

# Occupations Associated With Poor Cardiovascular Health in Women

## *The Women's Health Initiative Observational Study*

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**Introduction:** Research on the effect of occupation on cardiovascular health (CVH) among older women is limited. **Methods:** Each of the seven American Heart Association's CVH metrics was scored as ideal (1) or non-ideal (0) and summed. Multivariable logistic regression was used to estimate the odds of poor overall CVH (CVH score of 0 to 2) comparing women employed in each of the top 20 occupational categories to those not employed in that category, adjusting for age, marital status, and race/ethnicity. **Results:** (1) Bookkeeping, accounting, and auditing clerks; (2) first-line supervisors of sales workers; (3) first-line supervisors of office and administrative support workers; and (4) nursing, psychiatric, and home health aides were more likely to have poor overall CVH compared to women who did not work in these occupations. **Conclusions:** Several commonly held occupations among women were associated with poor CVH.

**Keywords:** cardiovascular health, women's heart health, workplace health

The American Heart Association (AHA)'s Life's Simple 7 (LS7) is an index of cardiovascular health (CVH) that is composed of seven modifiable risk factors for cardiovascular disease (CVD), including three clinical risk factors: blood pressure, total cholesterol, fasting glucose and four behavioral risk factors: body mass index (BMI), smoking, physical activity and diet.<sup>1,2</sup> This measure significantly predicts risk of CVD, self-reported health status<sup>3,4</sup> and all-cause mortality.<sup>5,6</sup> Improvements in CVH are associated with improved cardio metabolic profile.<sup>7</sup> Understanding variation in CVH helps to identify possible targets for intervention in order to meet the AHA strategic goals to improve the CVH of all

### Learning Objectives

- Discuss the limitations of previous research on the effects of occupation on cardiovascular health, particularly in women.
- Summarize the new findings on associations of occupation and occupational categories with cardiovascular health in postmenopausal women.
- Identify specific occupations associated with poor cardiovascular health in postmenopausal women and their implications for workplace health programs.

Americans by 20% while reducing mortality from CVD and stroke by 20%.<sup>1</sup>

Specific occupations have been associated with increased incidence of CVD, increased markers of CVD or poor CVH.<sup>2,8–17</sup> Moreover, various characteristics of jobs have been associated with increased CVD, including stress,<sup>10,18</sup> job strain,<sup>11</sup> long working hours,<sup>12–15</sup> physical demands,<sup>19</sup> shift job,<sup>16</sup> physical hazards.<sup>9</sup> However, little research evaluating the role of occupation on CVH has focused specifically on women.

A deeper understanding of the role of work on women's cardiovascular health is important because women increasingly participate in the workforce across different employment sectors.<sup>20</sup> Additionally, women are increasingly likely to remain in the workforce to older ages, with the largest percentage increase in labor force participation among women in the 45 to 64 years age

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The Women's Health Initiative program is funded by the National Heart, Lung, and Blood Institute, National Institutes of Health, U.S. Department of Health and Human Services through contracts HHSN268201600018C, HHSN268201600001C, HHSN268201600002C, HHSN268201600003C, and HHSN268201600004C.

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Ethical approval for this analysis was provided by Drexel's Institutional Review Board.

Michael, Nriagu, Ako, Wang, De Roos, Wallace, Allison, and Seguin have no relationships/conditions/circumstances that present potential conflict of interest.

The JOEM editorial board and planners have no financial interest related to this research.

Clinical significance: Occupation is an important correlate of women's heart health. Better understanding of occupations that may pose higher risks for women is important in designing workplace programs to address these risks. Our study helps identify specific occupations that may benefit from workplace health programs to improve cardiovascular health among women.

Supplemental digital contents are available for this article. Direct URL citation appears in the printed text and is provided in the HTML and PDF versions of this article on the journal's Web site ([www.joem.org](http://www.joem.org)).

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DOI: 10.1097/JOM.0000000000002135

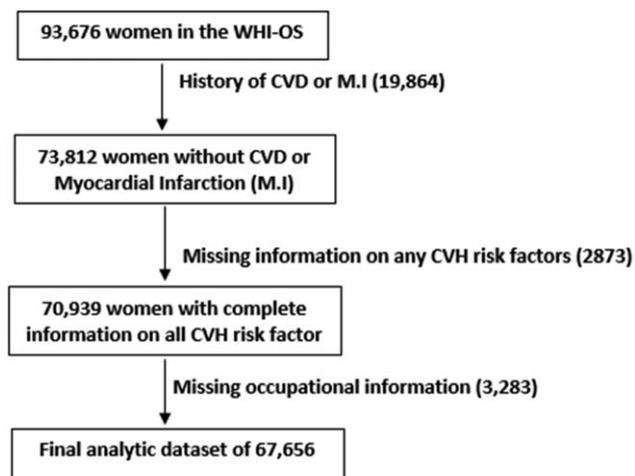


FIGURE 1. Diagram showing the study population.

