# Relationship of Psychiatric Disorders and Sleep Quality to Physical Symptoms in Coronary Artery Disease

*Anshu Peng, MD, Ze Lin, MD, and Chunying Zhu, MD*

**Abstract:** Psychiatric disorders (depression/anxiety) and sleep quality are linked to coronary artery disease (CAD). CAD patients often complain of various physical symptoms (PSs), which are not only organic changes of biological origin, but also somatization of mental illness. PSs also affect CAD progression. However, the relationship between psychiatric disorders/sleep quality and PS in CAD is less studied, which this study aims to clarify. This cross-sectional observational study was conducted on the first 305 CAD patients diagnosed with PS by Patient Health Questionnaire-15. They were compared with 521 other CAD patients showing no PS. On multivariate analysis, sex, age, family history, psychiatric disorders, and sleep quality were the significant independent predictors of PS. A significant correlation was found between PS severity and the severity of both psychiatric disorders and sleep quality. Further studies are warranted to explore the impact of psychological and sleep intervention on PS and long-term outcomes.

**Key Words:** Physical symptoms, psychiatric disorders, sleep quality, coronary artery disease

Psychiatric disorders (depression/anxiety) and sleep quality are linked to coronary artery disease (CAD). Anxiety, depression, and other emotional problems are not only independent prognostic risk factors for various types of CADs but may aggravate other risk factors for cardiovascular diseases (Penninx, 2017). Previously, researchers conducted a survey on emotional problems in CAD patients and found that 21%, 46.6%, and 38% of patients had comorbid anxiety, depression, and combined depression and anxiety, respectively (Daniel et al., 2018; De Smedt et al., 2019; Greden, 2003). Epidemiological data show that the risk of death is doubled in acute myocardial infarction with comorbid depression (Feng et al., 2019). At the same time, studies show that sleep disorders and CAD have a close relationship, and sleep duration is one of the prognostic markers for cardiovascular diseases (Cappuccio et al., 2011). Interestingly, sleep disorders may induce CAD, and CAD will also exacerbate sleep disorders. A national health and nutrition survey for clinical research of US citizens found a significant correlation between sleep duration and the prevalence of stroke, myocardial infarction, congestive heart failure, CAD, and angina (Aggarwal et al., 2013). Another study shows that the risk of cardiovascular disease and CAD are increased by 63% and 79%, respectively, in subjects with short sleep duration and poor sleep quality compared with subjects with normal sleep patterns and good sleep quality (Hoevenaar-Blom et al., 2011). In conclusion, psychiatric disorders (depression/anxiety) and sleep quality were strongly correlated with the condition of CAD patients.

Physical symptoms (PSs) are defined as unpleasant subjective feelings associated with tissue injury or latent injury. CAD patients often complain of various PS, such as chest pain, dizziness, and shortness of breath (Ketterer et al., 2008). More and more studies are showing that these PS are not only organic changes of biological origin but may also be physical manifestations of psychiatric disorders (Bekhuis et al., 2015). However, cardiologists lack sufficient understanding of PS in patients at present. Symptomatic treatment is usually biomedical treatment based on coronary angiography results, and the roles of psychiatric and psychological factors tend to be ignored. This results in poor efficacy in the treatment of PS and, consequently, repeated follow-ups (Barsky et al., 2005). Studies conducted to better understand the relationship between PS and CAD found that cerebrocardiovascular disease patients, such as those with hypertension (Wiener et al., 2020) or coronary arteriosclerosis (Sokolov et al., 1984), not only experience physiological changes but also significant emotional changes. Anxiety, depression, and sleep disorders occur with disease progression and may lead to PS (Dijkstra-Kersten et al., 2017; Hansotia, 1996). The clinical presentations of PSs are diverse, and these may involve different systems, including a series of PS, such as pain (gastric pain, headache, and neuropathy), muscle tension, shivering, dyspnea, heart palpitations, fatigue, and gastrointestinal symptoms (Dorner et al., 2010). Patients with PS may also develop CAD. Severe PS may lead to autonomic dysfunction, increased plasma catecholamine levels, and increased heart rate. These in turn lead to vascular endothelial injury and increased incidence of CAD (Peters et al., 2018). Therefore, CAD patients develop more intense PS, and PS worsens the disease in CAD patients.

