

Effects of Quarantine due to the COVID-19 on Sleep Time, Anxiety, and Physical Activity in Adult Population: A Longitudinal Study in Kerman, Southeastern Iran

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ABSTRACT

Introduction: The COVID-19 outbreak imposed serious mental pressure on people worldwide. This study aimed to assess the effect of the two-month quarantine enforced at the beginning of the outbreak on physical activity (PA), sleep, and anxiety in inhabitants of Kerman.

Methods: The present study was conducted on 911 subjects randomly selected and interviewed twice: Before the COVID-19 outbreak (Feb 2020) and at the end of two-month quarantine. The level of anxiety was measured using the Beck Anxiety Inventory (BAI), PA by the Global Physical Activity Questionnaire (GPAQ), and daily sleep hours were reported by participants.

Results: A high percentage of people experienced a decrease in PA (39.6%), an increase in sleep hours (33.7%), and an increase in anxiety (16.3%) during the quarantine. Women, young people, students, and illiterate people were more susceptible to increased level of anxiety; and women, young people, hypersomniac people, and people with higher education levels experienced lower PA. Furthermore, the odds of an increase in sleep hours was higher in men and young people and lower in people with intense PA and higher levels of anxiety. The changes in the three variables were mostly related to the quarantine, although interaction between PA and sleep was also present.

Conclusion: The quarantine caused hypersomnia, a decrease in PA, and an increase in anxiety level especially among young people and women. As these are also risk factors of cardiovascular diseases, it is suggested that health authorities encourage an active lifestyle in the public and provide them with economic and psychological supports during the quarantine.

Keywords: COVID-19, Quarantine, Outbreak, Anxiety, Physical activity, Sleep hours

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Introduction

The COVID-19 outbreak has been a substantial health crisis with dramatic consequences worldwide (1). Not only this pandemic has led to the death of thousands people, but it has also imposed severe mental pressure on people around the world (2). Naturally, such a pandemic leads to undesirable mental health outcomes (1). The increased risk of being infected with an unknown pandemic disease, changes in travel plans, quarantine, social distancing, and concerns regarding the shortage of necessary goods created a universal atmosphere of anxiety and depression. Moreover, the sudden quarantine, closure of businesses, and social distancing due to the outbreak caused fundamental changes in people's lifestyle (1,3,4). The unpredictability of this situation, the uncertainty about how long it will take to control the disease, and the seriousness of the threat are some stressors which along with misanalysis and misinformation, can cause mental disorders such as anxiety in people (5). Recent studies have shown a high prevalence of anxiety in China and in other parts of the world, especially in the infected areas, during the COVID-19 outbreak (2,6-8). One recent study has shown that approximately 10% of the population in Iran experienced severe anxiety during the outbreak. In addition, the anxiety levels were higher in women and young people (9). It seems that the current situation has negatively affected mental health status, sleep, and physical activity (PA). In a study conducted in France and Switzerland using online questionnaires, it was found that the lockdown had led to a decrease in intense PA while the time allocated to moderate activities and walking had increased (8). Furthermore, the study showed that mental and physical health are directly associated with PA. Another similar study conducted on 41 children and adolescents in Italy, showed that the COVID-19 outbreak, quarantine, and closure of schools had decreased the amount of PA to four hours a week and increased sleep hours by 1 hour a day (10). In a study conducted by Casagrande *et al.* on 2291 Italians in April 2020, around 57.1% of the participants reported low sleep quality, 32.1% high anxiety levels, and 41.8% mental pressure during quarantine (11). Another study conducted by Roy *et al.* on 662 Indian adults in April 2020 showed that anxiety levels were high among the participants, and that 80% of them were preoccupied with and anxious about COVID-19.

Moreover, 12.5% reported sleep problems, 80% of whom had requested psychiatric services (12). A large number of the recent studies on mental health, sleep status, and PA have been cross-sectional studies, focusing on specific groups such as students (2), those with multiple sclerosis (MS) (3) or Parkinson's disease (13), COVID-19 patients, medical teams (14), and healthcare personnel (15). Consequently, there is not enough information on changes in mental health status, sleep, and PA in the general population, and factors that can affect these changes during the COVID-19 outbreak are relatively unknown. As sleep plays a crucial role in regulating emotions (16), sleep disorders can have a direct impact on the next day's emotional functioning. Moreover, changes in PA and having sedentary behaviors during the COVID-19 outbreak may affect mental and physical health (17). Considering the fact that the severity of the disease, economic and social status, religious beliefs, and tolerance threshold vary in different countries, and governments have had different approaches in terms of quarantine time and economic support during the outbreak, the impact of the disease might not be the same everywhere, and separate studies need to be conducted in each area. Therefore, the effect of the two-month quarantine (comparing pre-outbreak with post-quarantine data) on the people of Kerman, the largest southeastern city of Iran, was assessed. The novelty of this study is that the temporal changes of three health risk factors from February 2020 (before the outbreak) to the end of April 2020 (after the quarantine period in Iran), among the general population in Kerman, southeast Iran, were evaluated.