group.<sup>21</sup> The Women’s Health Initiative-Observational Study (WHI-OS), a large national health study initiated to address research questions regarding women’s health and aging, collected a limited work history among participants. These unique data have contributed to knowledge of women’s work and its influence on later life health, including mortality,<sup>22</sup> physical functioning,<sup>20,23</sup> hip fracture,<sup>24</sup> and inflammation.<sup>25</sup> Related to CVH, prior research in this cohort found no overall association between level of occupational physical activity and risk of coronary heart disease.<sup>26</sup> In this context, our study examined occupations associated with poor CVH in post-menopausal women in the WHI-OS.

## MATERIALS AND METHODS

### Study Population

The study population for this analysis included post-menopausal women, ages 50 to 79 years, enrolled in the WHI-OS. The WHI-OS study methodology has been discussed in detail elsewhere.<sup>27,28</sup> Briefly, the WHI-OS is a prospective cohort study composed of women who were ineligible or unwilling to participate in the clinical trials. WHI-OS study participants were enrolled in 40 health centers throughout the US between October 1, 1993 and December 31, 1998.<sup>29</sup> Baseline information collected from study participants included physical and clinical measurements including heart rate, height, blood pressure, weight, and waist and hip circumference, obtained by certified WHI clinic staff using standardized procedures and data collection forms.<sup>27</sup> Other factors,

including medical history, physical activity, smoking history and occupational history, were gathered using questionnaires.<sup>28</sup>

Of the 93,676 women in WHI-OS, women with no history of CVD or myocardial infarction were eligible for this analysis leaving a sample size of 73,812. Among these women, we excluded women with missing data for the variables included in the CVH index ( $n = 2873$ ) or occupation ( $n = 3283$ ), for a final analytic sample of 67,656 (72.2%) (See Fig. 1).

### Occupational History

The primary exposure of interest was the longest held occupation. At enrollment, women provided a brief occupational history from age 18 to the current time. The job history included the following information for each of the three longest held jobs: age when job began, the duration of the job in years, job title, and industry. A team of experts from the National Institute of Occupational Safety and Health (NIOSH) used the Standard Occupation Classification (SOC) system<sup>30</sup> to code every job reported into one of 461 occupations identified by five-digit SOC code and 23 major groupings of occupations identified by two-digit SOC code. We calculated the total number of years spent in each occupation to identify the longest held occupation for each participant and analyzed the top 20 longest-held occupations. Additionally, for each longest held occupation for each participant, we also categorized the time she spent in this occupation: less than 10 years and 10 years or more.

