Relationship of Cardiovascular Disease to Stress and Vital Exhaustion in an Urban, Midwestern Police Department

by Sandra L. Ramey, PhD, RN, Yelena Perkhounkova, PhD, Nancy R. Downing, PhD, RN, and Kennith R. Culp, PhD, RN, FAAN

RESEARCH ABSTRACT

This study explored risk factors for cardiovascular disease (CVD) among 336 officers of a Midwestern police force. Instruments used included the Perceived Stress Scale, the Maastricht Questionnaire (measuring vital exhaustion), and a general Health Risk Appraisal. Rates of CVD, hypertension, and hypercholesterolemia were 3%, 28%, and 43%, respectively. The relative risk of hypercholesterolemia for male officers, compared to female officers, was 1.98 (95% confidence interval [CI], 1.10 to 3.56). The officers' average body mass index was 28.6 (*SD* = 4.9), with 80% being overweight or obese. The average vital exhaustion score was higher for female officers than male officers ($p < .05$). Bivariate relationships of CVD with perceived stress, vital exhaustion, and age were statistically significant ($p < .05$). When controlling for age, odds ratios were 1.20 (95% CI, 1.03 to 1.39; $p < .05$) for perceived stress and 1.31 (95% CI, 1.12 to 1.53; $p < .01$) for vital exhaustion.

Police officers experience increased risk of morbidity from cardiovascular disease (CVD), a phenomenon that has been studied for three decades. Compared to their civilian peers in the general population, police officers are up to 1.7 times more likely to develop CVD (Franke, Collins, & Hinz, 1998; Ramey, Downing, & Franke, 2009), with an average of 38% of police officers having hypertension and 33% having hypercholesterolemia (Franke, Ramey, & Shelley, 2002; Ramey, 2003). The purpose of this study was to explore risk factors for CVD in a Midwestern police force.

Law enforcement is one of the most stressful occupations in the United States (National Institute for Occupational Safety and Health, 2008), and stress is a known risk factor for CVD. Chronic exposure to stress may result in vital exhaustion, a condition characterized by excessive fatigue, irritability, and demoralization (Appels, 1997; Appels & Schouten, 1991a; Kopp, Falger, Appels, & Szedmak, 1998). Stress inherent to law enforcement work emanates from multiple sources, including critical trauma-oriented incidents and law enforcement organizations themselves. A meta-analysis of 14 prospective cohort studies including more than 80,000 workers showed an average of 50% greater risk for coronary heart disease among workers who experience work stress (Kivimäki et al., 2006). Recently, these organizational stressors have included budget cuts and a reduced number of officer positions due to fiscal constraints. These stressors have

ABOUT THE AUTHORS

Dr. Ramey is Assistant Professor, Dr. Perkhounkova is Statistician, Office for Nursing Research, Dr. Downing is Postdoctoral Fellow, and Dr. Culp is Professor, College of Nursing, The University of Iowa, Iowa City, IA.

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Address correspondence to Sandra L. Ramey, PhD, RN, Assistant Professor, The University of Iowa, College of Nursing and College of Public Health, 50 Newton Road, NB 464, Iowa City, IA 52242. E-mail: sandra-ramey@uiowa.edu.

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Applying Research to Practice

Occupational health nurses can use sophisticated surveillance methods to assess risk factors for cardiovascular disease, including stress and vital exhaustion; plan ongoing screenings; and examine gender differences among police officers. Recognizing the impact of the current economic climate on workers' health will inform and prioritize future interventions targeted at decreasing comorbid conditions, including obesity and cardiovascular disease.

been supported by narratives from more than 40 officers employed by the Milwaukee Police Department (Ramey, Downing, & Knoblauch, 2008).

