Psychological Factors and Their Association with Ideal Cardiovascular Health Among Women and Men

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Abstract

Background: The cardiovascular effects of stress and other psychological factors may be different between women and men. We assessed whether self-perceived adverse psychological factors were associated with achievement of ideal cardiovascular health (CVH) as measured by the American Heart Association's Life's Simple Seven (LS7) and whether this differed by sex.

Methods: This was a cross-sectional study of employees from a large healthcare organization. The LS7 metrics (smoking, physical activity, diet, body mass index, blood pressure, cholesterol, and glucose) were each scored as ideal (2), intermediate (1), or poor (0). Total scores were categorized as optimal (11–14), average (9–10), and inadequate (0–8). Using logistic regression, we tested whether psychological factors obtained by questionnaire (self-perceived stress, low life satisfaction, hopelessness, sadness, depression, and anxiety) were associated with CVH, after adjustment for age, ethnicity, and education.

Results: Among 9,056 participants, the mean (SD) age was 43 (12) years, 74% were women, 57% Hispanic/Latino, 17% white, and 16% black. Stress was associated with reduced odds of having optimal/average CVH [OR 0.58 (95% CI 0.50–0.66) and 0.63 (0.50–0.81), for women and men, respectively]. Similarly, depression was associated with reduced odds of optimal/average CVH [0.58 (0.43–0.78) and 0.44 (0.26–0.76), for women and men, respectively]. Low life satisfaction, hopelessness, sadness, and anxiety were also associated with statistically significantly lower odds of optimal/average CVH in women, but not in men; however, there were no interactions by sex.

Conclusions: In an ethnically diverse population, both women and men with several adverse self-perceived psychological factors were less likely to have optimal or adequate CVH. Future studies are needed to determine whether addressing psychological stressors can improve CVH.

Keywords: sex differences, gender differences, Life's Simple 7, ideal cardiovascular health, stress, psychological factors

Introduction

DESPITE DECLINES IN CARDIOVASCULAR DISEASE (CVD) mortality over the past decade,^{1,2} it still remains the leading cause of morbidity and mortality in women and men. While there have been declines in CVD rates in both women and men due to the efforts targeted at traditional risk factors,

nontraditional risk factors may affect men and women differently and account for the sex differences in CVD presentation and outcomes.³ Psychosocial stressors, including depression, social, and work stress, are emerging risk factors for the development of CVD^{4,5} and are associated with worse outcomes.^{6–8} Chronic mental stress leads to abnormal levels of glucocorticoids, catecholamines, and proinflammatory cytokines that can

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have adverse effects on the cardiovascular system.⁹ In addition, chronic stress may result in negative effects on behavior and lifestyle.⁹ Women have about a twofold higher prevalence of stress-related psychiatric disorders such as depression and anxiety than men and this is accentuated during the menopausal transition.^{10,11} Women and men are affected by stress differently,^{12–15} and the magnitude of stress response and the effect on CVD outcomes differ.^{7,11,16} Sex hormones may play an important role in regulation of the hypothalamic–pituitary–adrenal axis and may be the basis for the sex differences in response to stress.¹³ Therefore, interventions targeted at specific and easily measured risk factors such as psychosocial stress may improve sex disparities in CVD outcomes.

In 2010, the American Heart Association (AHA) set a goal to improve the cardiovascular health (CVH) of all Americans by 20% and to reduce deaths from CVD by 20% by the year 2020 by defining health behaviors and indicators to achieve ideal CVH.¹⁷ Seven easily measured metrics also known as “Life’s Simple Seven” (LS7) were proposed to define and monitor the prevalence of ideal CVH (smoking status, diet, physical activity, body mass index (BMI), cholesterol, blood pressure, and fasting glucose). Given the association of psychosocial stressors with adverse cardiovascular outcomes, we investigated whether self-reported and self-perceived psychological stressors were associated with having inadequate CVH as assessed by the AHA LS7 metrics and whether these associations differed by sex. We hypothesized that the association of psychological stress with CVH measures would be greater among women.