Materials and Methods

Study design and study population

This study was conducted in two rounds: In February 2020 (before the COVID-19 outbreak) and in April 2020 (after the peak of COVID-19, the end of quarantine) in Kerman, the largest city in southeastern Iran, with a population of 750,000. The present study was performed by focusing on the risk factors of coronary artery diseases (called Kerman Coronary Artery Disease Risk Factor Study; KERCADRS, Phase 3) on adult subjects aged 15 to 80 years. When the sample size of 911 (out of 10,000 in KERCADRS) reached, the study had to be stopped due to the outbreak and quarantine. The units of sampling were households who were

randomly selected from the city postcode list. The sampling method and risk factor measurement details may be found in the methodology report of KERCADRS (18). In brief, 420 post codes were randomly selected in phase 2, each representing a house (called a seed), and all eligible people (aged 15-80 years) in the household were invited to participate in the present study. All participants completed an informed consent form before participating in the study. They were attended to the study site in the morning for medical examination and interviewed while they were fasting for 10-12 hours. The study was conducted according to the Declaration of Helsinki, and the study protocol was approved by the Ethics Committee of the Kerman University of Medical Sciences, Iran (Ethical code: IR.KMU.REC.1399.609). Written informed consent form was obtained from all participants or their guardian before they took part in the study for both the examination and interview.

Interview and measurements

Study participants were examined and interviewed by a physician and trained interviewers for medical history of nine CAD risk factors (including anxiety, sleep duration, and level of PA) and demographic variables using standard structured questionnaires. The level of anxiety was measured using valid translations of the Beck anxiety inventory (BAI). The anxiety questionnaire was completed during face-to-face interviews before the COVID-19 outbreak and through phone interviews at the end of quarantine. The total score of the questionnaire (containing 21 statements, each scored by a value ranging from 0 to 3) ranged from 0 to 63. In Iran, the validity and reliability of BAI are 72% and 83%, respectively (19). The score ranges for different levels of anxiety were normal (0 to 7), mild (8 to 15), moderate (16 to 25), and severe (26 to 63). In this study, a score higher than 15 was taken to be abnormal for anxiety.

Physical activity was measured using the Global Physical Activity Questionnaire (GPAQ), and the metabolic equivalent of task (MET) was used to express the intensity of PA, as low (less than four times the energy consumed at rest), moderate (between four and eight times the energy consumed at rest), and intense (more than eight times the energy consumption at rest) PA. In Iran, the validity and reliability of the GPAQ are 81% and 82%, respectively (20). A

few questions were asked by the interviewer to quantify the participants' sleep duration and sleep time. Based on the American sleep association (ASA), insomnia was defined as sleep hours less than six hours, hypersomnia as more than nine hours, and normal sleep as seven to eight hours each day (21).

Statistical analysis

Data management and statistical analyses were performed by SPSS version 21.0. Categorical/ordinal variables were described by n (%). The McNemar and Wilcoxon tests were used to analyze the differences in the scores of the participants' sleep durations, levels of PA, and levels of anxiety before and after the COVID-19 lockdown. Generalized estimating equations (GEE) were used to estimate the effects of demographic variables on anxiety, sleep time, and low PA as outcomes. All tests were two-tailed, with a significance level of $P < 0.05$.

Results

Of 911 participants, 365 (40.1%) were men. Almost half of the participants (51.7%) aged over 55 years. Married people accounted for 80.4% of the samples, 72.7% were illiterate or have non-university education, and 67.6% were unemployed. The results of the prevalence of anxiety, sleep time level, and low physical activity (LPA) before and after the COVID-19 lockdown overall and in females and males are presented in Figure 1.