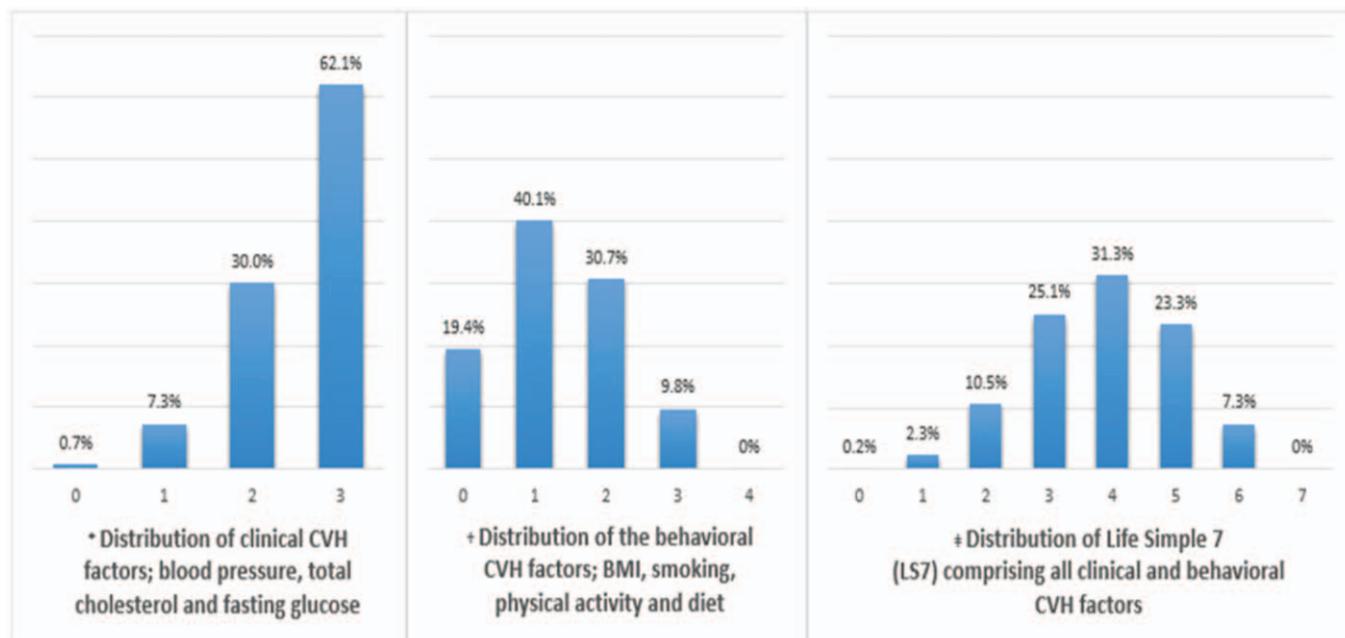
### Outcome Assessment

We classified women as having poor CVH at baseline using a modified version of the LS7.<sup>6</sup> Each of the seven CVH risk factors were classified as ideal and non-ideal. Thus, for each of the three clinical metrics present at baseline (blood pressure, total cholesterol and fasting blood glucose) and each of the four behavioral factors present at baseline (physical activity, BMI, diet quality and smoking), “ideal CVH” was assigned a score of 1 and “non-ideal CVH” was assigned a score of 0 based on previously published cut-points.<sup>6</sup> For the CVH clinical risk factors, ideal was defined as never diagnosed with high blood pressure, diabetes mellitus, or, high blood cholesterol requiring pills (See Table 1). All the clinical risk factors were self-reported. For the CVH behavioral metrics, ideal was defined as a BMI of less than 25 kg/m<sup>2</sup>, never smoked, total energy expenditure of more than 8.33 MET hours/week, and a healthy diet score of 4 or more (See Table 1). Dietary information was assessed using a food frequency questionnaire. BMI was calculated using the values of weight and height of participants collected by certified staff during clinic visits. Physical activity and smoking history were self-reported using standardized questionnaires.<sup>29</sup>

TABLE 1. The Life Simple 7—Three Clinical and Four Behavioral CVH Metrics

	Ideal CVH	Non-ideal CVH
Clinical metrics		
Blood pressure	Never hypertension	Treated/untreated hypertension
Fasting plasma glucose	Never diabetes	Treated/untreated diabetes
Total cholesterol	Never high cholesterol requiring pills	Ever high cholesterol requiring pills
Behavioral metrics		
Smoking	Never smoker	Past/current smoker
BMI	<25 kg/m <sup>2</sup>	≥25 kg/m <sup>2</sup>
Diet*	4 or more components reached	Less than 4 components reached
Physical activity	>8.33 MET h/wk	≤8.33 MET h/wk

\*One point for each of the following healthy diet score components: ≥2 3.5-ounce servings/wk of fish; ≤36 ounces/wk of sugar-sweetened beverages; ≥3 1-ounce servings/d of whole grains; ≥4.5 cups/d of fruits and vegetables; and <1,500 mg/d of sodium.



**FIGURE 2.** Distribution of CVH factors for clinical, behavioral and the LS7 among women employed in the top 20 occupations in the WHI Observational Study (N=67,656). Clinical factors include blood pressure, total cholesterol, and fasting glucose. Behavioral factors include body mass index (BMI), smoking, physical activity and diet. LS7 includes all clinical and behavioral factors.