Although several studies have detected the high risk police officers have for CVD (Franke et al., 2010; Joseph et al., 2009; Ramey et al., 2009), few studies have addressed the reasons for the increased risk. Those studies that have suggested, surprisingly, that CVD risk might correlate with factors emanating from within law enforcement organizations themselves (Garcia, Nesbary, & Gu, 2004; Gershon, Lin, & Li, 2002; Ramey, 2003; Ramey et al., 2008). For example, one study linked officers' CVD risk to fatigue associated with shift work, barriers to controlling working hours, work-life imbalance, and continual exposure to stress (Puttonen, Harma, & Hublin, 2010). Moreover, Violanti et al. (2009) found that officers who work the night shift, work overtime, and have shortened sleep are more prone to suffer negative health consequences.

The prolonged psychological tensions associated with police work may culminate and manifest as vital exhaustion (Williams et al., 2010). Workers suffering from vital exhaustion may display elevated levels of pro-inflammatory cytokines (Meyer et al., 2010). Specifically, vital exhaustion has been associated with the inflammatory marker C-reactive protein and interleukin 6 (Bryant, Stevens, Truesdale, Mosley, & Chambless, 2008). Increased levels of these biomarkers are known indicators of increased risk for CVD; increased levels have also been found in obese individuals (Bryant et al., 2008). Accordingly, previous studies have reported that vital exhaustion can predict 30% to 60% of all first cardiac events (Kop, Hamulyak, Pernot, & Appels, 1998; Prescott et al., 2003; von Kanel, Frey, & Fischer, 2003). This risk may be mediated by the effects of inflammation and vital exhaustion on the imbalance between blood coagulation and fibrinolysis; however, the exact mechanism is not understood (van Diest, Hamulyak, Kop, van Zandvoort, & Appels, 2002; von Kanel et al., 2003).

Most previous studies of police specifically and workers in general have not attempted to measure and compare the impact of stress or vital exhaustion that arises from the workplace (e.g., administrative structure, decision-making, workload, and job demand), critical incident (exposure to traumatic or violent events), and personal or individual sources. All of these sources of stress may have an additive effect or require unique interventions. Once the specific stressors are identified and the etiology and biology of associated health consequences are better understood, occupational health professionals can develop and prioritize strategic interventions for this and other high-stress professions. Identifying the underlying sources of stress and finding methods to prevent them could have far-reaching effects. Approximately 17,876 local, state, and federal criminal justice agencies in the United States employ more than 732,000 sworn officers (Bureau of Justice Statistics, 2007); therefore, improving the health of this occupational group benefits not only law enforcement agencies, but also communities that need protection but have strained budgets.

The purpose of this study was to evaluate the prevalence of CVD and its association with stress and vital exhaustion among law enforcement officers. The researchers specifically wanted to explore these two infrequently studied risk factors—stress and vital exhaustion—and examine differences by gender, given that female officers are an understudied subgroup in this population.

METHODS

The Des Moines Police Department (DMPD) is the largest law enforcement agency in Iowa. Data were collected from a convenience sample of 342 (92%) of the 370 Des Moines police officers who attended an annual in-service training session. Of those participants reporting gender (n = 314), 272 (87%) were men and 42 (13%) were women. Table 1 lists demographics.

Measures

Instruments used included the Perceived Stress Scale; Form B (9-item version) of the Maastricht Questionnaire (Vital Exhaustion Survey); and a Health Risk Appraisal (HRA).

The Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) is a 14-item, Likert-type questionnaire that asks to what degree individuals perceive situations in their lives to be stressful. This instrument was previously used by the authors and found to be an effective predictor of stress-induced health consequences, including burnout, physical symptoms, and job dissatisfaction. The Perceived Stress Scale scores range from 0 to 56, with higher scores indicating greater perceived stress (Cronbach's alpha = 0.75) (Cohen et al., 1983; Cohen & Williamson, 1988).

Vital exhaustion was assessed using a 9-item version of Form B of the Maastricht Questionnaire, which was designed to characterize feelings of fatigue, irritability, and demoralization. The summary scores range from 9 to 27, with higher scores representing increased feelings of vital exhaustion (Cronbach's alpha = 0.83) (Appels, 1997; Appels & Schouten, 1991b; Kopp et al., 1998).