According to Figure 1, 19.5% and 26.3% of the participants experienced anxiety before and at the end of lockdown, respectively. Moreover, 42.8% and 58.8% experienced sleep time abnormality before and after the quarantine, respectively. The prevalence of LPA in the study population was 39.7% and 62.2% before and after the outbreak, respectively. The COVID-19 outbreak caused an increase in LPA in both sexes (from 39.4% to 65.8% in females and from 40.3% to 57.0% in males) and a decrease in intense PA in females (from 15.9% to 10.1%). In addition, anxiety levels and sleep hours increased in both sexes (Anxiety: from 23.1% to 31.9% in females and from 14.2% to 16.4% in males, Sleep time more than 9 hours: from 15.8% to 34.4% in females and from 19.2% to 38.7% in males).

The results of Figure 2 indicate that during the lockdown, 16.3% of people experienced a rise in anxiety levels. Furthermore, 33.7% of the

people experienced an increase and 17.1% a decrease in sleep hours. Moreover, PA decreased in 39.6% of the people. These changes were statistically significant ($P < 0.001$). In terms of

age group, the highest increase in anxiety, LPA, and sleep hours were observed in young and middle-aged people (Figure 3).

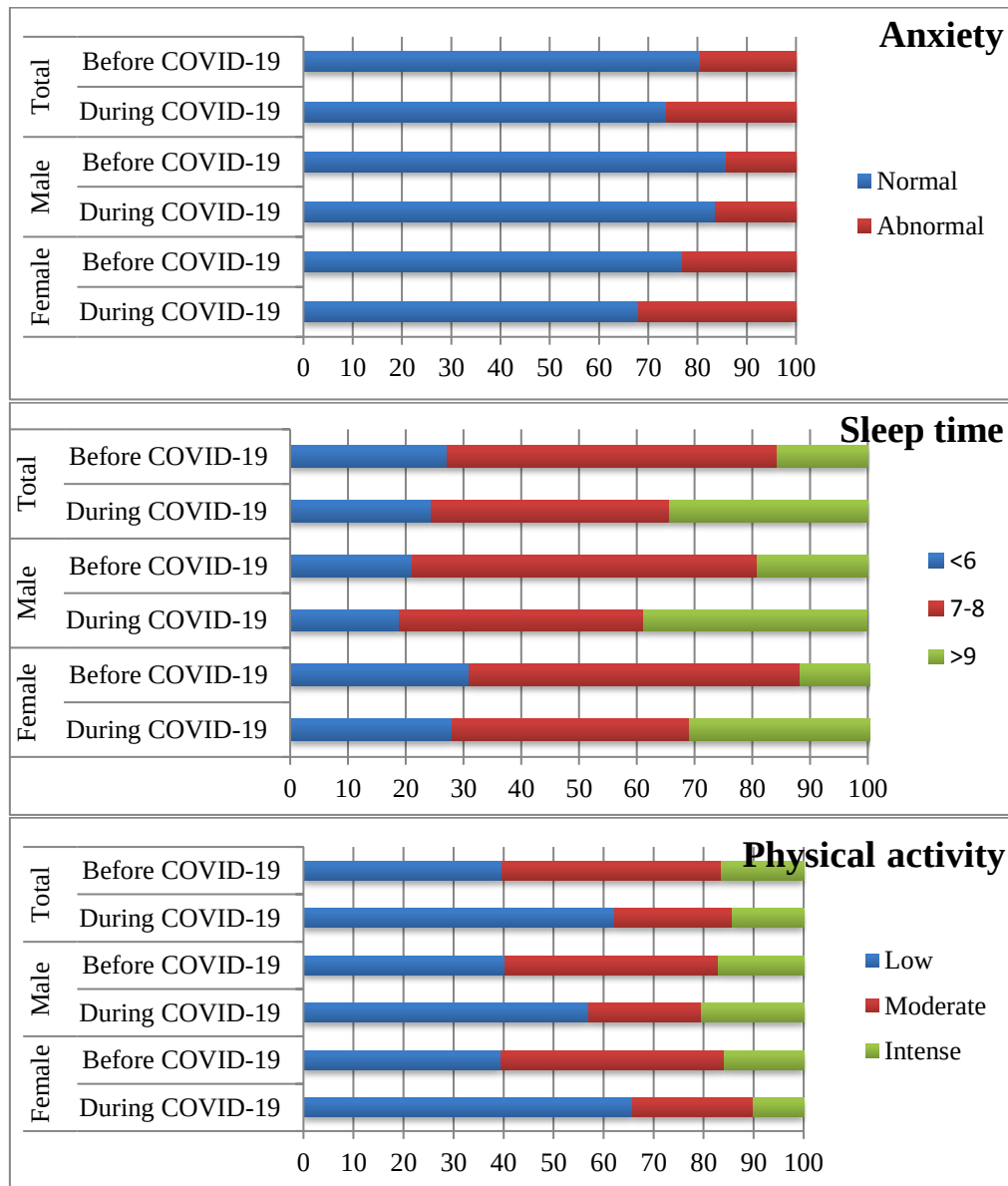


Figure 1. The prevalence of anxiety, sleep hours, and low physical activity in the participants by sex before and at the end of the COVID-19 lockdown in Kerman, Iran ($n = 911$).