Materials and Methods

Study population

Our study population included employees at the Baptist Health South Florida (BHSF) system, which is a large nonprofit healthcare organization. The BHSF Employee Study was a cross-sectional study conducted in 2014 and has been previously described.^{18,19} Briefly, the study consisted of a Health Risk Assessment (HRA) questionnaire that measured demographic characteristics (age, sex, race/ethnicity, and education level), lifestyle habits (diet, smoking status, and physical activity), self-assessment of health status, and the perceptions of stress level by questionnaire.

Out of more than 15,000 individuals employed at BHSF, there were 9,364 individuals who participated in the HRA and who consented to use their health data for the Employee Study. Among these participants, 9,056 individuals had nonmissing data regarding the psychological factors and the metrics needed to calculate LS7 and were included in the current analysis (Supplementary Fig. S1; Supplementary Data are available online at www.liebertpub.com/jwh). The study was approved by the Institutional Review Board (IRB) at BHSF.

Assessment of LS7 metrics

Smoking status, diet, physical activity, and use of medications (for cholesterol, blood pressure, and diabetes) were ascertained by questionnaire. Diet was assessed by asking about five items: fruits/vegetables, whole grains, protein, salt, and sugary drinks. A “healthy diet score” was calculated on a scale of 0–10 based on the self-reported daily servings of these five items and classified as poor (0–7), intermediate (8–

9), or ideal (10) diet. Physical activity was assessed by self-reported amounts of moderate or vigorous physical activity (in minutes per week). Physical examinations were conducted by trained healthcare professionals to measure height, weight, BMI, and waist circumference using standardized techniques. Blood pressure was measured in the seated position after 5 minutes of rest using an automated oscillometric device (Welch Allyn Spot Vital Signs 4200B-E). Nonfasting blood glucose and total cholesterol were measured from venous samples using point-of-care electronic devices (CardioChek PA Analyzer).

Psychological factors

The 6 factors of stress, depression, low life satisfaction, hopelessness, sadness, and anxiety were obtained by self-report, assessed by the HRA questionnaire. Depression, hopelessness, sadness, and anxiety were scored as yes (1) or no (0) as follows: Depression was recorded as being present if one answered yes to the question “Over the past 2 weeks, have you felt down, depressed, or hopeless all or most of the time?” Hopelessness was considered present if there was a yes response to “In the past year, have you experienced any of the following intensely for 2 weeks or more: feelings of hopelessness or guilt?” Sadness was considered present if one answered yes to the question “In the past year, have you experienced any of the following intensely for 2 weeks or more: persistent sadness?” Anxiety was considered present if a yes response was given to the question “In the past year, have you experienced any of the following intensely for 2 weeks or more: persistent or troublesome anxiety?”

Life satisfaction and stress were assessed by how strongly the participants agreed or disagreed with the following statements using a Likert scale as follows: (0 strongly disagree, 1 disagree, 2 neutral, 3 agree, and 4 strongly agree). For life satisfaction, the statement was “In general, I am satisfied with my life,” and scores 0–1 were considered unfavorable. For stress, the statement was “In the past year, stress has affected my health or well-being,” and scores of 3–4 were considered unfavorable.

These simple survey questions were designed *a priori* by the study investigators with the goal of capturing a brief insight into participants’ self-perceived psychological state. The questions were included as part of a larger extensive survey and were intended to be brief given the limited time constraints for completing the entire HRA. However, these survey questions were not validated questionnaires for formal psychiatric diagnostic assessment.