General health (e.g., self-reported hypertension, hypercholesterolemia, and physical inactivity) was assessed

using the HRA. This instrument has been used in other studies of police in more than 18 departments in the Midwest. It is composed of 50 questions from the Behavioral Risk Factor Surveillance System (BRFSS) Questionnaire (Centers for Disease Control and Prevention [CDC], 2009b; Franke et al., 2002; Kilmer et al., 2008; Ramey, Welk, Franke, & Shelley, 2003).

Body mass index (BMI) was calculated from self-reported weight and height as weight in kilograms divided by height in meters squared. Healthy weight was defined as BMI of 18.5 to 24.9, overweight was defined as BMI of 25.0 to 29.9, and obesity was defined as BMI of 30 or greater (World Health Organization, 2010). Hypertension and hypercholesterolemia were determined through self-report of physicians telling participants they had high blood pressure or high cholesterol levels (CDC, 2009b). The presence of CVD was determined by responding "yes" to a history of any of the following: angina, stroke, or myocardial infarction (CDC, 2009b). Physical activity was defined operationally as answering "yes" to the following question on the HRA: "During the past 1 month, have you participated in any activity, such as running, calisthenics, golf, gardening, or walking, for exercise?"

Procedures

Data were collected at the annual in-service training sessions held at the Des Moines, Iowa, Police Academy. Attendance at the in-service sessions was required, so every officer selected a time to attend a session offered annually between January and March. The Sergeant in charge of the in-service sessions read a script that imparted the elements of recruitment and consent, as approved by the Institutional Review Board at the University of Iowa. Packets distributed to officers contained a consent letter, the surveys, and a return envelope. The Sergeant left the room while officers completed the surveys. Completing the surveys took less than 20 minutes in most instances. If officers decided not to participate, they simply returned the blank surveys in the envelope provided.

Data Analysis

Descriptive statistics were calculated for the sample, including officers' age, BMI, gender, ethnicity, and replies to selected questions. Perceived Stress Scale and Vital Exhaustion Survey scores were calculated for each participant by summing item-level scores. The average Perceived Stress Scale and Vital Exhaustion Survey scores were calculated for the entire group, as well as for groups defined by gender and rank. Gender differences were examined, as well as differences among officer ranks.

To investigate bivariate relationships between self-reported CVD and stress and vital exhaustion, separate logistic regression models were fit for CVD as an outcome variable and Perceived Stress Scale score or Vital Exhaustion Survey score as independent variables. Finally, age was added to the models for CVD.

RESULTS

Demographics, including self-reported rates of CVD, hypertension, and hypercholesterolemia, are shown in Table 1. No female officers reported a history of CVD. The difference in prevalence rates for hypertension was

Table 1

Demographics

	N	M ± SD *or* %[a]
Years in law enforcement	335	16.2 ± 10.1 (1-40)[b]
Age (years)	335	41.2 ± 9.4 (22-64)[b]
BMI	336	28.6 ± 4.9 (17.0-50.8)[b]
Gender		
Male	272	87
Female	42	13
Race		
African American	8	2
Asian	7	2
White	306	93
Other	7	2
Rank		
Police officer	207	61
Detective	44	13
Sergeant	50	15
Lieutenant and above	29	9
Other	7	2
Engaged in physical activity		
Yes	301	90
No	33	10
Hypercholesterolemia		
Yes	140	43
No	182	57
Hypertension		
Yes	94	28
No	240	72
BMI		
Normal (18.5-24.9)	66	20
Overweight (25.0-29.9)	160	48
Obese (≥ 30.0)	108	32
CVD		
Yes	11	3
No	316	97

Note. BMI = body mass index; CVD = cardiovascular disease. [a]Percentages may not sum to 100 due to rounding. [b]Range.