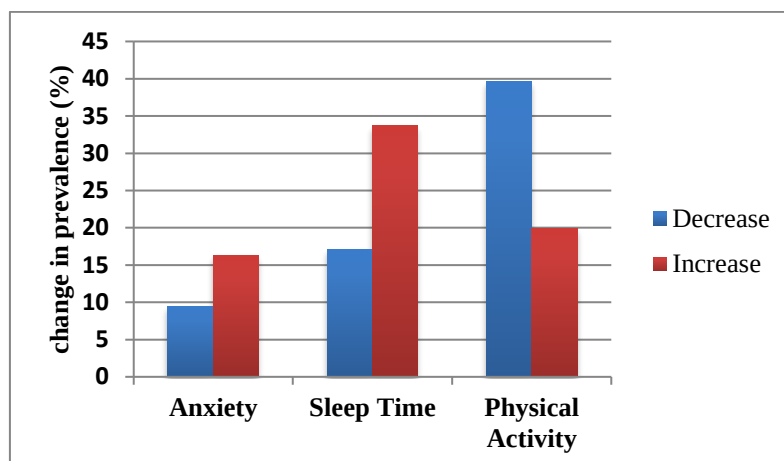


Figure 2. The changes in the prevalence (%) of anxiety, sleep time, and physical activity during the COVID-19 lockdown in Kerman residents, Iran (n = 911).