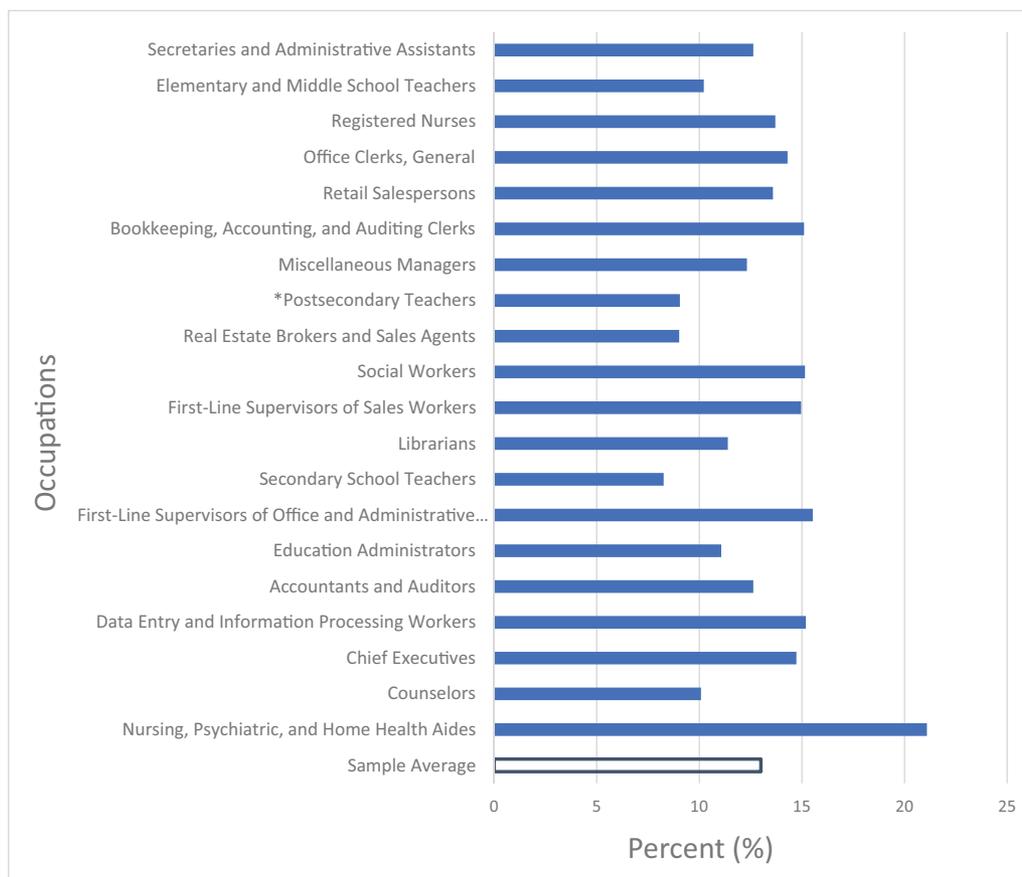
Overall CVH (LS7), clinical health (three factors) and behavioral health (four factors) were computed by summing scores for each of the CVH metrics. Those with a total score ranging from 0 to 2, clinical health score from 0 to 1 or a behavioral health score of 0 were classified as “poor CVH”. While a systematic review of the association between CVH and CVD and other health outcomes noted inconsistencies in cut-points used to identify poor CVH, our classification is consistent with definitions used in prior research in US and non-US populations.<sup>31</sup>

**Statistical Analysis**

We used logistic regression models to estimate the odds ratios and 95% confidence intervals for the association between each longest held occupation and poor CVH. Additionally, we estimated the association between years spent in the longest held occupation (never, <10y, 10+ y) and poor CVH. We tested for a linear association between years spent in occupation and CVH by treating the ordinal duration variable as continuous in the model. The reference group in each model included all women who were not

**TABLE 2.** Characteristics of Study Participants—Age, Race, Ethnicity, Marital Status and Income by Poor Overall CVH, Poor Clinical CVH and Poor Behavioral CVH

	Total	Poor Overall	Poor Clinical	Poor Behavioral
Age (mean, SD)	63.1 (7.3)	64.1 (7.0)	65.3 (6.8)	62.6 (7.1)
Race/ethnicity N (%)				
Black/African American	4,935 (7.3)	1,322 (15.1)	818 (15.2)	1,425 (10.9)
Hispanic/Latino	2,313 (3.4)	308 (3.5)	214 (4.0)	429 (3.3)
White (not Hispanic)	57,162 (84.7)	6,764 (77.3)	3,968 (73.9)	10,884 (83.0)
Others	3076 (4.6)	362 (4.1)	370 (6.9)	375 (2.9)
Education N (%)				
Less than or Some high school (9–11 years) & Vocational/training school	9,091 (13.5)	1,659 (19.0)	1,054 (19.7)	2,187 (16.8)
High school diploma or GED	10,578 (15.8)	1,691 (19.4)	1,067 (20.0)	2,316 (17.8)
Some college/Associate degree	17,823 (26.5)	2,488 (28.6)	1,448 (27.1)	3,839 (29.4)
College graduate/Baccalaureate degree or higher	29,659 (44.2)	2,878 (33.0)	1,774 (33.2)	4,708 (36.1)
Marital status N (%)				
Never married	3,230 (4.8)	420 (4.8)	258 (4.8)	613 (4.7)
Divorced or separated	10,455 (15.5)	1,556 (17.8)	802 (15.0)	2,541 (19.4)
Widowed	10,881 (16.2)	1,793 (20.6)	1,192 (22.2)	2,314 (17.7)
Presently married/marriage-like relationship	42,807 (63.5)	4,958 (56.8)	3,108 (58.0)	7,614 (58.2)
Income N (%)				
Less than or equal to \$34,999	22,975 (35.4)	3,929 (46.5)	2,421 (46.8)	5,266 (41.5)
\$35,000 to \$74,999	26,203 (40.4)	3,196 (37.9)	1,924 (37.2)	5,093 (40.1)
\$75,000 and above	13,879 (21.4)	1,079 (12.8)	653 (12.6)	2,033 (16.0)
Don't know	1,819 (2.8)	240 (2.8)	181 (3.5)	304 (2.4)