Table 2

Perceived Stress Scale and Vital Exhaustion Survey Descriptive Statistics

	Perceived Stress Scale			*Vital Exhaustion Survey*		
Group	**N**	**M ± SD**	***Range***	**N**	**M ± SD**	***Range***
Overall	332	20.0 ± 5.1	7-36	327	15.6 ± 4.6	9-27
Gender						
Male	267	19.8 ± 4.9	7-36	263	15.4* ± 4.5	9-27
Female	42	20.9 ± 5.7	11-34	40	17.2* ± 5.1	9-26
Rank						
Police officer	205	19.8 ± 4.9	7-36	204	15.6 ± 4.3	9-26
Detective	43	19.9 ± 4.9	13-31	41	14.9 ± 4.4	9-27
Sergeant	48	20.2 ± 5.1	8-36	49	15.4 ± 4.8	9-27
Lieutenant and above	28	20.5 ± 5.9	8-31	27	16.5 ± 5.5	9-26

Note. **The difference was statistically significant (p < .05).*

not statistically significant by gender (29% for male vs. 19% for female officers). However, the difference in rates for hypercholesterolemia was statistically significant by gender (46% for male vs. 23% for female officers; $p < .01$). The relative risk of hypercholesterolemia for male officers, compared to female officers, was 1.98 (95% confidence interval [CI], 1.10 to 3.56).

The average BMI was 28.6 ($SD = 4.9$), with 80% of officers overweight or obese. However, the majority of officers (90%) self-reported engaging in the previously described forms of physical activity during the past month.

The average Perceived Stress Scale scores were 20.0 ($SD = 5.1$) for the overall group, 19.8 ($SD = 4.9$) for male officers, and 20.9 ($SD = 5.7$) for female officers (Table 2). The average Vital Exhaustion Survey scores were 15.6 ($SD = 4.6$) for the overall group, 15.4 ($SD = 4.5$) for male officers, and 17.2 ($SD = 5.1$) for female officers. The difference between the average Vital Exhaustion Survey scores for male and female officers was statistically significant ($p < .05$).

The majority of participants replied "yes" to the following three questions from the Vital Exhaustion Survey (Table 3): "Do you often feel tired?" (58%), "Do you repeatedly wake up during the night?" (55%), and "Do you ever wake up with feelings of exhaustion and fatigue?" (50%). Responses by gender and officer rank are shown in Table 3. Female officers tended to reply "yes" to these questions more often than male officers. For example, compared to 48% of male officers, 68% of female officers reported waking up with feelings of exhaustion and fatigue. However, the differences were not statistically significant, in part because three response categories (i.e., "yes," "don't know," and "no") were offered on the Vital Exhaustion Survey.

Because all of the officers who reported CVD were male ($n = 11$), the regression analyses excluded female officers. The bivariate relationships of CVD with perceived stress, vital exhaustion, and age were statistically significant ($p < .05$). When controlling for age, odds ratios were 1.20 (95% CI, 1.03 to 1.39; $p < .05$) for perceived stress and 1.31 (95% CI, 1.12 to 1.53; $p < .01$) for vital exhaustion. Thus, when controlling for age, a unit change in perceived stress or vital exhaustion increased the odds of CVD by 20% or 31%, respectively. Both models for CVD were statistically significant ($p < .01$ for perceived stress and $p < .001$ for vital exhaustion). Hosmer and Lemeshow Goodness-of-Fit Test results were not significant, indicating acceptable fit for the models.

DISCUSSION

The prevalence of CVD was similar to rates found in nine Midwestern police departments (Franke et al., 2002; Ramey et al., 2008). The rate for hypertension was greater than the rates found in the Buffalo New York Police Department and the Western New York Police Department (24.4%) (Joseph et al., 2009) and greater than rates for the general population in Iowa (25.5%) (Centers for Disease Control and Prevention, 2009a; Lloyd-Jones et al., 2010; Taylor et al., 2010).