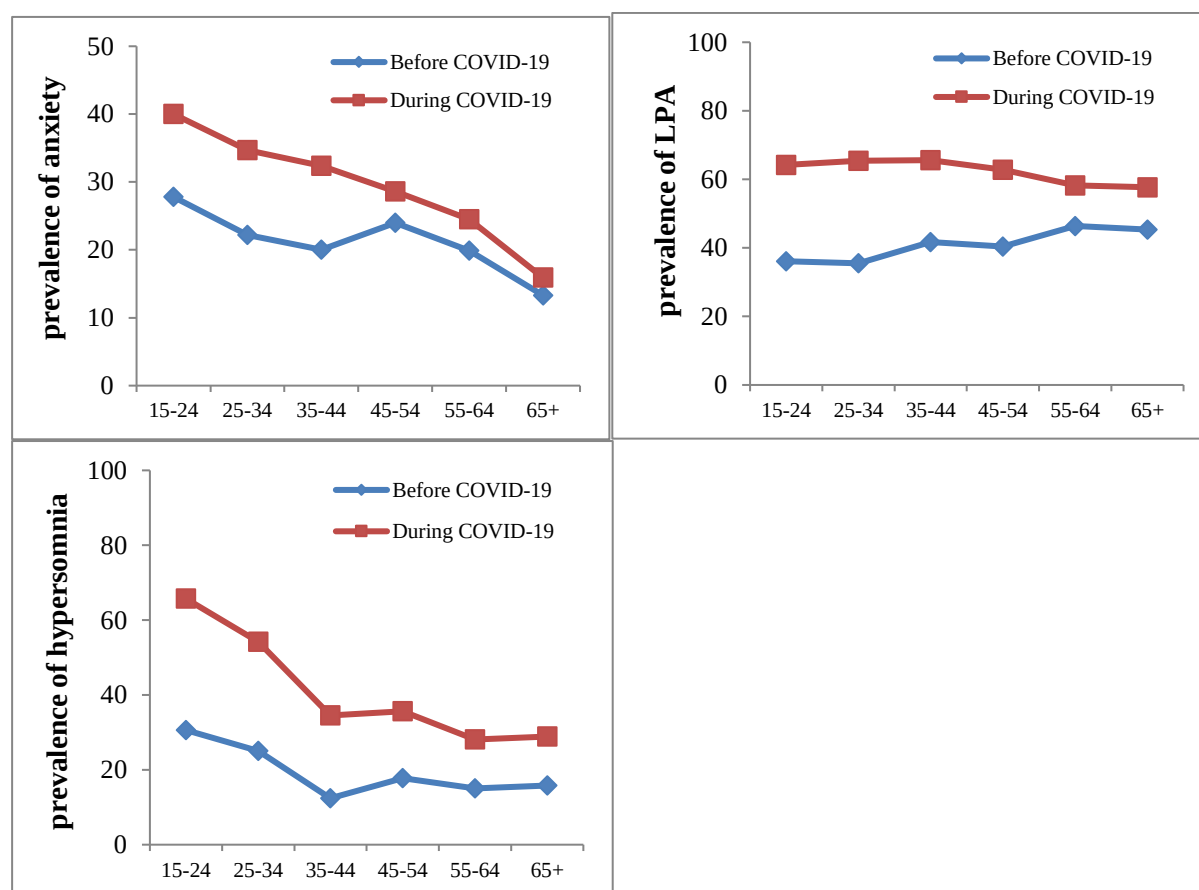


Figure 3. The prevalence (%) of anxiety, low physical activity, and hypersomnia in the participants by age groups before and at the end of the COVID-19 lockdown in Kerman, Iran (n = 911).

Figure 4 shows scatter plots of the relations among the three studied variables before and after the quarantine time. There was a negative relationship between anxiety and sleep hours and between PA and sleep hours both before and after quarantine. Meanwhile there was no

relationship between anxiety and the level of PA either before or after the quarantine. There was also a dependency between PA and sleep hours during the quarantine time, reflecting in steeper negative slope of regression line after quarantine.

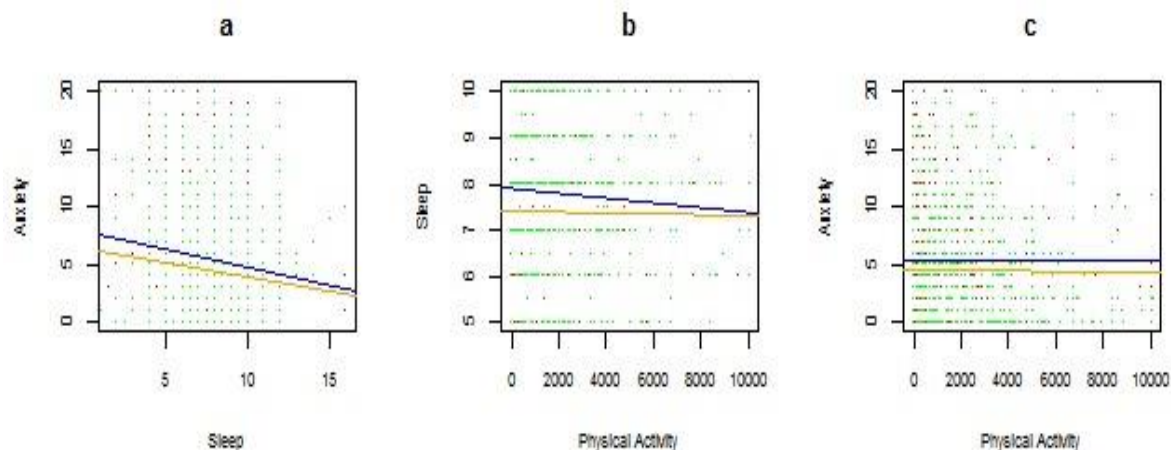


Figure 4. Scatter plots of the relations among the three studied variables; (a) between anxiety and sleep hours; (b) between physical activity and sleep hours; and (c) between anxiety and the level of physical activity, before (orange line) and after (blue line) the quarantine time in an urban population in Kerman, southeastern Iran. $n = 911$, KERCADRS Study phase 2.

The results of Table 1 shows that after excluding other variables, the chance of an increase in anxiety in women was 45% higher than that of men during the lockdown (AOR = 1 in women and 0.55 in men). Considering the 15-24 years age group as reference, the probability of an increase in anxiety declined with age, in such a way that it is 80% lower in the over 65 years age group compared with the 15-24 years age group ($P = 0.001$). In addition, the chance of an increase in anxiety in married people and in widows was 96% and 73.7%, respectively, which was higher compared with single people (AOR = 1 in single females, 1.95 in married, and 1.73 in widows); however, these differences were not statistically significant ($P = 0.075$ and $P = 0.217$). The chance of an increase in anxiety in people with primary education was 2.2 times higher than that of illiterate people ($P = 0.008$), and changes were not significant in other education levels. Furthermore, the chance of an increase in anxiety was 97.6% higher in students compared with unemployed people (0.041%). Moreover, the chance of an increase in anxiety in hypersomniac people and those with normal sleep hours were 51% and 35.4% lower, respectively, compared with those of insomniac people ($P < 0.001$) (AOR = 1 in people with a

sleep time less than 6 hours, 0.64 in people with normal sleep, and 0.49 in those with more than 9 hours of sleep).

