Iran J Psychiatry 2022; 17: 3: 247-256

**Original Article**

# Prevalence, Incidence and Health Impacts of Sleep Disorders on Coronary Artery Disease Risk Factors: Results of a Community-Based Cohort Study (KERCADRS)

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**Abstract**

**Objective:** Sleep disorders are associated with many health problems including anxiety, depression and coronary artery disease (CAD). This study investigated the prevalence, predictors and health impacts of insomnia and hypersomnia in southeastern Iran as well as the five-year incidence rate (IR) of these sleep disorders.
**Method:** The present study was a cross-sectional, single-stage, cluster sampling study examining nine CAD risk factors (KERCADR study phase two), including sleep disorders, carried out in Kerman on 9997 participants, 15 to 80 years old. Medical examination along with demographic, sleep status, Physical activity level (GPAQ), anxiety and depression status (Beck Inventories) were assessed and fasting blood sample was taken for blood glucose and lipids analysis. STATA v15 software was used for data analysis using survey data analysis package and a univariable survey logistic regression model.
**Results:** From 9997 participants, 59.4% were female. 45.3% of the participants were suffering from insomnia and hypersomnia, which was 15% more than the phase 1 prevalence ($P < 0.001$). Participants with insomnia had higher chance of being anxious, but participants with hypersomnia had higher chance of being depressed, be a cigarette smoker, opium user, and sedentary ($P < 0.001$). In regards to marital status, prevalence of hypersomnia was as follows in ascending order of prevalence: singles > married > widowed > divorced. While the IR of insomnia was higher in females, males had higher IR of hypersomnia. In addition, the IR of both sleep disorders was higher in participants with Low Physical Activity (LPA).
**Conclusion:** The results showed high current prevalence and increasing trends of sleep disorders in the past five years. If left unaddressed, burden of CVDs in the community will demonstrate a significant increase in the future as a result of sleep disorders and other associated risk factors.

**Key words:** *Coronary Artery Disease; Incidence; Mental Health; Prevalence; Sleep Disorders*

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**Article Information:**
Received Date: 2021/07/06, Revised Date: 2021/12/26, Accepted Date: 2022/05/18

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Happiness, energy, and physical health require sleep as one of the most vital human necessities needed by the brain to function properly (1, 2). Sleep disorders are now among the main public health concerns due to lifestyle changes and industrialization. In terms of pathology, sleep disorders are associated with depression, anxiety, and other psychological disorders and somatic diseases.

Healthy sleep is characterized by adequate duration, good quality, appropriate timing, and absence of sleep disorders (2, 3), with the greatest focus on sleep duration as the main factor. A recent survey demonstrated that 83.6 million adults in the USA reported sleeping less than 7 hours a day (4). In addition, the Institute of Medicine has estimated that 50–70 million American citizens have a chronic sleep disorders (5), which may increase the risk of coronary artery disease (CAD), worsened diabetes and hypertension, stroke, depression, anxiety, and obesity (6-9). It was observed that participants with less than 5 hrs sleep per night had a higher risk of hypertension in the middle-aged groups but not in the old-aged groups (9). Tani *et al.* (10) concluded in their review study that short duration of sleep (< 6 h/day) was associated with a 38% increase in the incidence of obesity, and Jike *et al.* (11) reported that long sleep duration (> 9 h/day) was associated with an 8% increase in incidence of obesity. Sleep disturbances are observed in about 90% of individuals with a major depressive episode. Furthermore, evidence suggested that there was a significant correlation between insomnia and depression progression as well as depression reoccurrence rate (12). Opium use and Low Physical Activity (LPA) are the other issues which seem to be correlated with sleep duration but this correlation has not been studied yet.

The relationship between sleep disorders and health problems could be mediated by several factors referred to as sleep disorder predicators. A study by Magee *et al.* (13) showed that there is significant correlation between sleep disorders and work hours, education level, marital status, smoking cigarettes, alcohol consumption, obesity, depression, and anxiety. In addition, Finland and Kornholm (14) reported that gender, marital status, and occupation are the main predicting factors of insomnia. By and large, many studies have shown that insufficient sleep and behavioral problems are interconnected and have mutually facilitating effects (2), highlighting the importance of insomnia and hypersomnia studies. However, such studies are limited in Iran especially in the form of large scale, community based models. Two studies have reported the prevalence of insomnia being 59% (15) and 57% (16) in Kashan and Kurdistan (two provinces in Iran), respectively. In our previous study (phase 1 of Kerman Coronary Artery Disease Risk Factor Study KERCADRS), from 2008-2011 (9) in southeastern Iran, we reported that about one-third of 5900 participants were suffering from insomnia or hypersomnia. We also showed a significant correlation between anxiety, depression, LPA and hypertension with sleep disorders. In the present study on a larger population of 10,000 (2014-2018), we sought to describe the prevalence, predictors and health impacts of insomnia and hypersomnia in the described population as well as to figure out trend of changes in the prevalence of these sleep disorders during last five years, and any relations with CAD risk factors. Correlation of sleep duration with opium use and LPA was also investigated. Moreover, the study assessed the five-year incidence rate of sleep disorders, overall and in subpopulation groups associated with the above mentioned CAD risk factors. This will provide a better insight into the predictors and underlying effectors of these two important risk factors of CVDs, helping local health authorities to implement intervention programs to correct these unsafe disorders and decrease the burden of CVD in the population under study.

## Materials and Methods

The present paper is a sub-analysis of data collected on sleep status in the second phase of the KERCADRS study, focused on the risk factors of CADs.

### *Ethical considerations*

The Ethics Committee of Kerman University of Medical Sciences (KMU) approved the study protocols (Ethics code: IR.KMU.REC.1392.405) and a written informed consent was obtained from the participants.