Of concern was the frequency of self-reported hypercholesterolemia, especially by male officers. Within the DMPD, male officers were almost twice as likely as their female counterparts to have elevated cholesterol levels and nearly half (46%) of the male officers self-reported a history of elevated cholesterol. This rate is greater than the rate of 33% reported by 2,818 male officers employed by nine Midwestern police departments (Franke et al., 2002) and exceeded the rate of 37.3% within the general population of Iowa (Centers for Disease Control and Prevention, 2009a). However, the rate in the DMPD is lower than the 61.2% of officers with hypercholesterolemia obtained from blood samples (not self-report) in the Buffalo New York Police Department and the Western New York Police Department (Joseph et al., 2009).

Although the female officers in this study reported lower rates of hypertension and cholesterol than the

Table 3

Percentages of Participants Replying "Yes" to Selected Vital Exhaustion Survey Questions

	Often Feel Tired		*Repeatedly Wake Up During the Night*		*Wake Up With Feelings of Exhaustion and Fatigue*	
Group	***N[a]***	***% Yes***	***N[a]***	***% Yes***	***N[a]***	***% Yes***
Overall	325	58	322	55	322	50
Gender						
Male	263	57	259	55	258	48
Female	39	67	39	59	40	68
Rank						
Police officer	202	57	202	54	200	54
Detective	41	59	41	49	41	39
Sergeant	49	61	46	57	48	42
Lieutenant and above	27	52	27	63	27	52

Note. [a]*Number of participants who answered the questions.*

male officers, the self-reported prevalence of hypertension and hypercholesterolemia among female officers in the DMPD was much higher than rates for hypertension (19%) and triglycerides (2.5%) among Buffalo New York Police Department officers (Violanti et al., 2006). Violanti et al. (2006) also reported that hypertension and elevated triglycerides were more common in males. Furthermore, because self-reported hypercholesterolemia often is underreported (Bays, Chapman, Fox, Grandy, & SHIELD Study Group, 2008; Huerta, Tormo, Egea-Caparros, Ortola-Devesa, & Navarro, 2009; Martin, Leff, Calonge, Garrett, & Nelson, 2000; Taylor et al., 2010), more officers in this study may have had hypercholesterolemia but were unaware of it.

In this study, 80% of the officers had a BMI greater than 25.0 (considered overweight or obese), close to the 83% found for 2,818 officers in the study by Franke et al. (2002). This is disturbing because obesity is a known risk factor for and comorbid condition of CVD.

The average BMI within this department was 28.6 ($SD = 4.9$), but the majority of officers self-reported being physically active during the past month. Excessive weight and physical inactivity combined with chronic exposure to stress and exhaustion may result in negative health consequences, including chronic disease (Bellingrath, Weigl, & Kudielka, 2009).

The Perceived Stress Scale mean in this study was 20.0 ($SD = 5.1$). This value slightly exceeds the value of 19.2 ($SD = 7.3$) found in the study by Franke et al. (2010) and is similar to the value found in the Milwaukee Police Department (20.3; $SD = 7.7$), a large, metropolitan, high-crime agency (Ramey et al., 2008).

Female officers self-reported higher levels of stress than their male counterparts, but the difference was not statistically significant. Yoo and Franke (2010) also found that female officers self-reported significantly greater stress than male officers. Those authors also found more self-reported vital exhaustion among female officers. This phenomenon has also been observed among female teachers (Bellingrath et al., 2009), a profession with a high-stress work environment.

In this study, the mean score for vital exhaustion (15.6; $SD = 4.6$) was considerably lower than that for a subset of the Milwaukee Police Department (18.0; $SD = 5.9$; $n = 71$) but still considered high (Franke et al., 2010; Kop et al., 1998; Ramey et al., 2008). Half or more of all DMPD officers reported often feeling tired, repeatedly waking during the night, or waking feeling exhausted and fatigued. Other studies have also found that women report being significantly more exhausted than men (Kop et al., 1998; Prescott et al., 2003; Schuitemaker, Dinant, van der Pol, & Appels, 2004); this may indicate that women are at greater risk for CVD than their male counterparts (Yoo & Franke, 2010). That women continue to provide more child care than men may be a related factor (Sayer, Bianchi, & Robinson, 2004).