However, to our knowledge, very few data are available on the relationship between psychiatric disorders/sleep quality and PS in CAD. Prompt identification of the effects of psychiatric disorders/sleep quality on PS and timely intervention will not only improve the treatment protocol and prevent excessive diagnosis and treatment but also the prognosis and efficacy of treatment in cardiovascular disease patients. Thus, this study aims to elucidate the relationship between psychiatric disorders/sleep quality and PS in CAD.

## METHODS

### Study Population

This is a retrospective clinical study wherein we collected the previous data of the target patients from January 2021 to May 2021 through outpatient follow-up and telephone follow-up. A total of 833 patients hospitalized for coronary heart disease between July 2018 and December 2019 were included in this study. On the day of admission, basic information was collected, and the Patient Health Questionnaire-15 (PHQ15), Pittsburgh Sleep Quality Index (PSQI), General Anxiety Disorder-7 (GAD7), and Patient Health Questionnaire-9 (PHQ9) scales were completed. For elderly patients who were unable to fill in the forms, staff described the scale contents and assisted in completion. The exclusion criteria were patients younger than 25 years and uncooperative patients. Authors had access to information that could identify individual participants during data collection.

### Clinical Assessment

All patients were assessed for CAD risk factors and body mass index (BMI), which was calculated by dividing the body weight (in kilograms) over the square of the height (in meters). Blood was drawn on the day of admission for random blood glucose testing. Smoking status was documented as current tobacco use or ex-smoker (if stopped >2 years).

Psychosocial Department, The Affiliated Hospital of Hangzhou Normal University, Hangzhou, China.

Send reprint requests to Chunying Zhu, MD, The Affiliated Hospital of Hangzhou Normal University, No.126 Wenzhou Road, Hangzhou, China, 310000. E-mail: zcy20182985@126.com.

**TABLE 1.** Demographic Data, Risk Factors, and Psychiatric Test Results in Study Groups

| | | Frequency | % |
|---|---|---|---|
| Sex | Male | 471 | 57.00 |
| | Female | 355 | 43.00 |
| Age | 25–44 y | 75 | 9.10 |
| | 45–64 y | 353 | 42.70 |
| | >65 y | 397 | 48.10 |
| Surgical history | No | 310 | 37.50 |
| | Yes | 514 | 62.20 |
| Culture | Primary school or below | 306 | 37.00 |
| | Junior high school | 389 | 47.10 |
| | Senior high school | 94 | 11.40 |
| | University | 37 | 4.50 |
| Marital history | Unmarried | 5 | 0.60 |
| | Married | 790 | 95.60 |
| | Widowed | 31 | 3.80 |
| Smoking history | No | 538 | 65.10 |
| | Yes | 288 | 34.90 |
| Drinking history | No | 586 | 70.90 |
| | Yes | 240 | 29.10 |
| Previous history | No | 170 | 20.60 |
| | Yes | 656 | 79.40 |
| Family history | No | 707 | 85.60 |
| | Yes | 118 | 14.30 |
| Psychiatric history | No | 776 | 93.90 |
| | Yes | 49 | 5.90 |
| PHQ15 | No | 521 | 63.10 |
| | Yes | 305 | 36.90 |
| PSQI | No | 298 | 36.10 |
| | Light | 264 | 32.00 |
| | Medium/heavy | 263 | 31.80 |
| GAD7 | No | 689 | 83.40 |
| | Light | 109 | 13.20 |
| | Medium/heavy | 27 | 3.30 |
| PHQ9 | No | 693 | 83.90 |
| | Light | 110 | 13.30 |
| | Medium/heavy | 22 | 2.70 |

| | Mean | Mid | SD | Range | Min | Max |
|---|---|---|---|---|---|---|
| BMI | 23.81 | 23.80 | 3.52 | 37.40 | 14.50 | 51.90 |
| Blood glucose | 9.66 | 9.66 | 2.75 | 27.30 | 2.70 | 30.00 |