Statistical analysis

The LS7 metrics (smoking status, physical activity, diet, BMI, blood pressure, cholesterol, and glucose) were each scored as poor (0), intermediate (1), or ideal (2) based on the AHA criteria¹⁷ (Supplementary Table S1). The combined scores of all the LS7 metrics ranged from 0 to 14. Total scores were categorized into three groups of CVH status: optimal (11–14), average (9–10), and inadequate (0–8), as has been done previously.²⁰ In addition, we categorized the number of ideal metrics into three groups (0–1, 2–5, and 6–7), as also has been done previously.²⁰

We used multivariable-adjusted logistic regression to analyze the associations for each of the six adverse psychological

factors obtained by questionnaire (self-perceived stress, low life satisfaction, hopelessness, sadness, depression, and anxiety) with the categories of CVH (optimal, average, and inadequate) and with the number of metrics rated as “ideal.” We adjusted for age as a continuous variable, ethnicity as categorical (white, black, Hispanic, other), and education as binary (high school or less, some college or higher). The primary outcome was assessed as a binary variable with the optimal and average CVH categories combined and compared with the inadequate category as the reference. In secondary analysis, we compared achievement of optimal status (6–7 ideal metrics) versus meeting <6 ideal factors. The results were expressed as odds ratios (OR) and 95% confidence intervals, with an OR <1 signifying a lower odds of the presence of ideal CVH. For our primary and secondary analyses, we tested for interaction by sex using the Wald test.

We performed the following sensitivity analyses. (1) We used multinomial logistic regression to compare the optimal and average categories separately (instead of combined) with the inadequate category; results were similar (data not shown) to the combined optimal/average scores presented here for simplicity of a binary outcome. (2) We also examined associations of the psychological factors with each of the seven CVH metrics separately. (3) Although prevalent CVD was uncommon in this population of healthcare employees, we performed additional sensitivity analyses adjusting for prevalent CVD (history of myocardial infarction, stroke, congestive heart failure, and/or atrial fibrillation) and also analyses excluding these individuals. (4) Although menopausal status was not available in this cohort, we assessed for interactions of the psychological factors and CVH by age (stratified at <50 vs. ≥50, which was used as a surrogate for

TABLE 1. BASELINE CHARACTERISTICS OF BAPTIST HEALTH SOUTH FLORIDA EMPLOYEE STUDY PARTICIPANTS

	Women N=6,706 (74.1%)	Men N =2,350 (25.9%)	p value
Demographic factors			
Age, years	43.0 ± 12.1	41.9 ± 11.7	<0.001
Ethnicity			0.04
Hispanic	3,725 (55.6)	1,463 (62.3)	
White	1,188 (17.7)	372 (15.8)	
Black	1,145 (17.1)	314 (13.4)	
Other	648 (9.7)	201 (8.6)	
Education			
Some college or higher	6,126 (91.4)	2,090 (88.9)	<0.001
High school or less	580 (8.6)	260 (11.1)	
Life's Simple 7 metrics			
Body mass index (kg/m ²)	28.3 ± 6.4	29.4 ± 5.2	<0.001
Healthy diet score	6.1 ± 2.2	6.1 ± 2.2	0.32
Total cholesterol, mg/dL ^a	177.4 ± 38.2	167.1 ± 37.8	<0.001
Systolic blood pressure, mmHg	119.1 ± 13.1	126.0 ± 11.1	<0.001
Diastolic blood pressure, mmHg	75.7 ± 7.9	78.4 ± 7.5	<0.001
Hypertension	1,149 (17.1)	506 (21.5)	<0.001
Physical activity at goal	4,804 (71.6)	1,906 (81.1)	<0.001
Current smoking	101 (1.5)	29 (1.2)	0.34
Blood glucose, mg/dL ^a	95.3 ± 23.5	98.2 ± 26.5	<0.001
Life's Simple 7 score			
Inadequate	1,792 (26.7)	694 (29.5)	<0.001
Average	2,393 (35.7)	1,029 (43.8)	
Optimal	2,521 (37.6)	627 (26.7)	
Psychological factors			
Stress	1,443 (21.5)	383 (16.3)	<0.001
Low life satisfaction	350 (5.2)	142 (6.0)	0.13
Hopelessness	139 (2.1)	45 (1.9)	0.64
Sadness	139 (2.1)	43 (1.8)	0.47
Depression	235 (3.5)	64 (2.7)	0.07
Anxiety	297 (4.4)	65 (2.8)	0.0004
Cardiovascular conditions			
Congestive heart failure	5 (0.0)	5 (0.0)	0.08
Myocardial infarction	16 (0.0)	16 (0.0)	0.002
Stroke	20 (0.0)	9 (0.0)	0.53
Atrial fibrillation	32 (0.0)	33 (0.0)	<0.001
Other comorbidities			
Emphysema	17 (0.0)	4 (0.0)	0.47
Breast cancer	110 (0.0)	0 (0)	<0.001
Lung cancer	6 (0.0)	1 (0.0)	0.48
Prostate cancer	0 (0)	12 (0.0)	<0.001

Results are presented as mean ± SD or N (%).