The results of Table 1 also indicate that after excluding other variables, the probability of an increase in sleep time during the lockdown in men was 54.6% higher than that in women ($P = 0.001$). In addition, this probability in 15-24 years age group was 70% higher than that in people aged over 65 years ($P = 0.010$). In people with intense PA and in anxious people, the probability of an increase in sleep hours was 50.6% and 27.6% lower, respectively, compared with normal people ($P = 0.008$).

The results of Table 1 demonstrate that after excluding other variables, compared with men, the probability of LPA in women was 7.8% higher ($P = 0.001$). The probability of LPA in people aged over 65 years was 21.7% lower compared with that in those aged 15-24 years, and it was 10.2% higher in people with academic education compared with illiterate people ($P = 0.02$). This probability in people with hypersomnia was 2.17 times higher than that in people with insomnia ($P = 0.000$). And finally, the probability of being low physically active had no relationship with anxiety ($P = 0.454$).

Table 1. Adjusted odds ratio (95% CI) for predictors of growth of anxiety, sleep time, and low physical activity during the COVID-19 lockdown (February to April 2020). A community-based study (n = 911) in Kerman, Iran

Subgroups	Category	N (%)	Anxiety		Sleep Time		Low Physical Activity	
			AOR (95% CI)	P-value	AOR (95% CI)	P-value	AOR (95% CI)	P-value
Sex	Female	546 (59.9)	1	-	1	-	1	-
	Male	365 (40.1)	0.550 (0.377-0.802)	0.002	1.546 (1.184-2.018)	0.001	0.922 (0.879-0.967)	0.001
Age group (years)	15-24	36 (4.0)	1	-	1	-	1	-
	25-34	72 (7.9)	0.853 (0.359-2.026)	0.719	0.923 (0.392-2.177)	0.855	1.044 (0.954-1.143)	0.897
	35-44	140 (15.3)	0.541 (0.220-1.329)	0.180	0.508 (0.214-1.202)	0.123	1.066 (0.973-1.168)	0.728
	45-54	192 (21.1)	0.444 (0.180-1.096)	0.078	0.491 (0.203-1.188)	0.115	1.100 (0.995-1.204)	0.168
	55-64	231 (25.4)	0.339 (0.135-0.849)	0.021	0.391 (0.162-0.943)	0.037	0.993 (0.894-1.104)	0.351
	+65	240 (26.3)	0.199 (0.076-0.523)	0.001	0.302 (0.122-0.748)	0.010	0.783 (0.593-0.982)	0.040
Marital status	Single	72 (7.9)	1	-	1	-	1	-
	Married	732 (80.4)	1.959 (0.934-4.106)	0.075	0.785 (0.486-1.263)	0.322	1.077 (0.998-1.162)	0.057
	Widowed	107 (11.7)	1.737 (0.724-4.169)	0.217	0.853 (0.467-1.559)	0.605	0.987 (0.925-1.054)	0.694
Education level	Illiterate	85 (9.3)	1	-	1	-	1	-
	Primary	133 (14.6)	2.207 (1.227-3.970)	0.008	0.907 (0.580-1.418)	0.668	1.020 (0.937-1.109)	0.651
	Secondary	444 (48.8)	1.495 (0.853-2.620)	0.160	1.049 (0.711-1.547)	0.809	1.084 (1.004-1.170)	0.040
	University	249 (27.3)	0.905 (0.494-1.660)	0.748	1.078 (0.706-1.646)	0.728	1.102 (1.014-1.198)	0.022
Occupation	Unemployed	617 (67.7)	1	-	1	-	1	-
	Office clerk	76 (8.3)	0.670 (0.402-1.119)	.126	0.742 (0.474-1.163)	0.194	0.962 (0.891-1.038)	0.315
	Self-employed	193 (21.2)	0.769 (0.556-1.065)	0.114	0.961 (0.702-1.316)	0.809	1.031 (0.973-1.091)	0.300
	Student	25 (2.8)	1.976 (1.030-3.791)	0.041	1.511(0.581-3.933)	0.397	1.090 (0.965-1.232)	0.167
Physical activity	Low	141 (15.5)	1	-	1	-	-	-
	Moderate	268 (29.4)	0.817 (0.607-1.098)	0.180	0.631 (0.504-0.790)	0.001	-	-
	Intense	502 (55.1)	0.789 (0.601-1.035)	0.086	0.494 (0.402-0.607)	0.001	-	-
Sleep time	<6 hours	240 (27.1)	1	-	-	-	1	-
	7-8 hours	507 (57.1)	0.646 (0.463-0.902)	0.010	-	-	1.009 (0.962-1.060)	0.708
	>9 hours	140 (15.8)	0.491(0.373-0.646)	0.001	-	-	2.172 (1.115-3.233)	0.001
Anxiety	Normal	733 (80.5)	-	-	1	-	1	-
	Abnormal	178 (19.5)	-	-	0.724 (0.571-0.918)	0.008	0.983 (0.938-1.029)	0.454