When controlling for age, male officers had statistically significant associations between CVD and stress and vital exhaustion. A unit change in perceived stress or vital exhaustion increased the odds of CVD by 20% or 31%, respectively. Nevertheless, the prevalence of CVD was lower than expected for police officers. Studies comparing working and retired law enforcement officers have found CVD rates to be low among working officers, likely due to the "healthy worker" effect (Shah, 2009). Moreover, many states have heart/lung presumption laws, based on the assumption that CVD-related morbidity or mortality is job-related. The true rate of CVD might be

masked because officers with actual CVD morbidity may have self-selected out of the sample through retirement or disability. This likely also explains the lower rate found in this group of working officers and the higher rates found in studies of retirees (Franke et al., 1998; Gershon et al., 2002; Ramey et al., 2009).

Surprisingly, even in the presence of several significant risk factors (i.e., overweight, obesity, perceived stress, vital exhaustion, and relevant physical inactivity), most officers (93%) rated their health as "good to excellent." This indicates a possible disconnect between awareness of health consequences and the presence of CVD risk.

LIMITATIONS

These pilot results were limited for gender and ethnicity. The DMPD is homogeneous in that 87% of the DMPD are men and ethnic diversity is limited in Iowa. Nevertheless, the ethnic composition of the sample is similar to that found in the city of Des Moines and the state of Iowa. Nationwide, 9% of law enforcement officers in medium-size law enforcement agencies (100 to 500 sworn officers) are female (Langton, 2010).

Using logistic regression may be problematic for data with few "events" (an event is the less common of the two possible outcomes, such as a case of CVD among cases with no CVD present). For these participants, the complete data for each model had only 9 to 10 cases of CVD (total number was 322 and 324, respectively). The rule of thumb supported by simulation experiments (Peduzzi, Concato, Kemper, Holford, & Feinstein, 1996) is that the number of "events" per predictor should be at least 10. In each model, the researchers had either perceived stress or vital exhaustion as the independent variable. Moreover, the researchers adjusted for age in the models. However, examination of the diagnostic information, model fit, and standard errors of the estimates indicated that the models were appropriate for the data.

Self-reported data may have underestimated study variables. For example, the actual BMIs may be higher because self-reported height and weight may have been inaccurate. Self-reported measures of CVD risk factors tend to be reasonably accurate, especially for hypertension; hypercholesterolemia is more likely to be underreported (Bays et al., 2008; Huerta et al., 2009; Martin et al., 2000; Taylor et al., 2010).

IMPLICATIONS FOR PRACTICE

Surveillance of CVD risks and morbidity, including stress and vital exhaustion, is needed for those employed in law enforcement to facilitate subsequent chronic disease management. This is especially relevant in the current economic climate, with officers working more hours and longer into their careers (Gershon et al., 2002). Examining data by gender may identify possible risks for female officers.

Based on BMI, overweight and obesity are clearly risk factors within this group and for law enforcement agencies in general. Law enforcement agencies should be assisted to address issues such as overweight and obesity, stress, and vital exhaustion, as well as other health consequences. Then, interventions can be developed within agencies to address risk and disease.

Risk factor surveillance is the first step in informing interventions targeted toward improving the health of officers employed by the DMPD. Future studies should investigate weight and obesity (because BMI can be distorted by muscle mass), biological outcome markers, and possible mediators, including sleep. Work shift is also important and should be analyzed. Sources of stress specific to law enforcement that arise from within organizations must be understood. Increased knowledge of how to provide ongoing screenings and assessments of officers' health is needed. Interventions that include physiologic and pharmacologic measures should be developed and tested for this and other high-stress occupations characterized by risk and chronic disease.

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