### *Study design, community, and sampling method*

This study was carried out between 2014 and 2018 on the urban population of southeastern Iran, including 9997 individuals aged between 15 and 80, 2813 of whom also had participated in the first phase of the study (2009–2011). Households who had been living in Kerman for at least one year before the interview were considered the sampling unit. We randomly selected 420 codes using the post office city zip code list. We then approached the household associated with the zip code and the neighbors on the right side of their alley, recruiting around 10 thousand individuals in six age and sex strata. The eligible individuals were asked to provide informed consent and were invited to the clinic at the study site where they provided information on their demographic features and CAD risk behaviors through several face-to-face interviews. They were also asked to report the factors influencing sleep, such as physical activity, opium use, smoking, mental status (anxiety and depression) and also provide a 12–14 hour fasting blood sample for measurement of serum lipid and glucose levels. A physician measured their blood pressure (using a RISHTER mercury manometer, Germany), weight, and height (17). Cholesterol and triglyceride values higher than 200 mg/dl were considered above normal. DSM-IV criteria were used to define Opium use. Participants were asked if they had ever used opium.

***Inclusion and exclusion criteria***

The inclusion criteria were to be Iranian, aged 15–80 years, living at least one year in Kerman, and agreeing to participate in the study. More details about the research methodology have been published elsewhere (18).

***Survey tools***

The Beck Anxiety Inventory (BAI) and Beck Depression Inventory (BDI) both with a score range of 0-63 were completed by face-to-face interviews. Disease state was defined as depression score and anxiety score higher than 30 and 26, respectively. In Iran, validity and reliability are measured to be 83% and 80% for BAI and 85% and 80% for BDI (19, 20).

The WHO global physical activity questionnaire (GPAQ) was used to record physical activities at home and work place (21). The use of energy in an adult individual while they are sitting at rest (i.e. metabolic equivalent of task (MET)) was used as a basis for scoring the intensity of physical activity. Low, moderate, and intense physical activity were defined as less than four METs, between four and eight METs, and more than 8 METs energy use, respectively (22). The results of assessing reliability and validity of the GPAQ in short term and long-term test–retest reliability was found to be good to very good (23). This questionnaire was used to assess the Physical activity profile of the Iranian population in the STEPS survey, 2016 and in another study (24, 25).

***Sleep disorder assessment***

A sleep screening checklist was completed. The criteria for insomnia is defined as six hours or less sleep time, difficulty initiating or maintaining sleep, or non-restorative sleep. Nine hours or more sleep time, deteriorated wakefulness quality, or sleep inertia are called Hypersomnia (26).

***Incidence rate calculation***

Incidence rate was calculated based on using the data from 2813 individuals that participated in both phases of the study. To calculate the incidence rate, we used individual records in both phases. Firstly, we determined cases who were in the normal sleep group in the first phase and moved to either insomnia or hypersomnia in five years. Then, the corresponding person-year follow-up time for these was calculated. The resultant person-year follow-up time was divided by total person-year follow-up time of 2813 individuals. Finally, the result was multiplied by 1000 to give a measure of person per 1000 person-years incidence rate of insomnia/hypersomnia between the two phases of the study.

***Statistical analysis***

Taking the households as primary sampling units, all analyses were performed using STATA v15 under survey data analysis. The real sex-age distribution of the target population was used to standardize the total estimates, and a decision was made considering the non-proportionate to size sampling method (national census of Kerman population size for 2016). Weighted prevalence was reported for insomnia and hypersomnia, and the results of phase two and phase one were compared using the z test.

The relationship between CAD risk factors and the different levels of sleep disorders were evaluated by a univariable survey logistic regression model. We adjusted the estimates controlling for sex, age, occupation, education, and marital status to control for any potential confounding factors. $P < 0.05$ was considered as statistically significant.

## Results

***Prevalence of Insomnia and Hypersomnia***

Of those who were eligible to participate in this study, more than 95% agreed and attended the study site. The analysis included data from 9997 individuals (5939 (59.4%) females and 4058 (40.6%) males with mean (SD) age of 46.2 (15.7) years. Data analysis showed that 45.3% of participants were suffering from insomnia or hypersomnia, which was higher by 15% compared to phase one (30.5%). Similar to phase one, prevalence of insomnia was higher in females than males (Figure 1). In phase one and two, 11.5% and 22.9% of participants were suffering from insomnia, respectively. These ratios were closer regarding hypersomnia (22.4% in phase two versus 19% in phase one, $P < 0.05$), highlighting increasing trend in both sleep disorders between the two phases.

The average sleep hours were $7.5 \pm 1.6$ per day from which $6.7 \pm 1.5$ hours (89% of participants) were night sleepers. In addition, Snoring disorder was seen in 2.7% of participants.

According to Figure 2, insomnia increased until the age of 65 and then decreased. In contrast, hypersomnia showed an opposing trend where it decreased until the age of 65 and then increased. Widows showed higher prevalence of insomnia and singles showed higher prevalence of hypersomnia compared to others ($P < 0.001$). In addition, insomnia showed significantly higher prevalence in illiterate individuals but literates had higher rates of hypersomnia ($P < 0.001$). What's more, insomnia and hypersomnia were more widespread among unemployed and college students, respectively ($P < 0.001$) (Table 1).

Comparing insomnia or hypersomnia groups with normal sleepers, it was observed that anxiety was more prevalent in participants with insomnia than normal sleepers (Table 2). Furthermore, prevalence of smoking, opium use, depression and LPA was more in the participants with hypersomnia than others.