## Psychiatric Assessment

Psychiatric interviews were performed to assess the severity of PS, anxiety, depression, and sleep quality using the following scales:

- PHQ-15: This 15-item scale assesses PS severity. Item scores were summed (score: 0–4, normal; >4, presence of PS).
- PSQI: This 18-item scale assesses sleep quality. Item scores were summed (score: 0–4, normal; 5–9, mild sleeplessness; 10–15, moderate sleeplessness; >15, severe sleeplessness).
- PHQ-9: This 9-item scale assesses depression severity. Item scores were summed (score: 0–4, normal; 5–9, mild anxiety; 10–15, moderate anxiety; >15, severe anxiety).
- GAD-7: This 7-item scale assesses depression severity. Item scores were summed (score: 0–4, normal; 5–9, mild anxiety; 10–15, moderate anxiety; >15, severe anxiety).

## Statistical Methods

SPSS 23.0 (IBM, Armonk, NY) was used for data analysis. Qualitative data were described as frequency (percentage). The chi-square test (categorical data) and nonparametric test (ranked data) were used to analyze qualitative data. Quantitative data that were normally distributed or approximately normally distributed were described using mean ± standard deviation, and the independent sample *t*-test was used for analysis. Nonnormally distributed quantitative data were described using median (lower quartile, upper quartile), and the nonparametric *U* test was used for analysis. Quantitative data were analyzed using Spearman's rank correlation to establish correlations among the four scales. Finally, PHQ15 (control = 0; case = 1) was used as the dependent variable; PSQI, GAD7, and PHQ9 were used as main effect variables, and variables that were statistically significant in the aforementioned univariate analysis were used as control variables in the regression formula to construct a multivariate logistic regression model. The odds ratio (OR) was used as the parameter for risk assessment. Subsequently, sex and age were used as subgroup variables for analysis to test differences in PSQI, GAD7, and PHQ9 between the two PHQ15 (control = 0; case = 1) groups. Furthermore, $p < 0.05$ was considered statistically significant, and a two-tailed test was used.

## RESULTS

### Descriptive Analysis

A total of 826 subjects were enrolled. Among these, 471 were male (57.02%) and 355 were female (42.98%). The oldest patient was

**TABLE 2.** Correlation Between the Baseline Characteristics and Physical Symptoms

| | PHQ15 | | | |
|---|---|---|---|---|
| Atherosclerotic Risk Factors | Control (*n* = 521) | Case (*n* = 305) | *t/Z/*$\chi^2$ | *p* |
| Sex | | | | |
| Male | 333 (63.9) | 138 (45.2) | 27.362 | 0.001 |
| Female | 188 (36.1) | 167 (54.8) | | |
| Age | | | | |
| 25–44 | 57 (10.9) | 18 (5.9) | 12.198 | 0.002 |
| 45–64 | 235 (45.1) | 118 (38.8) | | |
| More than 65 | 229 (44.0) | 168 (55.3) | | |
| BMI, kg/m$^2$ | 23.94 ± 3.57 | 23.55 ± 3.44 | 1.63 | 0.103 |
| Blood glucose | 9.66 ± 2.82 | 9.66 ± 2.63 | −0.017 | 0.986 |
| Culture | | | | |
| Primary school or below | 183 (35.1) | 123 (40.3) | 2.398 | 0.494 |
| Junior high school | 253 (48.6) | 136 (44.6) | | |
| Senior high school | 62 (11.9) | 32 (10.5) | | |
| University | 23 (4.4) | 14 (4.6) | | |
| Marriage | | | | |
| Unmarried | 2 (0.4) | 3 (1.0) | 1.201 | 0.554 |
| Married | 500 (96.0) | 290 (95.1) | | |
| Widowed | 19 (3.6) | 12 (3.9) | | |
| Smoking history | | | | |
| No | 329 (63.1) | 209 (68.5) | 2.449 | 0.118 |
| Yes | 192 (36.9) | 96 (31.5) | | |
| Drinking history | | | | |
| No | 361 (69.3) | 225 (73.8) | 1.874 | 0.171 |
| Yes | 160 (30.7) | 80 (26.2) | | |