^aNonfasting measurements.

TABLE 2. THE ASSOCIATIONS OF ADVERSE PSYCHOLOGICAL FACTORS AND THE ATTAINMENT OF OPTIMAL/AVERAGE CARDIOVASCULAR HEALTH BY AHA'S LS7 CRITERIA COMPARED WITH INADEQUATE CARDIOVASCULAR HEALTH

<i>Psychological factors</i>	<i>Women OR (95% CI)</i>	<i>Men OR (95% CI)</i>	<i>p value for sex interaction</i>
Stress	0.58 (0.50–0.66)	0.63 (0.50–0.81)	0.76
Depression	0.58 (0.43–0.78)	0.44 (0.26–0.76)	0.41
Low life satisfaction	0.55 (0.43–0.70)	0.77 (0.52–1.13)	0.15
Hopelessness	0.46 (0.31–0.66)	0.53 (0.28–1.01)	0.75
Sadness	0.47 (0.32–0.68)	0.80 (0.41–1.59)	0.19
Anxiety	0.54 (0.41–0.71)	0.66 (0.38–1.15)	0.65

The results are expressed as odds ratio (OR) and 95% confidence intervals (95% CI) comparing the composite score of optimal/average LS7 scores (9–14), to reference of inadequate score (0–8). An OR <1 is interpreted as being less likely to have optimal/average cardiovascular health. Models are adjusted for age, ethnicity, and education.

Results in bold font are statistically significant ($p < 0.05$).

pre- and postmenopausal status in women). (5) Finally, we examined whether self-reported health status was associated with psychological stressors.

For all analyses, we considered a two-tailed p-value of <0.05 as statistically significant. Data analysis was performed using Stata 12.1 (StataCorp, College Station, TX).

Results

Among 9,056 employees participating in the 2014 BHSF Employee Study, the mean age ($\pm$ standard deviation) was 43 ± 12 years. The range of ages was 18–85 years and there were 309 participants (3.4%) who were older than 65 years. Seventy-four percent were women, 57% Hispanic/Latino, 17% white, 16% black/African American. Ninety-one percent had attended some college, vocational school, or higher education. The baseline characteristics of study population are summarized in Table 1. The prevalence of self-perceived stress was 22% in women and 16% in men. The prevalence of other psychological factors, including low life satisfaction, hopelessness, sadness, depression, and anxiety, was low and ranged between 2% and 6% for both men and women (Table 1). The proportion of the study population in each category of the LS7 metrics is shown in Supplementary Table S1. The prevalence of inadequate CVH score was 27% and 30% in women and men, respectively (Table 1).

Overall, self-perceived psychological stressors were associated with being less likely to achieve optimal/average CVH (Table 2). Stress was associated with 42% lower odds in women

[OR 0.58 (95% CI 0.50–0.66)] and 37% lower odds in men [0.63 (0.50–0.81)] of having optimal/average scores compared with inadequate scores. Depression was associated with 42% lower odds in women [0.52 (0.43–0.78)] and 56% lower odds in men [0.44 (0.26–0.76)] of having optimal/average CVH. Low life satisfaction, hopelessness, sadness, and anxiety were also associated with statistically significantly lower odds of optimal/average CVH in women, but not in men. However, there were no interactions by sex for any of the six psychological factors evaluated. In addition, there were no interactions by age (<50 vs. ≥ 50 years) for the associations of psychological factors and CVH categories in women. In sensitivity analyses adjusting for baseline CVD (Supplementary Table S2) and excluding those with known CVD ($n = 126$; Supplementary Table S3), results were similar to the primary findings.