Considering sleep duration as an independent variable, crude and adjusted Odds Ratios for having CAD risk factors were presented in Table 3. After adjusting for sex, age, marital status, education level, and occupation, no significant adjusted odds ratios were observed for being hypertensive, obese, and hypercholesterolemic in participants with hypersomnia or insomnia compared

with normal sleepers. The chance of being a cigarette smoker was higher in participants with hypersomnia than others (P = 0.043). The chance of being anxious increased with insomnia (78.3% higher chance) (AOR = 1.783, P < 0.001), and the chance of being depressed increased with hypersomnia (AOR = 3.107, P < 0.001). Added to that is higher chance for hypertriglyceridemia in the participants who slept more than nine hours per day (P = 0.048). In addition, the chance of being an opium user was higher in participants with hypersomnia by 42% (AOR = 1.42, P < 0.001). Hypersomnia was also associated with LPA level as the chance of being sedentary was 1.12 folds in participants with hypersomnia (P = 0.029) (Table 3).

***Incidence rate of insomnia and hypersomnia***

During the five-year period between phase one and two of the study, 25 and 21 persons out of 1000 person-years have become insomniac and hypersomniac, respectively. While the incidence rate of insomnia was higher in females, males had higher incidence rate of hypersomnia. The lowest incidence rate of insomnia and hypersomnia was in participants with anxiety and depression. Furthermore, the incidence rate of both sleep disorders was higher in participants with LPA, while incidence rate of insomnia was lower in obese participants (Table 4). The incidence rate of sleep disorders was not affected significantly by hypertension, smoking and opium use.

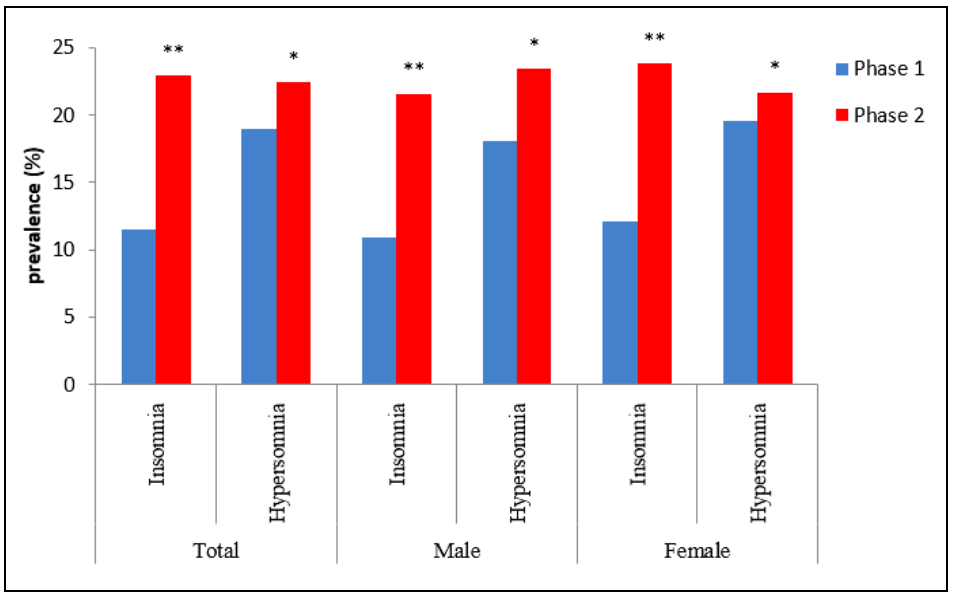


**Figure 1. Comparison of Prevalence of Different Levels of Sleep Time in Two Phases of Kerman Coronary Artery Disease Risk Factor Study (KERCADRS) Based on Sex Compared with Phase One. Phase One Data Were Used Here for Comparison and Are Extracted from Our Previous Study (9). *P < 0.5, **P < 0.01.**

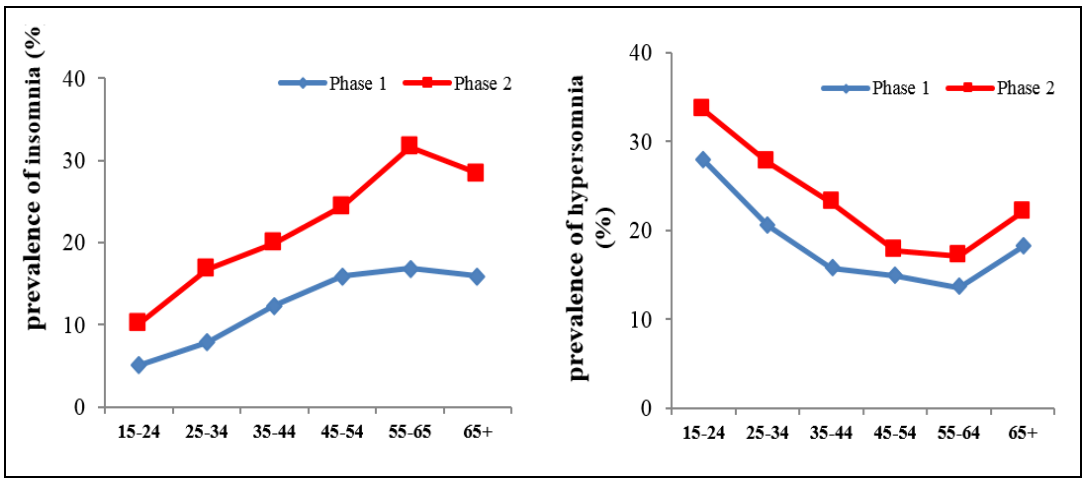


**Figure 2. Comparison of Prevalence of Different Levels of Sleep Time in Two Phases of Kerman Coronary Artery Disease Risk Factor Study based on Age Groups. Phase One Data Were Used Here for Comparison and Are Extracted from Previous Study (9).**