**TABLE 3.** Correlation Between the Key Factors and Physical Symptoms

| Atherosclerotic Risk Factors | PHQ15 | | $t/Z/\chi^2$ | $p$ |
| --- | --- | --- | --- | --- |
| | Control ($n = 521$) | Case ($n = 305$) | | |
| Previous history | | | | |
|   No | 110 (21.1) | 60 (19.7) | 0.244 | 0.621 |
|   Yes | 411 (78.9) | 245 (80.3) | | |
| Family history | | | | |
|   No | 465 (89.3) | 242 (79.6) | 14.574 | 0.001 |
|   Yes | 56 (10.7) | 62 (20.4) | | |
| Psychiatric history | | | | |
|   No | 503 (96.5) | 273 (89.8) | 15.622 | 0.001 |
|   Yes | 18 (3.5) | 31 (10.2) | | |
| Surgical history | | | | |
|   No | 118 (36.2) | 122 (40.0) | 1.167 | 0.280 |
|   Yes | 331 (63.8) | 183 (60.0) | | |
| PSQI | | | | |
|   No (0–4) | 244 (46.8) | 54 (17.8) | −11.316 | 0.001 |
|   Light (5–9) | 185 (35.5) | 79 (26.0) | | |
|   Medium/heavy (≥10) | 92 (17.7) | 171 (56.3) | | |
| GAD7 | | | | |
|   No (0–4) | 479 (91.9) | 210 (69.1) | −8.584 | 0.001 |
|   Light (5–9) | 36 (6.9) | 73 (24.0) | | |
|   Medium/heavy (≥10) | 6 (1.2) | 21 (6.9) | | |
| PHQ9 | | | | |
|   No (0–4) | 490 (94.0) | 203 (66.8) | −10.348 | 0.001 |
|   Light (5–9) | 28 (5.4) | 82 (27.0) | | |
|   Medium/heavy (≥10) | 3 (0.6) | 19 (6.3) | | |

98 years old, the youngest was 25 years old, and the median age was 66 years. Seventy-five patients (9.09%) were aged 25–44 years, 353 (42.87%) were aged 45–64 years, and 397 patients (48.12%) were aged older than 65 years. Five patients were unmarried (0.61%), 790 patients were married (95.64%), and 31 patients were widowed (3.75%). A total of 288 patients (34.86%) had a history of smoking, whereas 240 patients (29.05%) had a history of alcohol drinking. Lastly, 520 patients (62.95%) had previous surgical histories (Table 1).

**TABLE 4.** Independent Predictors of Physical Symptoms

| | | β | OR | 95% CI for OR | $p$ |
| --- | --- | --- | --- | --- | --- |
| Sex | Male | 0.000 | 1.000 | | |
| | Female | 0.350 | 1.419 | 1.011–1.991 | 0.043 |
| Age | 25–44 | 0.000 | 1.000 | | |
| | 45–64 | 0.591 | 1.805 | 0.892–3.654 | 0.101 |
| | More than 65 | 0.954 | 2.597 | 1.291–5.222 | 0.007 |
| Family history | No | 0.000 | 1.000 | | |
| | Yes | 0.784 | 2.191 | 1.393–3.445 | 0.001 |
| Psychiatric history | No | 0.000 | 1.000 | | |
| | No | −0.092 | 0.912 | 0.456–1.826 | 0.796 |
| PSQI | No | 0.000 | 1.000 | | |
| | Mild | 0.298 | 1.347 | 0.885–2.053 | 0.165 |
| | Moderate/severe | 1.510 | 4.528 | 2.931–6.996 | 0.001 |
| GAD7 | No | 0.000 | 1.000 | | 0.001 |
| | Mild | 0.877 | 2.405 | 1.433–4.036 | 0.001 |
| | Moderate/severe | 1.168 | 3.217 | 1.113–9.293 | 0.031 |
| PHQ9 | No | 0.000 | 1.000 | | |
| | Mild | 1.100 | 3.005 | 1.762–5.126 | 0.001 |
| | Moderate/severe | 1.576 | 4.836 | 1.261–18.545 | 0.022 |