**FIGURE 3.** Percentage of women with poor overall CVH by top 20 occupations (most to least common), WHI Observational Study ( $N = 67,656$ ).

employed for any time in that occupation and thus this occupation effect estimate varies among various occupations. We adjusted all models for age, race/ethnic group, and marital status, and used the Benjamini and Hochberg correction of  $P$  values to account for multiple comparisons.<sup>32</sup> In sensitivity analyses, we added education and income to the model to better understand the role of socioeconomic status in explaining the observed associations. Analyses were conducted using PROC LOGISTIC in SAS, version 9.4 (SAS Institute, Inc., Cary, North Carolina).

Ethical approval for this analysis was provided by Drexel's Institutional Review Board.

## RESULTS

On average, women were 63.1 years old (standard deviation = 7.3) at baseline. The majority of women were white (84.7%), well-educated (44% having college degree or higher), with an income over \$34,999 (62%), and married or in a marriage-like relationship (64%). Of the 67,656 women in our sample population, 8775 (13.0%) had poor overall CVH, 5387 (8.0%) had poor clinical CVH and 13,135 (19.4%) had poor behavioral CVH (See Fig. 2). Women with poor overall CVH were more likely to be older, non-White, and have less education (See Table 2). Almost 60% of the WHI-OS participants worked in the twenty most common occupations represented in this cohort for an average of 19 (SD = 10) years, including secretaries and administrative assistants (12.2%, mean (standard deviation) years in this job = 18 (10) y), elementary and middle school teachers (11.2%, mean (standard deviation) 22 (10) y) and registered nurses (5.6%, mean (standard deviation) 22 (12) y).

Figure 3 shows the unadjusted percent of women with poor overall CVH by occupation. Thirteen percent (13%) of women had poor overall CVH. Occupations above average poor overall CVH included retail salespersons (13.6%), registered nurses (13.7%), office clerks, general (14.3%), chief executives (14.7%), first-line supervisors of sales workers (15.0%), bookkeeping, accounting, and auditing clerks (15.1%), social workers (15.2%), data entry and information processing workers (15.2%), first-line supervisors of office and administrative support workers (15.5%), and nursing, psychiatric, and home health aides (21.1%).

Table 3 provides the effect estimates for the association between occupation and poor CVH based on models adjusted for age, ethnicity/race, and marital status. Most occupations in the office and administration sector were associated with increased odds of poor overall CVH, with significant associations for first-line supervisors of office and administrative support workers (OR: 1.25, 95% CI: 1.04 to 1.52) and bookkeeping, accounting, and auditing clerks (OR: 1.25, 95% CI: 1.10 to 1.41). Odds for poor overall CVH were increased among health care related sectors, with significant associations for nursing, psychiatric, and home health aides (OR: 1.38, 95% CI: 1.13 to 1.70). In the sales and sales related sector, first-line supervisors of sales workers had increased odds for poor overall CVH (OR: 1.25, 95% CI: 1.05 to 1.49) while the odds for poor overall CVH were reduced among real estate brokers and sales agents (OR: 0.71, 95% CI: 0.57 to 0.87). Occupations in the education, training, and library sectors were associated with reduced odds for poor overall CVH: secondary school teachers (OR: 0.63, 95% CI: 0.49 to 0.80), postsecondary teachers (OR: 0.72, 95% CI:

**TABLE 3. Poor Overall CVH Associated with Employment in the Top 20 Commonly Held Occupations Among Post-Menopausal Women, WHI Observational Study (N = 67,656)<sup>¶</sup>**