**Table 1. Standardized Prevalence, % (95% CI) of Insomnia and Hypersomnia in the Participants by Sex and Age, Marital Status, Education, and Occupation**

| Subgroups | Sleep Time | |
|---|---|---|
| | Insomnia | Hypersomnia |
| **Sex** | | |
| Male | 21.6 (20.3-22.9) | 23.4 (22.1-24.7) |
| Female | 23.8 (22.7-24.9) | 21.7 (20.6-22.8) |
| **P-value** | 0.009 | 0.045 |
| **Age Group (year)** | | |
| 15-24 | 10.2 (8.2-12.2) | 33.6 (30.5-36.7) |
| 25-34 | 16.8 (15.8-17.8) | 27.7 (25.6-29.8) |
| 35-44 | 20.0 (18.3-21.7) | 21.1 (21.3-24.9) |
| 45-54 | 24.5 (22.6-26.4) | 17.7 (16.0-19.4) |
| 55-64 | 31.6 (29.6-33.6) | 17.1 (15.5-18.7) |
| +65 | 28.4 (26.0-31.0) | 22.1 (19.8-24.4) |
| **P-value** | < 0.001 | < 0.001 |
| **Marital Statues** | | |
| Never Married | 13.4 (11.5-15.3) | 30.7 (28.2-33.2) |
| Married | 23.6 (22.7-24.5) | 21.5 (20.6-22.4) |
| Divorced | 25.3 (16.7-33.9) | 15.2 (8.1-22.3) |
| Widowed | 34.2 (30.2-38.2) | 18.1 (14.8-21.4) |
| **P-value** | < 0.001 | < 0.001 |
| **Education Level** | | |
| Illiterate | 34.8 (31.7-37.9) | 21.5 (18.9-21.1) |
| Primary | 27.8 (25.8-29.8) | 21.5 (76.7-80.3) |
| Secondary | 20.2 (19.1-21.3) | 23.0 (21.8-24.2) |
| University | 19.5 (17.7-21.3) | 22.1 (20.3-23.9) |
| **P-value** | < 0.001 | 0.486 |
| **Occupation** | | |
| Unemployed | 24.9 (23.8-26.0) | 22.2 (21.2-23.2) |
| Student/Soldier | 10.1 (7.7-12.5) | 33.5 (29.8-37.2) |
| Self-employed | 21.3 (19.6-23.0) | 21.8 (20.1-23.5) |
| Office clerk | 22.0 (19.3-24.7) | 17.3 (14.8-19.8) |
| **P-value** | < 0.001 | < 0.001 |

**Table 2. Standardized Prevalence % (95% CI) of Coronary Artery Diseases Risk Factors among People with Different Sleep Durations**

| Risk factor | Normal | Insomnia | | Hypersomnia | |
|---|---|---|---|---|---|
| | % (95% CI) | % (95% CI) | P-value [a] | % (95% CI) | P-value [b] |
| Hypertension | 17.0 (16.0-18.0) | 20.7 (18.9-22.5) | 0.064 | 16.4 (14.9-17.9) | 0.784 |
| Obesity | 22.5 (21.4-23.6) | 20.9 (19.2-22.6) | 0.472 | 24.4 (22.6-26.2) | 0.406 |
| Smoking | 8.6 (7.9-9.3) | 9.1 (7.9-10.3) | 0.764 | 9.8 (8.6-11.0) | 0.033 |
| Anxiety | 14.6 (13.7-15.5) | 23.4 (21.7-25.1) | < 0.001 | 14.2 (12.8-15.6) | 0.860 |
| Depression | 1.1 (0.7-1.5) | 0.9 (0.6-1.2) | 0.824 | 2.7 (1.0-3.4) | 0.014 |
| Triglyceride > 200 mg/dL | 14.3 (13.4-15.2) | 14.9 (13.4-16.4) | 0.770 | 15.2 (13.7-16.7) | 0.085 |
| Cholesterol > 200 mg/dL | 31.8 (30.6-33.0) | 34.5 (32.5-36.5) | 0.313 | 29.8 (27.9-31.7) | 0.444 |
| Opium use | 7.6 (6.5-9.7) | 8.0 (7.3-8.7) | 0.810 | 10.7 (9.4-12.0) | 0.026 |
| Low Physical Activity | 46.6 (45.3-47.9) | 49.1 (47.0-51.2) | 0.438 | 52.5 (50.5-54.5) | 0.027 |