**TABLE 5.** Sex Stratification

| | Male | | | | Female | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | PHQ15 = Control | PHQ15 = Case | Z | p | PHQ15 = Control | PHQ15 = Case | Z | p |
| PSQI | 4.00 (2.00, 7.00) | 10.00 (6.00, 13.00) | −9.083 | 0.001 | 6.00 (4.00, 10.00) | 11.00 (7.00, 13.00) | −6.65 | 0.001 |
| GAD7 | 0.00 (0.00, 1.00) | 2.00 (0.00.5.00) | −7.637 | 0.001 | 1.00 (0.00, 2.75) | 3.00 (1.00, 6.00) | −6.698 | 0.001 |
| PHQ9 | 0.00 (0.00, 2.00) | 3.00 (1.00.5.00) | −9.439 | 0.001 | 1.00 (0.00, 2.00) | 4.00 (1.00, 6.00) | −8.766 | 0.001 |

## Baseline Characteristics

Demographic data and risk factors are summarized in Table 1. Sex, age, family history, and psychiatric history were higher in the case group. BMI, blood glucose, culture, marital status, smoking, drinking, and surgical history have no significant correlation with PS (Table 2).

## Main Effect Analysis

PS patients had significantly higher PSQI, GAD7, and PHQ9I scores. Most of the patients had moderate to severe sleep disorders ($n = 171$, 56.3%) (Table 3).

## Multivariate Analysis

A multivariate regression model using significant univariate variables (sex, age, family history, psychiatric history, PSQI, GAD7, and PHQ9) revealed that sex, age, family history, PSQI, GAD7, and PHQ9 were significant independent determinants of PS ($\chi^2 = 221.102$; $p = 0.001$). The ">65 years group" was an independent determinant of PS, whereas the "45–64 age group" was significantly associated but not an independent factor of PS (Table 4).

## Subgroup Analysis

### Sex Stratification

Sex was an independent determinant of PS. However, psychiatric disorders and sleep quality both significantly increased the PS positivity rate in both male and female patients (Table 5).

### Age Stratification

Although the ">65 years group" was the only independent determinant of PS, psychiatric disorders and sleep quality significantly increased the PS positivity rate in all age groups (Table 6).

## DISCUSSION

The present study showed that PS was significantly and independently associated with sex, age, and family history. Psychiatric history was significantly associated with but not independent risk factor of PS. The ">65 years group" (OR, 2.597; 95% confidence interval [CI], 1.291–5.222; $p = 0.07$) and "family history" (OR, 2.191; 95% CI, 1.393–3.445; $p = 0.01$) are the most important independent predictors of PS. In addition, female sex is also an important independent predictor of PS (OR, 1.419; 95% CI, 1.011–1.991; $p = 0.043$). Old age and family history are both traditional risk factors for CAD and both lead to risk of CAD exacerbation (Arad, 2002). In addition, severe disease often leads to a higher PS positivity rate. Most female CAD patients are menopausal women. Due to hormone fluctuations, they experience a higher incidence of psychiatric disorder compared with men (Gonda et al., 2008). At the same time, women are more sensitive to physical discomfort than men. This therefore leads to a higher PS positivity rate in female patients. These findings underscored the need for psychiatrists to intervene or treat patients with traditional high-risk factors more aggressively. These would be of great benefit to the improvement of CAD patients' condition.