In analyses evaluating strictly “ideal” status for the seven health metrics (Table 3), the psychological factors of stress, low life satisfaction, and anxiety were associated with lower odds of having 6–7 ideal cardiovascular metrics (compared with having <6 ideal metrics) in women (approximately 35% lower odds, $p < 0.05$ for all). In men, only stress was statistically significantly associated with lower odds of having 6–7 ideal cardiovascular metrics; however, the overall numbers in men were fewer. Interaction by sex was found for low life satisfaction only.

Finally, the relationship of each of the six psychological factors with each of the seven CVH metrics individually is shown in Table 4. Depression, low life satisfaction, hopelessness, sadness, and anxiety in women, and anxiety in men,

TABLE 3. THE ASSOCIATIONS OF ADVERSE PSYCHOLOGICAL FACTORS AND THE PRESENCE OF 6–7 IDEAL METRICS BY AHA'S LS7 CRITERIA COMPARED WITH <6 IDEAL LS7 METRICS

<i>Psychological factors</i>	<i>Women OR (95% CI)</i>	<i>Men OR (95% CI)</i>	<i>p value for sex interaction</i>
Stress	0.65 (0.54–0.79)	0.51 (0.26–0.98)	0.39
Depression	0.64 (0.41–1.00)	— ^a	0.98
Low life satisfaction	0.66 (0.45–0.97)	1.31 (0.66–2.61)	0.03
Hopelessness	0.60 (0.34–1.06)	0.33 (0.04–2.46)	0.48
Sadness	0.65 (0.36–1.17)	0.45 (0.06–3.34)	0.69
Anxiety	0.65 (0.45–0.95)	0.26 (0.04–1.92)	0.34

The results are expressed as odds ratios (OR) and 95% confidence intervals (95% CI) comparing individuals with 6–7 ideal LS7 metrics to reference category of individuals with <6 ideal LS7 metrics. An OR <1 is consistent with less likely to be associated with having 6–7 ideal LS7 metrics. Models are adjusted for age, ethnicity, and education.

Results in bold font are statistically significant ($p < 0.05$).

^aOR undetermined due to small sample size.

TABLE 4. THE ASSOCIATION OF ADVERSE PSYCHOLOGICAL FACTORS AND EACH OF THE SEVEN METRICS OF IDEAL CARDIOVASCULAR HEALTH COMPARING INDIVIDUALS WITH IDEAL LS7 METRICS TO INDIVIDUALS WITH INTERMEDIATE AND POOR LS7 METRICS