[a]. and [b]. comparison with Normal

**Table 3. Crude and Adjusted Odds Ratios for Coronary Artery Diseases Risk Factors Associated with Sleep Durations**

| Risk factor | Sleep Time | OR (95% CI) Crude | P-value | OR (95% CI) Adjusted | P-value |
|---|---|---|---|---|---|
| Hypertension | Normal | 1 | | 1 | |
| | < 6 hours | 1.357 (1.201-1.533) | < 0.001 | 1.054 (0.925-1.201) | 0.429 |
| | > 9 hours | 0.958 (0.839-1.094) | 0.531 | 1.042 (0.903-1.203) | 0.572 |
| Obesity | Normal | 1 | | 1 | |
| | < 6 hours | 0.907 (0.804-1.023) | 0.113 | 1.014 (0.904-1.137) | 0.819 |
| | > 9 hours | 1.110 (0.990-1.245) | 0.074 | 1.051(0.933-1.184) | 0.415 |
| Smoking | Normal | 1 | | 1 | |
| | < 6 hours | 1.065 (0.898-1.264) | 0.469 | 1.113 (0.92201.343) | 0.266 |
| | > 9 hours | 1.157 (0.978-1.370) | 0.089 | 1.212 (1.006-1.460) | 0.043 |
| Anxiety | Normal | 1 | | 1 | |
| | < 6 hours | 1.790 (1.583-2.024) | < 0.001 | 1.783 (1.569-2.026) | < 0.001 |
| | > 9 hours | 0.971 (0.843-1.118) | 0.681 | 0.947 (0.819-1.095) | 0.462 |
| Depression | Normal | 1 | | 1 | |
| | < 6 hours | 1.224 (0.748-2.003) | 0.421 | 1.196 (0.727-1.967) | 0.481 |
| | > 9 hours | 3.089 (2.109-4.532) | < 0.001 | 3.107 (2.103-4.591) | < 0.001 |
| Triglyceride > 200 mg/dL | Normal | 1 | | 1 | |
| | < 6 hours | 1.057 (0.920-1.213) | 0.435 | 0.992 (0.862-1.142) | 0.910 |
| | > 9 hours | 1.076 (0.937-1.236) | 0.300 | 1.154 (1.001-1.329) | 0.048 |
| Cholesterol > 200 mg/dL | Normal | 1 | | 1 | |
| | < 6 hours | 1.132 (1.021-1.256) | 0.019 | 1.030 (0.921-1.152) | 0.600 |
| | > 9 hours | 0.910 (0.817-1.013) | 0.084 | 0.997 (0.895-1.110) | 0.953 |
| Opium use | Normal | 1 | | 1 | |
| | < 6 hours | 1.140 (0.981-1.324) | 0.087 | 0.807 (0.665-0.979) | 0.029 |
| | > 9 hours | 1.260 (1.090-1.456) | 0.002 | 1.416 (1.183-1.695) | < 0.001 |
| Low Physical Activity | Normal | 1 | | 1 | |
| | < 6 hours | 1.103 (0.999-1.217) | 0.052 | 1.084 (0.981-1.197) | 0.112 |
| | > 9 hours | 1.123 (1.019-1.239) | 0.020 | 1.118 (1.011-1.235) | 0.029 |

**Table 4. Five-Year Incidence Rate of Insomnia and Hypersomnia, Overall and for Subgroups (Person per 1,000 Person-Years), among Adult Population in Kerman, Iran (KERCADR First Phase, 2009–2012 and Second Phase, 2014–2018, n = 2813 Match Cases)**

| Subgroups | Insomnia | | | | Hypersomnia | | | |
|---|---|---|---|---|---|---|---|---|
| | new cases | Person-years | Incidence Rate | P-value | new cases | Person-years | Incidence Rate | P-value |
| **Overall** | 425 | 17117.5 | 24.8 (22.5-27.3) | | 299 | 14477.5 | 20.7 (18.4-23.1) | |
| **Sex** | | | | | | | | |
| Male | 173 | 7925.0 | 21.8 (18.7-25.3) | 0.021 | 166 | 6637.5 | 25.0 (21.3-29.1) | 0.001 |
| Female | 252 | 9192.5 | 27.4 (24.1-31.0) | | 133 | 7840.0 | 17.0 (14.2-20.1) | |
| **Age Group (year)** | | | | | | | | |
| 15-24 | 9 | 2582.5 | 3.5 (1.6-6.6) | < 0.001 | 11 | 1502.5 | 7.3 (3.6-13.1) | < 0.001 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 25-34 | 52 | 2382.5 | 17.5 (13.1-23.0) | | 40 | 2122.5 | 18.8 (13.5-25.7) | |
| 35-44 | 82 | 3190.0 | 25.7 (20.4-31.9) | | 45 | 2822.5 | 15.9 (11.6-21.3) | |
| 45-54 | 83 | 3427.5 | 24.2 (19.3-30.0) | | 58 | 3425.0 | 16.9 (12.9-21.9) | |
| 55-64 | 116 | 2537.5 | 45.7 (37.8-54.8) | | 66 | 2592.5 | 25.5 (19.7-32.4) | |
| +65 | 83 | 2997.5 | 27.7 (22.1-34.3) | | 79 | 2012.5 | 39.3 (31.1-48.9) | |
| **Smoking** | | | | | | | | |
| No | 377 | 14960.0 | 25.2 (22.7-27.9) | 0.421 | 259 | 12637.5 | 20.8 (18.4-23.5) | 0.804 |
| Yes | 48 | 2157.5 | 22.2 (16.4-29.5) | | 40 | 2042.5 | 19.6 (14.0-26.7) | |
| **Opium Use** | | | | | | | | |
| No | 382 | 15807.5 | 24.1 (21.7-26.6) | 0.228 | 266 | 13347.5 | 20.1 (17.8-22.7) | 0.162 |
| Yes | 43 | 1310.0 | 32.8 (23.8-44.2) | | 33 | 1272.5 | 25.9 (17.8-36.4) | |
| **Low phys. activity** | | | | | | | | |
| No | 205 | 9417.5 | 21.8 (18.9-25.0) | 0.005 | 146 | 8070.0 | 18.1 (15.3-21.3) | 0.017 |
| Yes | 220 | 7700.0 | 28.6 (24.9-32.6) | | 153 | 6407.5 | 23.9 (20.2-28.0) | |
| **Obesity** | | | | | | | | |
| No | 318 | 10112.5 | 31.4 (28.1-35.1) | < 0.001 | 239 | 11965.0 | 20.0 (17.5-22.7) | 0.220 |
| Yes | 107 | 7005.0 | 15.3 (12.5-18.5) | | 60 | 2512.5 | 23.9 (18.2-30.7) | |
| **Depression** | | | | | | | | |
| No | 413 | 16340.0 | 25.3 (22.9-27.8) | 0.176 | 297 | 13622.5 | 21.8 (19.4-24.4) | < 0.001 |
| Yes | 26 | 777.5 | 33.4 (21.8-49.0) | | 2 | 855.0 | 2.3 (0.3-8.4) | |
| Anxiety | | | | | | | | |
| No | 314 | 10237.5 | 30.7 (26.4-34.3) | < 0.001 | 258 | 8185.0 | 31.5 (27.8-35.6) | < 0.001 |
| Yes | 111 | 6880.0 | 16.1 (13.3-19.4) | | 41 | 6292.5 | 6.5 (4.7-8.8) | |
| **Diabetes** | | | | | | | | |
| No | 355 | 14630 | 24.3 (21.8-26.9) | 0.259 | 246 | 12075 | 20.4 (17.9-23.1) | 0.574 |
| Yes | 70 | 2487.5 | 28.1 (21.9-35.6) | | 53 | 2402.5 | 22.1 (16.5-28.9) | |
| **Hypertension** | | | | | | | | |
| No | 297 | 12337.5 | 24.1 (21.4-27.0) | 0.314 | 214 | 9687.5 | 22.1 (19.2-25.3) | 0.085 |
| Yes | 128 | 4780 | 26.8 (22.3-31.8) | | 85 | 4790 | 17.5 (14.0-21.7) | |