In the present study, PS was also significantly associated with depression and anxiety, irrespective of sex and age. Moderate/severe depression (OR, 4.836; 95% CI, 1.261–18.545; $p = 0.022$) is the most important independent predictor for PS; every unit increase in the PHQ9 score is associated with a 4.836-fold increase in PS probability ($p = 0.022$). Mild anxiety (OR, 2.405; 95% CI, 1.433–4.036; $p = 0.01$) and moderate/severe anxiety (OR, 3.217; 95% CI, 1.113–9.293; $p = 0.031$) are also significantly associated with PS. These findings are concordant with the previous study: Many CAD patients experience anxiety, depression, and other psychiatric disorders. Anxiety and depression in patients will increase the PS positivity rate. In-patients usually worry about high medical fees and may develop anxiety, depression, and other emotional problems due to disease occurrence, progression, uncertain prognosis, and other factors. Previous studies also proved that PS are closely associated with anxiety and depression and are in fact common in anxious and depressed patients. In addition, the risk of developing anxiety and depression is increased by at least twofold in patients with PS (Zhang et al., 2018). Furthermore, patients with anxiety and depression tend to develop habits such as smoking, alcoholism, insomnia, and binge drinking and eating and exercise less due to distorted and erroneous thinking. This increases visceral fat and activates the hypothalamus-pituitary-adrenal axis that promotes the secretion of proinflammatory cytokines, thereby promoting a vicious cycle of atherosclerosis and ischemia (Brown et al., 2005; Capuron et al., 2008; Skilton et al., 2007). Studies also showed that persistent negative emotions may overstimulate the sympathetic nervous system, increase blood catecholamine and norepinephrine concentrations, and release many procoagulation factors and vasoconstrictors such as angiotensin II (Peters et al., 2018). These in turn exacerbate myocardial ischemia and cause myocardial infarction or even sudden death. Therefore, cardiologists need to focus not only on early psychological problems and the prompt identification of patients with atypical psychological problems but also on secondary psychological problems caused by cardiovascular disease factors.

Sleep quality is the second most important independent predictor for PS; in the "moderate/severe group," every unit increase in the PSQI score is associated with a 4.5282-fold increase in PS probability ($p = 0.001$). In addition, sleep quality significantly increases PS probability in different sex and age groups. Sleep possibly affects cardiovascular pathophysiology through different methods, but the relationship between sleep duration and cardiovascular disease is still unclear. Endothelial cell dysfunction may be a marker of the causal relationship between sleep duration and cardiovascular risk. Endothelial dysfunction is usually the clinical presentation that precedes cardiovascular disease and indicates a potential mechanism in the relationship between cardiovascular disease and sleep quality. Sleep disorders may be a highly suggestive marker of endothelial cell dysfunction and is an important marker of cardiovascular disease risk (Hall et al., 2017). A study also showed that insufficient sleep or lack of sleep induces the spontaneous activation of innate immunity, signal transduction, and transcription factor activation, which are involved in the molecular signaling pathway of dynamic inflammation regulation and other immune responses ensuing from lack of sleep. Taken together, this cascade of reactions promotes a proinflammatory microenvironment that eventually leads to cardiovascular diseases (Irwin et al., 2015). Therefore, poor sleep in CAD patients will