<i>Ideal LS7 metric</i>	<i>Ideal smoking status</i>	<i>Ideal physical activity</i>	<i>Ideal diet</i>	<i>Ideal BMI</i>	<i>Ideal blood pressure</i>	<i>Ideal total cholesterol</i>	<i>Ideal blood glucose</i>
Women							
Stress	0.70 (0.48–1.02)	0.57 (0.50–0.65)	0.65 (0.47–0.89)	0.70 (0.62–0.80)	0.86 (0.76–0.98)	0.86 (0.74–0.98)	0.81 (0.70–0.94)
Depression	0.29 (0.16–0.53)	0.46 (0.35–0.60)	0.59 (0.26–1.35)	0.81 (0.61–1.08)	1.00 (0.75–1.32)	0.84 (0.62–1.13)	0.99 (0.70–1.41)
Low life satisfaction	0.52 (0.28–0.95)	0.51 (0.41–0.64)	0.51 (0.25–1.05)	0.68 (0.53–0.87)	0.79 (0.62–1.00)	0.96 (0.75–1.23)	0.91 (0.69–1.20)
Hopelessness	0.27 (0.13–0.54)	0.36 (0.26–0.51)	0.48 (0.15–1.52)	0.83 (0.57–1.20)	0.95 (0.66–1.36)	0.92 (0.62–1.36)	0.84 (0.55–1.30)
Sadness	0.33 (0.15–0.68)	0.45 (0.32–0.63)	0.62 (0.23–1.71)	0.78 (0.54–1.14)	1.00 (0.69–1.44)	0.77 (0.52–1.12)	0.79 (0.52–1.19)
Anxiety	0.30 (0.18–0.52)	0.45 (0.35–0.57)	0.27 (0.10–0.73)	0.77 (0.59–0.99)	0.93 (0.73–1.20)	1.08 (0.82–1.43)	0.71 (0.53–0.94)
Men							
Stress	0.62 (0.28–1.39)	0.53 (0.41–0.68)	1.12 (0.69–2.10)	0.66 (0.48–0.92)	1.04 (0.79–1.35)	0.81 (0.64–1.04)	0.82 (0.61–1.09)
Depression	0.36 (0.08–1.58)	0.23 (0.14–0.37)	0.94 (0.22–3.93)	0.70 (1.34–1.44)	0.82 (0.45–1.52)	0.82 (0.46–1.46)	0.87 (0.44–1.71)
Low life satisfaction	0.44 (0.15–1.29)	0.43 (0.30–0.63)	0.84 (0.30–2.33)	0.85 (0.53–1.34)	1.23 (0.83–1.81)	1.38 (0.90–2.12)	0.86 (0.55–1.37)
Hopelessness	0.27 (0.06–1.18)	0.21 (0.11–0.38)	— ^a	1.37 (0.68–2.77)	1.32 (0.69–2.53)	1.86 (0.80–4.32)	1.39 (0.53–3.65)
Sadness	0.28 (0.07–1.23)	0.27 (0.15–0.51)	0.62 (0.08–4.56)	1.10 (0.50–2.41)	1.50 (0.76–2.95)	2.01 (0.90–4.50)	0.80 (0.37–1.74)
Anxiety	0.19 (0.07–0.57)	0.34 (0.20–0.56)	0.41 (0.06–2.97)	0.93 (0.48–1.80)	0.95 (0.52–1.73)	0.93 (0.53–1.64)	0.84 (0.64–1.12)

The results are expressed as odds ratios (OR) and 95% confidence intervals (95% CI). An OR <1 is consistent with less likely to be associated with the ideal LS7 metrics. Models are adjusted for age, ethnicity, and education.

Bold results are statistically significant ($p < 0.05$).

^aOR undetermined due to small sample size.

were associated with smoking. All six psychological factors were associated with lower odds of meeting ideal physical activity levels for both men and women. Among women, stress and anxiety were associated with lower odds of having an ideal diet. Lower odds of an ideal BMI were seen for stress, low life satisfaction, and anxiety in women and for stress in men. Stress was associated with lower odds of ideal blood pressure and cholesterol in women. Stress and anxiety were associated with lower odds of ideal blood glucose in women. Individuals who self-reported good to excellent health status were less likely to have adverse psychological factors compared with those who reported poor to fair health (Supplementary Table S4).

Discussion

In a cross-sectional survey of an ethnically diverse population of healthcare employees, participants with adverse self-perceived psychological factors were less likely to have optimal/average CVH as measured by LS7, and less likely to have higher numbers of ideal cardiovascular metrics. We found that there generally were no sex differences in the association of adverse psychological factors and ideal CVH; there were no significant interactions by sex except for low life satisfaction and ideal metrics, which appeared to be a stronger risk factor in women than in men. In addition, there were no interactions by age <50 and ≥50 in women. Our exploratory findings suggest that psychosocial stress may be an additional pathway in increasing vulnerability to CVD, but further work is needed to determine if psychosocial interventions can improve CVH in both women and men.