## Discussion

The present study assessed the prevalence, predictors, and effects of hypersomnia and insomnia (the most common sleep disorders) in the 15- to 80-year-old adult population in Kerman (southeastern Iran) in 9997 participants. The study also determined changes in trends of prevalence and incidence rates of these important CVD risk factors in the time-gap between the two phases of the KERCADR study (5 years). The study revealed a meaningful increase in prevalence of sleep disorders during the above-mentioned period (45.3% in the present study vs. 30.5% in phase 1). Insomnia was associated with higher prevalence of anxiety, and hypersomnia was associated with higher prevalence of depression, low physical activity (LPA), cigarette smoking, and opium use.

A study conducted in Tabriz, Iran, reported that 35% of the general population have sleep disorders (27). However, a previous study in Kashan, Iran reported 59% prevalence rate for insomnia. One reason for the differences in prevalence may be the ethnicity of the population, as it is generally accepted that the Azeri ethnicity in Iran are more active with lower rate of unemployment. The results of the present study about the prevalence of sleep disorders (45.3%) are in line with findings in the USA (28). In our study, while the prevalence of hypersomnia was higher in males, insomnia was higher in females. This is in contrast to the result of phase 1 of KERCADRS as well as other studies (15, 29, 30) that showed higher prevalence for both sleep disorders in women. We believe that socioeconomic changes in recent years occurring in Iran not only have made men less active but also resulted in men sleeping more. This hypothesis is in agreement with the results of the studies that found a negative impact of low socioeconomic status on sleep and health (31). The differences in the prevalence of sleep disorders may also vary depending on definition, methodology and the population studied.

In the present study, the average sleep hours were 7.5 ± 1.6 per day from which mostly (89%) were night sleepers which is in line with other reports (3, 32, 33). Age was another mediating factor of sleep disorders. Insomnia and hypersomnia showed opposite age trends until the age of 65 years, with insomnia increasing and hypersomnia decreasing with age (Table 1). Furthermore, our results showed that marital status could also be considered as another sleep disorder mediator with different effects on insomnia and hypersomnia. The prevalence of hypersomnia was in the order of single >

married > widowed > divorced. In addition, occupation was also a predicating factor for sleep disorders. Unemployed and student/soldier participants had the highest rate of insomnia and hypersomnia, respectively. Conversely, insomnia had the lowest rate in student/soldiers and hypersomnia had the lowest rate in office clerk (31). It seems that unemployment is a great worry for people in Iran, and the fast increasing rate of unemployment in recent years (34) may be one of the main reasons for sleep disorders found in the present study.

The present study also indicated that lower education levels were associated with the increased probability of experiencing insomnia. This may also be related to socioeconomic status as illiterate people may have less earning and more economic problems due to their lower job status. Whinnery *et al.* (35) found no significant relationship between education levels and sleep quality in USA that is a country with high employment rate.

Our findings demonstrated that hypersomnic participants had higher chance of being cigarette smokers among others, which is in line with the results of Zarowski *et al.* (36). The reason for this association may be high blood nicotine levels as a stimulating substrate that may cause sleep disturbance.

Multivariate analysis showed higher chance of being anxious in insomniac participants. This is in agreement with the study of Saleh *et al.* (37). Insomnia is the most common sleep disturbance associated with anxiety disorders. Research indicated that 60%–70% of the patients with anxiety disorder and panic disorder have reported prominent sleep disorder (38). In contrast to anxiety, the chance of being depressed was higher in hypersomniacs although some studies have showed no correlation between hypersomnia and depression (11), and some others reported increased risk of depression (39) by sleep deprivation (insomnia). Therefore, it is not certain that anxiety is associated with insomnia and depression is associated with hypersomnia. Undoubtedly, it is necessary to have normal mental function to have normal sleep and it is reasonable that anxious individuals have shorter sleep durations. Due to release of stress hormones such as cortisol and sympathetic hormones that increase excitement and awareness, anxiety may cause insomnia. Depressed people may have less energy and less motivation for activity and they may prefer to sleep instead although their sleep quality may not be good. Of course, it is not possible to decide whether anxiety and depression are the causes of or manifestations of sleep disorders (reverse causality) based on this study alone.

We may conclude that insomniac people are at risk of being hypertensive in the near future. This conclusion is inferred from the results of phase one of the study (9) and phase two (unpublished observations) showed that anxiety is a strong risk factor of hypertension, and the results of the present study showed that there was a significant association between insomnia and anxiety (Tables 2 and 3). This was consistent with a study by Ojike *et al.* in 2016 that showed higher psychological distress and less well-being in patients with hypertension and that incidence of hypertension was higher with shorter sleep durations (less than six h/day) compared with seven to eight hours of sleep (39).