**TABLE 6.** Age Stratification

| | 25–44 y | | | | 45–64 y | | | | >65 y | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PHQ15 = Control | PHQ15 = Case | Z | p | PHQ15 = Control | PHQ15 = Case | Z | p | PHQ15 = Control | PHQ15 = Case | Z | p |
| PSQI | 4.00 (2.00, 6.50) | 9.50 (4.75, 12.25) | −3.571 | 0.001 | 5.00 (3.00, 8.00) | 10.00 (6.00, 14.00) | −7.827 | 0.001 | 5.00 (3.00, 9.00) | 11.00 (6.00, 13.00) | −8.049 | 0.001 |
| GAD7 | 1.00 (0.00, 2.50) | 6.50 (4.00, 11.25) | −4.843 | 0.001 | 0.00 (0.00, 2.00) | 4.00 (1.00, 5.25) | −7.61 | 0.001 | 0.00 (0.00, 1.00) | 2.00 (0.00, 4.00) | −6.986 | 0.001 |
| PHQ9 | 1.00 (0.00, 2.00) | 5.50 (4.00, 9.00) | −4.774 | 0.001 | 0.00 (0.00, 2.00) | 3.00 (1.00, 7.00) | −9.425 | 0.001 | 0.00 (0.00, 2.00) | 3.00 (1.00, 5.00) | −8.662 | 0.001 |

aggravate CAD, leading to an increase in the positive rate of related symptoms including PS. Similarly, poor sleep will also exacerbate anxiety and depression in patients and overlap with somatization symptoms in psychiatric disorders to further increase the positivity rate of PS in patients.

## CONCLUSIONS

Psychiatric disorders, sleep quality, female sex, age, and family history are highly associated with PS in CAD patients. A significant correlation was found between PS severity and the severity of both psychiatric disorders and sleep quality. This guided psychiatrists to participate more actively in the treatment of CAD patients for specific patients. As the statistical results showed, psychiatrists should focus on anxiety, depression, and sleep therapy. Early detection and early intervention could significantly improve the clinical symptoms of CAD patients, which was conducive to the rehabilitation of patients. Further studies are warranted to explore the impact of psychological and sleep intervention on PS, so as to provide a theoretical basis for the relevant treatment.

## DISCLOSURE
*The authors declare no conflict of interest.*

## REFERENCES

Aggarwal S, Loomba RS, Arora RR, Molnar J (2013) Associations between sleep duration and prevalence of cardiovascular events. *Clin Cardiol*. 36:671–676.

Arad Y (2002) Beyond traditional risk factor analysis for coronary artery disease: The case for coronary artery calcium assessment with electron beam computed tomography. *Prev Cardiol*. 5:62–67.

Barsky AJ, Orav EJ, Bates DW (2005) Somatization increases medical utilization and costs independent of psychiatric and medical comorbidity. *Arch Gen Psychiatry*. 62:903–910.

Bekhuis E, Boschloo L, Rosmalen JG, Schoevers RA (2015) Differential associations of specific depressive and anxiety disorders with somatic symptoms. *J Psychosom Res*. 78:116–122.

Brown WJ, Ford JH, Burton NW, Marshall AL, Dobson AJ (2005) Prospective study of physical activity and depressive symptoms in middle-aged women. *Am J Prev Med*. 29:265–272.

Cappuccio FP, Cooper D, D'Elia L, Strazzullo P, Miller MA (2011) Sleep duration predicts cardiovascular outcomes: A systematic review and meta-analysis of prospective studies. *Eur Heart J*. 32:1484–1492.

Capuron L, Su S, Miller AH, Bremner JD, Goldberg J, Vogt GJ, Maisano C, Jones L, Murrah NV, Vaccarino V (2008) Depressive symptoms and metabolic syndrome: Is inflammation the underlying link? *Biol Psychiatry*. 64:896–900.

Daniel M, Agewall S, Berglund F, Caidahl K, Collste O, Ekenbäck C, Frick M, Henareh L, Jernberg T, Malmqvist K, Schenck-Gustafsson K, Spaak J, Sundin O, Sörensson P, Y-Hassan S, Hofman-Bang C, Tornvall P (2018) Prevalence of anxiety and depression symptoms in patients with myocardial infarction with non-obstructive coronary arteries. *Am J Med*. 131:1118–1124.