	**Longest Held Job vs Never		Employment Duration				P Value***
	N (%) <sup>§</sup>	OR (95% CI)	<10 y vs Never		10+ y vs Never		
			N (%) <sup>§</sup>	OR (95% CI)	N (%) <sup>§</sup>	OR (95% CI)	
Office and administrative support occupations*							
Secretaries and administrative assistants	8,225 (12.2)	1.02 (0.95, 1.09)	7187 (10.6)	0.92 (0.85, 0.99)	7427 (11.0)	1.01 (0.94, 1.08)	0.56
Office clerks, general	2,399 (3.6)	1.08 (0.96, 1.22)	4112 (6.1)	1.15 (1.05, 1.26)	2166 (3.2)	1.09 (0.96, 1.23)	0.01
Bookkeeping, accounting, and auditing clerks	2,119 (3.1)	† 1.25 (1.10, 1.41)	2350 (3.5)	1.19 (1.06, 1.35)	1948 (2.9)	1.27 (1.12, 1.44)	<0.0001
First-line supervisors of office and administrative support workers	850 (1.3)	† 1.25 (1.04, 1.52)	806 (1.2)	0.94 (0.75, 1.17)	849 (1.3)	1.34 (1.11, 1.61)	0.02
Data entry and information processing workers	665 (1.0)	1.20 (0.97, 1.49)	1533 (2.3)	1.16 (1.00, 1.34)	593 (0.9)	1.13 (0.90, 1.43)	0.04
Education, training, and library occupations*							
Elementary and middle school teachers	7,576 (11.2)	† 0.73 (0.67, 0.79)	3625 (5.4)	0.57 (0.50, 0.65)	7421 (11.0)	0.73 (0.68, 0.79)	<0.0001
Postsecondary teachers <sup>†</sup>	1,171 (1.7)	† 0.72 (0.59, 0.88)	952 (1.4)	0.68 (0.54, 0.85)	1293 (1.9)	0.74 (0.61, 0.89)	<0.0001
Librarians	887 (1.3)	0.87 (0.70, 1.07)	445 (0.7)	0.86 (0.64, 1.17)	869 (1.3)	0.86 (0.69, 1.06)	0.1
Secondary school teachers	872 (1.3)	† 0.63 (0.49, 0.80)	932 (1.4)	0.69 (0.55, 0.87)	883 (1.3)	0.59 (0.46, 0.76)	<0.0001
Sales and related occupations*							
Retail salespersons	2,207 (3.3)	1.08 (0.95, 1.22)	4575 (6.8)	1.08 (0.99, 1.19)	1693 (2.5)	1.12 (0.98, 1.29)	0.02
Real Estate brokers and sales agents	1,053 (1.6)	† 0.71 (0.57, 0.87)	845 (1.3)	0.79 (0.63, 1.00)	1143 (1.7)	0.68 (0.55, 0.83)	<0.0001
First-line supervisors of sales workers	1,016 (1.0)	† 1.25 (1.05, 1.49)	917 (1.4)	1.06 (0.87, 1.30)	1022 (1.5)	1.27 (1.06, 1.50)	0.008
Management occupations*							
Miscellaneous managers	1,631 (2.4)	0.95 (0.82, 1.10)	1227 (1.8)	0.85 (0.70, 1.02)	1539 (2.3)	0.95 (0.81, 1.11)	0.19
Education administrators	849 (1.3)	0.82 (0.66, 1.02)	714 (1.1)	0.71 (0.55, 0.91)	934 (1.4)	0.82 (0.67, 1.01)	0.001
Chief executives	645 (1.0)	1.05 (0.84, 1.31)	188 (0.3)	0.838 (0.52, 1.35)	282 (0.4)	0.85 (0.58, 1.25)	0.30
Community and social service occupations*							
Social workers	1,023 (1.5)	1.11 (0.93, 1.33)	923 (1.4)	0.98 (0.80, 1.19)	939 (1.4)	1.12 (0.93, 1.34)	0.32
Counselors	625 (0.9)	† 0.73 (0.56, 0.96)	596 (0.9)	0.60 (0.45, 0.81)	583 (0.9)	0.73 (0.56, 0.95)	0.0004
Business and financial operations occupations*							
Accountants and auditors	800 (1.2)	1.00 (0.81, 1.24)	594 (0.9)	0.94 (0.73, 1.22)	768 (1.1)	1.04 (0.84, 1.28)	0.91
Healthcare practitioners and technical occupations*							
Registered nurses	3,767 (5.6)	1.08 (0.98, 1.19)	1315 (1.9)	0.93 (0.78, 1.10)	3502 (5.2)	1.11 (1.00, 1.22)	0.09
Healthcare support occupations*							
Nursing, psychiatric, and home health aides	607 (0.9)	† 1.38 (1.13, 1.70)	879 (1.3)	1.47 (1.23, 1.74)	519 (0.8)	1.32 (1.06, 1.64)	<0.0001