The other risk factors of CAD (i.e. LPA, depression, smoking and opium use) had higher rates in people with hypersomnia. Therefore, hypersomnia may seem more important in increasing the burden of cardiovascular diseases than insomnia because this concert of risky behaviors may insert additive or synergic effect on the prevalence and incidence rate of CVDs. The findings that the incidence rate of both sleep disorders was higher in participants with LPA (Table 4) along with 42% more chance of opium use in participants with hypersomnia (Table 3) may underline this inappropriate risky life style.

## Limitation

Random sampling from a general population, the large sample size, the wide age range of participants, and the high response rate are the strong points of the present study. However, the study had three limitations. First, due to loss of 52% of the participants between phase one and phase two, we were not able to assess the effects of this loss to follow-up on incidence rate calculation although we checked the demographic characteristics of those who were lost with those who remained and there was no significant difference between them. Secondly, we used sleep hours as an index of hypersomnia or insomnia (as sleep disorders). We acknowledge that quality of sleep may not necessarily fit with the number of sleep hours. However, sleep duration is a main and primary index of sleep disorder. Accordingly, only 2.7% of participants reported snoring. Thirdly, our study was conducted on the urban population in southeastern part of Iran, which may limit the generalizability of the findings to the rural population and the whole nation.

## Conclusion

Overall, 45.3% of participants were suffering from sleep disorders, which has increased by 15% between the two phases of the study. The fast growth rate of insomnia and hypersomnia during the recent five years, especially hypersomnia in males who are more at the risk of CVD, predisposes the population to coronary artery disease, which is already a major health problem in the region. This risk profile would significantly increase the burden of CVDs in the community in the near future if left unaddressed.

## Acknowledgment

The authors are grateful from Vice Chancellor for Research and Technology at Kerman University of Medical Sciences for financial support of the project.
(Grant No IR.KMU.REC.1393/310).

## Conflict of Interest

None.

## References


1. Kryger MH, Rosenberg R, Kirsh D. Kryger's Sleep Medicine Review E-Book: A Problem-Oriented Approach. Elsevier Health Sciences; 2019 Feb 20.
2. Chattu VK, Manzar MD, Kumary S, Burman D, Spence DW, Pandi-Perumal SR. The Global Problem of Insufficient Sleep and Its Serious Public Health Implications. Healthcare (Basel). 2018;7(1).
3. Chaput JP, Dutil C, Featherstone R, Ross R, Giangregorio L, Saunders TJ, et al. Sleep duration and health in adults: an overview of systematic reviews. Appl Physiol Nutr Metab. 2020;45(10 (Suppl. 2)):S218-s231
4. Watson NF, Badr MS, Belenky G, Bliwise DL, Buxton OM, Buysse D, Dinges DF, Gangwisch J, Grandner MA, Kushida C. Joint consensus statement of the American Academy of Sleep Medicine and Sleep Research Society on the recommended amount of sleep for a healthy adult: methodology and discussion. J Clin Sleep Med. 2015 Aug 15;11(8):931-52.
5. Colten HR, Altevogt BM. Sleep disorders and sleep deprivation: an unmet public health problem. Washington, DC: Committee on Sleep Medicine and Research, Institute of Medicine. .
6. Luyster FS, Strollo PJ, Zee PC, Walsh JK. Sleep: a health imperative. Sleep. 2012 Jun 1;35(6):727-34..
7. Deng N, Kohn TP, Lipshultz LI, Pastuszak AW. The Relationship Between Shift Work and Men's Health. Sex Med Rev. 2018;6(3):446-56.
8. Matricciani L, Bin YS, Lallukka T, Kronholm E, Dumuid D, Paquet C, et al. Past, present, and future: trends in sleep duration and implications for public health. Sleep Health. 2017;3(5):317-23.
9. Najafipour H, Sabahi A, Mirrashidi F, Afshari M, Haghdoost AA. Sleep status and its relationship with other coronary artery diseases risk factors: Findings of a community-based study in South East of Iran. J Sleep Disord Ther. 2015;4(197):2167-0277..
10. Itani O, Jike M, Watanabe N, Kaneita Y. Short sleep duration and health outcomes: a systematic review, meta-analysis, and meta-regression. Sleep Med. 2017;32:246-56.
11. Jike M, Itani O, Watanabe N, Buysse DJ, Kaneita Y. Long sleep duration and health outcomes: A systematic review, meta-analysis and meta-regression. Sleep Med Rev. 2018;39:25-36.
12. Geoffroy PA, Hoertel N, Etain B, Bellivier F, Delorme R, Limosin F, et al. Insomnia and hypersomnia in major depressive episode: Prevalence, sociodemographic characteristics and psychiatric comorbidity in a population-based study. J Affect Disord. 2018;226:132-41.
13. Magee CA, Iverson DC, Caputi P. Factors associated with short and long sleep. Prev Med. 2009;49(6):461-7.
14. Kronholm E, Härmä M, Hublin C, Aro AR, Partonen T. Self-reported sleep duration in Finnish general population. J Sleep Res. 2006;15(3):276-90.
15. Ahmadvand A, Sepehrmanesh Z, Ghoreishi FS, Mousavi SG. Prevalence of insomnia among 18 years old people and over in Kashan city, Iran in 2008. KAUMS Journal (FEYZ). 2010 Feb 10;13(4):313-20.
16. Araste M. Evaluation of insomnia in medical students of Kurdistan University. Sci. J. Kurd. Univ. Med. Sci. 2007 Dec 10;12(3):58-63.
17. Najafipour H, Nasri HR, Rostamzadeh F, Amirzadeh R, Shadkam M, Mirzazadeh A. Prevalence and incidence of pre-hypertension and hypertension (awareness/control) in Iran: findings from Kerman coronary artery diseases risk factors study 2 (KERCADRS). J Hum Hypertens. 2020.
18. Najafipour H, Mirzazadeh A, Haghdoost A, Shadkam M, Afshari M, Moazenzadeh M, et al. Coronary Artery Disease Risk Factors in an Urban and Peri-urban Setting, Kerman, Southeastern Iran (KERCADR Study): Methodology and Preliminary Report. Iran J Public Health. 2012;41(9):86-92.
19. Khesht-Masjedi MF, Omar Z, Masoleh SM. Psychometrics properties of the Persian version of Beck Anxiety Inventory in North of Iranian adolescents. IJEPR. 2015 Apr 1;1(2):145..
20. Hojat M, Shapurian R, Mehryar AH. Psychometric properties of a Persian version of the short form of the Beck Depression Inventory for Iranian college students. Psychol Rep. 1986;59(1):331-8.
21. Armstrong T, Bull F. Development of the world health organization global physical activity questionnaire (GPAQ). J Public Health. 2006 Apr;14(2):66-70.
22. Najafipour H, Kahnooji M, Baneshi MR, Yeganeh M, Ahmadi Gohari M, Shadkam Farokhi M, et al. The prevalence and 5-Year incidence rate of low physical activity in an urban population of 10,000 in southeastern Iran: Relationship with other cardiovascular risk factors. J Phys Act Health. 2020;17(4):435-42.
23. Cleland CL, Hunter RF, Kee F, Cupples ME, Sallis JF, Tully MA. Validity of the global physical activity questionnaire (GPAQ) in assessing levels and change in moderate-vigorous physical activity and sedentary behaviour. BMC Public Health. 2014;14:1255.
24. Mohebi F, Mohajer B, Yoosefi M, Sheidaei A, Zokaei H, Damerchilu B, et al. Physical activity profile of the Iranian population: STEPS survey, 2016. BMC Public Health. 2019;19(1):1266.
25. Mahmoodabad SSM, Tonekaboni NR, Farmanbar R, Fallahzadeh H, Kamalikhah T. The effect of motivational interviewing-based intervention using self-determination theory on

