.041

Model adjusted for age, gender; MS, Metabolic Syndrome (1 = yes, 0 = no).

considered the greatest pandemic in centuries (12–14, 17, 23, 24, 32). Recently, studies conducted on populations in Istanbul, Turkey, found a high level of fatigue, stress, and fear associated with COVID-19 (12, 14, 24, 25). More recently, a systematic review and meta-analysis (11) comparing the effects of COVID-19 before and during lockdown, has shown a significant negative impact of the lockdown period in terms of changes in sleep quality among the general population. Consistently, the present study indicates the prevalence of poor sleep quality among Turkish populations and provides supporting evidence for the link between mental health symptoms and sleep disturbances. Studies examining associations between sleep quality and mental health symptoms often discuss the unclear direction of causality (3, 16). While mental health problems can result in the deterioration of sleep, on the other hand, sleep deprivation may lead to hormonal changes that can contribute to the development of mental health problems such as depression and anxiety. The present study suggests that the prevalence of sleep disorders remains high in the aftermath of the pandemic, and taking measures to improve sleep quality among the population should be considered a public health priority. Considering the main predictors and risk factors addressed in this research, implementing interventions to improve sleep quality among the general population could yield positive effects on both physical and mental health.

We are aware that our study has some limitations. First, we utilized a cross-sectional design, which may limit the ability to detect causal relationships. Second, the study was limited by the instruments employed to assess the variables. Our findings were derived from self-report assessments, and the assessment of mental health states did not involve clinical evaluation. The potential for recall bias and underreporting should therefore be considered. Third, since the study was based on self-administrated surveys, there is a possibility of selection bias in including participants based on their availability. On the other hand, one of the considerable strengths of the current study is its inclusion of a large sample size, enabling a thorough investigation that contributes valuable evidence supporting the link between sleep quality and mental health symptoms in a post-COVID-19 population.

## Conclusion

The current study revealed the prevalence of mental health symptoms (such as depression, stress, anxiety, and fatigue) among the general Turkish population who experienced the social trauma of the COVID-19 pandemic. The study provided supporting evidence concerning the association between sleep quality and mental health symptoms and indicated the substantial impact of the COVID-19 pandemic on this association. The findings show that, while negative mental health significantly contributes to poor sleep quality, insufficient sleep duration and unsatisfactory sleep quality have a negative impact on physical and mental health functioning. The current findings highlight the importance of providing adequate treatment and prevention strategies for sleep disorders as a public health concern, and this may help reduce the likelihood of the worsening, or onset, of several mental health disorders among the population.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving humans were approved by the Clinical Research Ethics Committee of Istanbul Medipol University, Institutional Review Board (Research Protocol IRB# E.10840098-604.01.01-0.14180 and IRB# E. 10840098-604.01.01- 1328). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

AB, EM, and MT contributed to the conception, design, data collection, organization, statistical analysis, wrote the first draft of

the article, they also contributed to the interpretation of the data, and writing and critical revision of the approved the final version of the manuscript. AV and TJ contributed to the conception, wrote the first draft of the article, contributed to the interpretation of the data and writing, and undertook critical revisions of the approved final version of the manuscript. All authors approved the final version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships

that could be construed as a potential conflict of interest.

The author(s) AB declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

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