Discussion

The present study assessed the effects of the COVID-19 outbreak on anxiety, sleep hours, and PA in a random sample of inhabitants of Kerman. According to the results, a high percentage of people experienced an increase in anxiety and sleep hours and a decrease in PA during the first two months of the outbreak. The probability of an increase in anxiety was higher in women, young people, university students, and insomniac people compared with other groups. In addition, the probability of an increase in sleep hours was high in men and young people, and lower in anxious people. Moreover, the probability of an increase in LPA was higher

in women, young people, hypersomniacs, and people with higher education levels.

One of the important results of this study was that young people were affected more in terms of anxiety, LPA, and increased sleep hours. This age group mainly consisted of students, affected by the closure of schools and universities and probably confused about their education. In addition, this group is among the active members of the society, and the closure of parks, unemployment, inflation, and future concerns can be sources of anxiety for them (9). Moreover, young people may have experienced extra anxiety due to the fear of the illness of relatives, especially their parents. A decrease in PA can occur due to the lockdown in quarantine

times, and an increase in sleep hours can be due to this issue and the confused planning and closures in schools and universities.

Another important result was that the level of anxiety increased by approximately 7%, and more than 16% of the people experienced an increase in anxiety. However, due to the circumstances of the first two months of quarantine, a higher increase was expected. This might be due to the fact that we conducted the second survey at the end of the two-month period, i.e. when the quarantine had ended, but the conditions must have been worse in mid-quarantine. Another reason might be the fact that Kerman province was not among the first areas infected by the virus and people were mostly affected by the news of the disease in other areas rather than by the disease itself. Moreover, because of quarantine and other serious measures taken by the government to control the outbreak, its prevalence had declined across the country, so there was less worrying news. Finally, another reason may have been the age of participants. The share of older people was higher in the participants of this study than that in the general population, and as the results of the tables and figures show, anxiety decreases with age. Meanwhile, the results of this study are consistent with those of another study in Iran, which was conducted in April using online questionnaires. The study showed that women, young people, people in areas with high COVID-19 prevalence rates, and people with at least one infected family member, friend, or relative experienced higher anxiety levels (9). According to a study conducted in Italy, female sex, uncertainty of encountering the infection, or direct contact with people infected with COVID-19 had significantly affected people's mental status (11). The high probability of an increase in anxiety among women is not unexpected as compared to men, women experience stronger negative and positive emotions (22). A longitudinal study conducted in China showed higher psychological impact of COVID-19 on women compared with men (6). Consistent with this study, the studies assessed the COVID-19 outbreak, it was proved that anxiety during these times was higher in women (9,11). There was also a significant relationship between age and occupation and probability of an increase in anxiety during the outbreak, so that the probability of an increase in anxiety was higher in young people and university students. As mentioned before, students experienced higher

levels of anxiety due to concerns about their future, stemming from the closure of universities (9). Furthermore, there was a significant inverse relationship between sleep hours and an increase in anxiety during the outbreak, and people with less than 6 hours of sleep having higher risk of experiencing an increase in anxiety levels. Insomniacs are more preoccupied with the adverse situation, and this will increase their anxiety (23). It is not clear whether it was higher anxiety levels that had led to insomnia, or insomnia has led to an increase in anxiety. It seems that both assumptions are true as Table 1 indicates that hypersomnia is associated with 50% decrease in anxiety, and anxiety is accompanied by a 28% decrease in sleep hours.