promotion of physical activity among women in reproductive age: A randomized clinical trial. Electron Physician. 2017;9(5):4461-72.
26. American Psychiatric Association. Diagnostic and statistical manual of mental disorders: DSM-5. Washington, DC: American psychiatric association; 2013 May.
27. Pourafkary N., Arafi A., Dadashzadeh H., Ghaem Maghami J. A comparative study on the prevalence of sleep disturbances in Psychiatric disorder and general population in Tabriz. Med. J. Tabriz Univ. Med. Sci. 2004 ;38(64):28-33.
28. Liu Y, Wheaton AG, Chapman DP, Cunningham TJ, Lu H, Croft JB. Prevalence of healthy sleep duration among adults—United States, 2014. MMWR. 2016 Feb 19;65(6):137-41.
29. Suh S, Cho N, Zhang J. Sex differences in insomnia: from epidemiology and etiology to intervention. Curr. Psychiatry Rep. 2018 Sep;20(9):1-2..
30. Franco P, Putois B, Guyon A, Raoux A, Papadopoulou M, Guignard-Perret A, et al. Sleep during development: Sex and gender differences. Sleep Med Rev. 2020;51:101276.
31. Stringhini S, Haba-Rubio J, Marques-Vidal P, Waeber G, Preisig M, Guessous I, et al. Association of socioeconomic status with sleep disturbances in the Swiss population-based CoLaus study. Sleep Med. 2015;16(4):469-76.
32. Hirshkowitz M, Whiton K, Albert SM, Alessi C, Bruni O, DonCarlos L, et al. National Sleep Foundation's sleep time duration recommendations: methodology and results summary. Sleep Health. 2015;1(1):40-3.
33. Watson NF, Badr MS, Belenky G, Bliwise DL, Buxton OM, Buysse D, et al. Joint Consensus Statement of the American Academy of Sleep Medicine and Sleep Research Society on the Recommended Amount of Sleep for a Healthy Adult: Methodology and Discussion. Sleep. 2015;38(8):1161-83.
34. Hasanpour Baysafar T. Investigation of the effect of growth in service, industrial and agricultural sectors, on unemployment in Iran. J. Intellect. Cap. 2020 Feb 20;5(2):139-59.
35. Whinnery J, Jackson N, Rattanaumpawan P, Grandner MA. Short and long sleep duration associated with race/ethnicity, sociodemographics, and socioeconomic position. Sleep. 2014;37(3):601-11.
36. Zarowski M, Mojs E, Kleka P, Steinborn B. [The impact of smoking cigarettes on insomnia and excessive daytime sleepiness symptoms among teachers]. Przegl Lek. 2007;64(10):645-8.
37. Saleh DK, Nouhi S, Zandi H, Lankarani MM, Assari S, Pishgou B. The quality of sleep in coronary artery disease patients with and without anxiety and depressive symptoms. Indian Heart J. 2008;60(4):309-12.
38. Cox RC, Olatunji BO. Sleep in the anxiety-related disorders: A meta-analysis of subjective and objective research. Sleep Med Rev. 2020;51:101282.
39. Ojike N, Sowers JR, Seixas A, Ravenell J, Rodriguez-Figueroa G, Awadallah M, et al. Psychological Distress and Hypertension: Results from the National Health Interview Survey for 2004-2013. Cardiorenal Med. 2016;6(3):198-208.