Psychosocial stressors, including depression, are emerging as risk factors for CVD in young adults²¹ and particularly in women.^{14,22,23} In addition, they are important to identify because they are potentially modifiable. Several mechanisms have been proposed as a cause of increased CVD associated with psychosocial stress, including activity of the hypothalamic–pituitary–adrenal axis,^{13,24} heightened sympathetic activation,²⁵ central obesity,²⁶ increased platelet reactivity,²⁷ and endothelial dysfunction.²⁸ Cardiovascular risk factors, including hypertension, obesity, and physical inactivity, have also been linked to self-perceived stress.²⁹ More importantly, there are physiological sex differences in the way both women perceive stress and the magnitude of the stress response.³⁰ Women experience both stress at work and strain from family life, and this stress may be stronger predictors of CVD in women.^{7,31} Women with coronary heart disease have a more adverse psychological profile than similar men,¹⁴ and a recent study suggested that psychosocial factors might partially explain the increased rates of readmission after myocardial infarction in women.³² Thus, improving psychosocial well-being might be one mechanism to improve CVD outcomes in these high-risk women.³²

In this context, we had hypothesized that psychological factors would be associated with a worse CVH profile among women compared to men. We found that among women, all 6 psychological factors were associated with being less likely to have adequate or optimal CVH, whereas in men, only stress and depression were associated. However, contrary to our hypothesis, there were generally no significant interactions by sex for the associations of psychological stress with LS7 metrics, although low life satisfaction appeared to be a stronger risk

factor in women. It is important to note that this study sample was predominantly women (74%), and the adverse psychological factors were less prevalent in men; therefore, the lack of association of certain psychological factors with LS7 metrics in men may be due to reduced statistical power.

The results of our study show that easily measured self-perceived psychological factors in healthy participants, who are predominantly ethnic minorities, are associated with lower attainment of ideal CVH metrics, and this is indicative of future CVD risk.³³ These findings are an opportunity for primary prevention strategies in improving psychological health particularly targeted at healthy employees, women, and ethnic minorities in reducing the growing burden of CVD both in the United States and globally. Psychological interventions, such as meditation, may help reduce cardiovascular risk as an adjunct to established medical and lifestyle preventive therapies,³⁴ but further research is needed.

Strengths and limitations

Our study has many strengths, including a large sample of ethnically diverse individuals (largely Hispanic/Latino) and notably a large number of women. However, our findings should be considered in the context of several limitations. First, as mentioned previously, the questionnaire used was not a validated tool for the assessment of psychological stress. These survey questions assessed a participant's own perception of the presence of depression, anxiety, and so on, but did not yield diagnostic data for the presence of a psychological condition as would be defined by formal *Diagnostic and Statistical Manual of Mental Disorders* criteria. Of note, the prevalence of psychological factors reported was lower than in the general population.³⁵ Prior studies have found self-reported depression to be only moderately correlated with clinical depression,³⁶ and underreporting based on age, sex, and severity of symptom could have resulted in underestimation of our association. Furthermore, this was an occupational-based health survey and employees might not wish to disclose to their employer about psychosocial factors due to concern about stigma, which could also contribute to underestimation of true prevalence. Second, other self-reported covariates, including diet and physical activity, ascertained by survey may have been subject to recall bias. However, other cohorts have found that simple short questionnaires to assess physical activity are reasonably valid epidemiologic tools, particularly when used by healthcare professionals.³⁷ Third, this survey was conducted among healthcare employees who may be more health conscious than the general population; indeed, the prevalence for CVD risk factors such as smoking was low in this population. While the results may not be generalizable to other populations, however, we do feel that the associations are still valid on an individual basis. Fourth, multiple testing was done and statistically significant findings may have been seen by chance, but results were generally consistent across our various definitions of ideal CVH and were generally consistent between men and women. Fifth, we adjusted for demographic characteristics but there may be potential unmeasured confounders that we did not account for. Finally, given the cross-sectional nature of this study, even though we found an association between several psychological risk factors and adverse cardiovascular profile, we were not able to make inferences about temporality or causation. Exploring these questions in a longitudinal study may better clarify temporality.

Conclusions

Our results showed that in an ethnically diverse population of healthcare employees, individuals with negative self-perceived psychological factors have a lower prevalence of ideal CVH as measured by the LS7 criteria. The associations of adverse psychological factors and reduced CVH were stronger in women than men; however, there were generally no significant interactions by sex. Future interventional studies are needed to determine if targeting adverse psychological stressors can improve CVH and reduce future incidence of CVD risk for both women and men.

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Disclosure Statement

The authors have no competing financial interests related to this work.

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