Model adjusted for age, race/ethnicity and marital status.  
 \*Represents major (two-digit) SOC code classification.  
<sup>†</sup>Benjamini and Hochberg corrected P value <0.05.  
<sup>‡</sup>Represents a minor SOC (three-digit) code classification.  
<sup>§</sup>Number and percentages of women who worked in each of the occupations.  
<sup>¶</sup>Women in each employment category are compared to women who never worked in that occupation.  
 \*\*\*P value for test of trend by duration of employment.

0.59 to 0.88), and elementary and middle school teachers (OR: 0.73, 95% CI: 0.67 to 0.79). Within the community and social service occupations, odds for poor overall CVH were reduced among counselors (OR: 0.73, 95% CI: 0.56 to 0.96). Occupations within management and business and financial operations were not associated with CVH.

Analyses that compared women who worked less than 10 years and women who worked 10 years or more in each occupation compared to women who were not employed for any time were consistent with these results. For bookkeeping, accounting, and auditing clerks, first-line supervisors of sales workers, and first-line supervisors of office and administrative support workers, odds for poor overall CVH increased linearly with years in occupation. For real estate brokers and sales agents and secondary school teachers, odds for poor overall CVH decreased linearly with years in occupation. We tested the adjusted model with occupational duration for trend, which provided further support for a dose response between duration in these occupations and overall CVH ( $P < 0.05$ ). For other occupations significantly associated with CVH, including elementary and middle school teachers, counselors, and nursing psychiatric and home health aides, the significant test for trend was consistent with threshold responses in the low-dose range.

Results were similar for clinical CVH and behavioral CVH (See Appendix 1 and 2, <http://links.lww.com/JOM/A869>).

In a sensitivity analysis adjusted for education and income, most estimates were attenuated with the exception of the statistically significant increased risk of poor overall CVH for registered nurses (OR: 1.15, 95% CI: 1.04 to 1.27) and social workers (OR: 1.40, 95% CI: 1.17 to 1.67) (See Appendix 3, <http://links.lww.com/JOM/A869>).

## DISCUSSION

Our study included the 20 most common occupations held by women in a large US cohort, which represented 8 of the 23 NIOSH major occupational sectors. Among the women in our study, those who worked in office and administrative support occupations, sales and related occupations, and healthcare support occupations had the greatest risk of poor overall CVH compared to women who were not employed in the occupations. Occupations in these sectors include first-line supervisors of office and administrative support workers; bookkeeping, accounting, and auditing clerks; first-line supervisors of sales workers; and nursing, psychiatric, and home health aides. Teachers and counselors were less likely to have poor CVH. We observed evidence of a dose-response and threshold-response association between duration of these occupations and CVH. We observed no increase in poor overall CVH among occupations in the education, training, and library occupations, management, or business and financial operations sectors.

Our results were similar to prior research that identified poor CVH among workers in the office and administrative support, and healthcare support occupations.<sup>2,33</sup> Additionally, our findings were consistent with prior research reporting lower probability of cardiovascular risk among employees in the education sector.<sup>2,34</sup> Our findings differed from prior research that reported poor CVH among workers in the community and social service occupations.<sup>17,33,34</sup> In a cross-sectional study of a large sample of adult workers in the U.S., employees in the community and social services sector had a high prevalence (14.6%) of poor CVH (defined as having ideal score on 2 or less of the CVH metrics) compared to other occupational groups (9.6%).<sup>17</sup> We evaluated two specific occupations within this sector: social workers and counselors. We observed a significant trend between duration of years as a social worker and increased probability of poor overall CVH but a significantly reduced probability of poor overall CVH among counselors. Two prior cross-sectional studies reported better CVH among management occupations and healthcare practitioners and technical occupations.<sup>2,34</sup>

We observed significant trend between duration of years as a registered nurse and increased probability of poor overall CVH. In contrast, we found no association with specific management occupations represented in our sample: chief executives, miscellaneous managers, and education administrators (although we did observe a small protective association for behavioral CVH in this latter group). Prior cross-sectional research studies reported worse CVH among sales and related occupations,<sup>2,33</sup> we found mixed results for the specific sales occupations represented in our sample. Poor overall CVH was increased among first-line supervisors of sales workers and non-significantly increased for retail salespersons while the risk of poor overall CVH was significantly reduced among the women working in real estate. Notably, in the analysis stratified by sex, an Australian study reported worse health for male workers in the sales and related occupations compared to managers but not for females.<sup>33</sup>