The results of the present study showed that almost half of the people experienced sleep disorders (hypersomnia or insomnia) during the lockdown, which was significantly higher compared with the related prevalence before the outbreak. This finding is not unexpected considering the odds of creation of psychological disorders and changes in PA and occupation in a global pandemic (11). The highest prevalence of hypersomnia was observed in young people (15-24 years). As mentioned before, the closure of schools and universities might have had a direct impact on their sleep hours. It seems that the results of the present study confirm the evidences observed in people during the quarantine (11). In terms of gender, hypersomnia was more prevalent in men. This result is not consistent with the results of other studies indicating that sleep disorder was more prevalent in women (11,24). The reason for this difference could be the fact that the majority of Iranian women are housewives, and home activities are not affected by the quarantine, while men's activities, which were mostly outdoors, were suspended during the quarantine. Another reason was that the present study considered sleep hours (insomnia and hypersomnia) as sleep disorders while in the other two studies, the quality of sleep was assessed.

The results of this study proved that approximately half of the study population experienced a decrease in PA at the end of the lockdown, which was significantly higher compared with their activity before the outbreak, and also, with the level of activity measured in another study recently conducted on the same population (25). Changes in PA and an increase in sedentary behaviors during the outbreak were

predictable (8). These results are consistent with the results of previous studies, indicating that quarantine had led to a decrease in PA (10,26). Another study conducted in France and Switzerland reported a simultaneous increase in low and moderate PA during the outbreak (8). In Belgium, people who used to be LPA reported higher PA during quarantine. On the other hand, among people who used to be very active before the outbreak, those aged over 55 years, and those who used to exercise with friends or at gyms, reported a lower PA due to the closure of gyms (27). In the present study, although quarantine had negative effects on the performance of people with intense PA and led to sedentary behaviors, it increased moderate PA (Figure 1). This might be due to more leisure time during quarantine, which provided an opportunity for exercising at home and doing moderate exercises such as walking for some people. The probability of an increase in LPA was higher in women, people with university education and employed, and in young people. These results are not consistent with the results of another study conducted in Italy. In the latter study, the recommended level of PA during quarantine was more frequently achieved by women and people under 22 years (24). The reason for this difference could be the fact that the mentioned study was conducted on a specific group, university students. Based on the results of the present study, there was a significant relationship between the increase in sleep hours and LPA. These results are consistent with the results of the study conducted in Italy and Australia, indicating that there was a significant relationship between sleep hours and LPA (26,28). Negative changes in PA, sleep, smoking, and alcohol intake were associated with higher depression, anxiety, and stress symptoms (28). Also, significantly higher scores in one or more psychological distress states were found for women, and those not in a relationship, in the lowest income category, and in people aged 18-45 years. An increase in sedentary behaviors in people with higher education levels can occur due to the fact that they used to be among people with high PA before the outbreak (24), and because of better jobs and financial status, they had greater access to gym equipment; the privilege that was lost with the closure of gyms. Even outbreak and quarantine has affected diet behavior of the people through psychological disturbances. In the United Kingdom, changes in diet, sleep quality, and PA

were related to differences in negative mood during COVID-19 lockdown (29). In France, during the lockdown, trends for unfavorable nutritional behaviors like weight gain, decreased PA, increased sedentary time, increased snacking, and decreased consumption of fresh food products were observed (30).

Overall considering the relationship among the three variables (Figure 4) showed that there was a negative relationship between anxiety and sleep hours and between PA and sleep hours both before and after quarantine. However, the steep on these negative associations was higher after quarantine (Figure 4). This means that in addition to the effect of quarantine that increased the level of anxiety and decreased the level of PA, there is also an interaction between the two paired variables, i.e. anxiety intensified sleep disturbances and more sleep hours has steepened the decrease in the level of PA.

Limitations

The present study had also some limitations. People aged over 55 years comprised a higher portion of the participants in this study compared with their share in the general population. Therefore, the results of the study may not be simply generalized to the whole population. Moreover, a control group that had not experienced the outbreak was not available; therefore, the impact of factors other than COVID-19 are not clear. Therefore, the results of the study cannot be ascribed to the outcomes of the COVID-19 outbreak alone with confidence. Also, there may be a change in the diet or drug use during quarantine that may have affected anxiety, sleep, and PA. These needs more investigation to explore their confounding effects. Finally, the data of the first stage was collected through face-to-face interviews while the second interviews were conducted through phone calls (since people fearing the disease were not willing to attend the interview site). This can cause changes in the results. However, we made sure that the same interviewer conducted the interviews before and after the lockdown.

Conclusion

According to the results of this study, a high percentage of the study population experienced an increase in sleep hours and anxiety and a decrease in PA. However, the chance of an increase in anxiety, LPA, and hypersomnia was higher in young people.

Conflict of interest

The authors declare that they have no conflict of interest.

Aknowledgment

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