De Smedt D, De Sutter J, De Pauw M, Vandekerckhove H, Trouerbach J, De Backer G, Willems AM, Pardaens S, Vervaet P, Deweerdt N, De Bacquer D (2019) Lifestyle behaviour and risk factor control in coronary patients: Belgian results from the cross-sectional EUROASPIRE surveys. *Acta Cardiol*. 74:21–27.

Dijkstra-Kersten SMA, Sitnikova K, Terluin B, Penninx BWJH, Twisk JWR, van Marwijk HWJ, van der Horst HE, van der Wouden JC (2017) Longitudinal

associations of multiple physical symptoms with recurrence of depressive and anxiety disorders. *J Psychosom Res*. 97:96–101.

Dorner TE, Stronegger WJ, Rebhandl E, Rieder A, Freidl W (2010) The relationship between various psychosocial factors and physical symptoms reported during primary-care health examinations. *Wien Klin Wochenschr*. 122:103–109.

Feng L, Li L, Liu W, Yang J, Wang Q, Shi L, Luo M (2019) Prevalence of depression in myocardial infarction: A PRISMA-compliant meta-analysis. *Medicine (Baltimore)*. 98:e14596.

Gonda X, Lazary J, Telek T, Pap D, Katai Z, Bagdy G (2008) Mood parameters and severe physical symptoms of the female reproductive cycle. *Neuropsychopharmacol Hung*. 10:91–96.

Greden JF (2003) Physical symptoms of depression: Unmet needs. *J Clin Psychiatry*. 64(suppl 7):5–11.

Hall MH, Mulukutla S, Kline CE, Samuelsson LB, Taylor BJ, Thayer JF, Krafty RT, Frank E, Kupfer DJ (2017) Objective sleep duration is prospectively associated with endothelial health. *Sleep*. 40:zsw003.

Hansotia P (1996) Emotional distress, physical symptoms and sleep disorders. *Wis Med J*. 95:836–837.

Hoevenaar-Blom MP, Spijkerman AM, Kromhout D, van den Berg JF, Verschuren WM (2011) Sleep duration and sleep quality in relation to 12-year cardiovascular disease incidence: The MORGEN study. *Sleep*. 34:1487–1492.

Irwin MR, Witarama T, Caudill M, Olmstead R, Breen EC (2015) Sleep loss activates cellular inflammation and signal transducer and activator of transcription (STAT) family proteins in humans. *Brain Behav Immun*. 47:86–92.

Ketterer MW, Knysz W, Keteyian SJ, Schairer J, Jafri S, Alam M, Farha AJ, Deveshwar S (2008) Cardiovascular symptoms in coronary-artery disease patients are strongly correlated with emotional distress. *Psychosomatics*. 49:230–234.

Penninx BW (2017) Depression and cardiovascular disease: Epidemiological evidence on their linking mechanisms. *Neurosci Biobehav Rev*. 74:277–286.

Peters JR, Eisenlohr-Moul TA, Walsh EC, Derefinko KJ (2018) Exploring the pathophysiology of emotion-based impulsivity: The roles of the sympathetic nervous system and hostile reactivity. *Psychiatry Res*. 267:368–375.

Skilton MR, Moulin P, Terra JL, Bonnet F (2007) Associations between anxiety, depression, and the metabolic syndrome. *Biol Psychiatry*. 62:1251–1257.

Sokolov EI, Khovanskaia TP, Novikova IV, Baluda MV (1984) Effect of emotional stress on the system of hemostasis in patients with coronary arteriosclerosis [in Russian]. *Kardiologiia*. 24:56–60.

Wiener A, Rohr CS, Naor N, Villringer A, Okon-Singer H (2020) Emotion regulation in essential hypertension: Roles of anxiety, stress, and the pulvinar. *Front Behav Neurosci*. 14:80.

Zhang LJ, Liu MY, Rastogi R, Ding JN (2018) Psychocardiological disorder and brain serotonin after comorbid myocardial infarction and depression: An experimental study. *Neurol Res*. 40:516–523.