Our study may differ from studies examining the effect of occupational sector on CVH in a cohort consisting of both men and women, which may not provide a valid representation of the effect estimate for either sex.<sup>2,17,33,34</sup> Prior research of occupation in relation to CVH included only two studies with estimates presented specifically for women; both cohorts were outside the US and selected for occupational-related health issues.<sup>33,34</sup> Differences in our findings may be related to the specific occupations represented in our study, compared to the more general occupational sectors evaluated in prior research. We evaluated the 20 most common specific occupations among this large cohort of women, thus our study over-represents occupations that have been primarily dominated by women.<sup>35</sup> Women may be less likely to be employed by specific occupations that confer health risks. Our study was similar to prior studies in terms of covariates included in adjusted models evaluating the association between occupation and CVH. All prior studies adjusted for age and U.S. studies additionally adjusted for race/ethnicity. One of the U.S. studies additionally adjusted for education,<sup>17</sup> which potentially resulted in over-controlled models, as shown in our sensitivity analyses, due to the correlation of education with income and occupation.

Education is typically a strong predictor of income and education may work to influence CVH primarily through increasing income and occupational prestige.<sup>25</sup> After controlling for education and income in our sensitivity analyses, most of the estimates are attenuated. However, in analyses evaluating registered nurses and social workers, the adjustment strengthened the association with poor CVH. While registered nurses and social workers require additional specialized education, the relatively greater education is not associated with high incomes. For these occupations, some aspect of the job imposes increased risk—even beyond any effects of socioeconomic status.

Our study has some limitations. We did not measure the content of work, such as job strain,<sup>11</sup> physical demands<sup>19</sup> and working hours or shift work,<sup>12,13,36</sup> which might play a mediating role in the pathway between occupation and CVD. Lack of information on specific hazardous occupational exposures is a common situation when a population sample is used in contrast to an occupational cohort. By focusing on the 20 most common occupations, we were not able to make inference about the less common occupational sectors identified in prior research.<sup>2,17</sup> Although many occupational groups were represented in our analysis, the majority of women were concentrated in a relatively small number of occupations. For example, women who worked for the longest duration as secretaries and administrative assistants, and elementary and middle school teachers made up approximately 23% of the study. Women reported information on CVH and covariates at study entry (average age 63) and the status of these characteristics at that time may not be representative of the status throughout her working life. Public health and clinical guidance regarding cardiovascular

risk factors have changed since the measures were assessed in this study; we used AHA's current guidelines to classify CVH. Additionally, we focused only on cardiovascular risk factors, rather than CVD outcomes like stroke or myocardial infarction. Prior research in WHI reported that CVH significantly predicted risk of CVD.<sup>6</sup> Finally, our findings may not be generally representative to all women. Thirteen percent (13%) of participants had poor overall CVH (defined as total CVH of 0, 1 or 2), potentially reflecting a "healthy worker effect". Our estimate is similar to another study of a large sample of adult US workers that reported 9.6% with a CVH score of 2 or less.<sup>17</sup> Additionally, healthy women are more likely to have participated in the observational study.

However, our research adds to limited research evaluating the association between occupation and CVH<sup>2,17,33,34</sup> using a large cohort of women with detailed information about CVH and occupation. Additionally, unlike prior research, we considered the dose response between duration worked in each occupation and CVH. In order to improve CVH, it is important to look beyond individual factors such as health knowledge<sup>37,38</sup> and consider the complex and interrelated behavioral factors that results in an increased risk for these workers.<sup>39</sup> The AHA has recommended designing workplace health programs involving "my life check enhance-health assessment", "workplace health achievement index" and "American Heart Association Health screening services" to encourage a culture of health and improve health of employees.<sup>40</sup> Our study identified specific occupations that could benefit from these workplace programs. Our findings could be used to guide decisions to target health promotion and preventive services.

## CONCLUSION

CVD is the major cause of morbidity and mortality among women.<sup>41-43</sup> Increased prevalence of non-ideal CVH and incident CVD have been observed in post-menopausal women.<sup>44</sup> Occupation is an important correlate of women's heart health. Better understanding of occupations that may pose higher risks for women is important in designing workplace programs to address these risks in the female population. Our study helps identify specific occupations that may benefit from workplace health programs to improve CVH among women (<http://links.lww.com/JOM/A878>).

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