

# The Effect of Work Shift and Sleep Duration on Various Aspects of Police Officers' Health

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## RESEARCH ABSTRACT

Police officers are prone to cardiovascular disease, overweight, and obesity. Because night-shift work affects sleep, a modifiable risk factor linked to chronic disease, the researchers explored the relationship among shift work, sleep, and wellness for police officers. Sleep, C-reactive protein (CRP) levels, stress, fatigue, and body mass index were used to compare officers who worked primarily day shifts to those who worked primarily evening or night shifts, and officers who slept less than 6 hours per day to those who slept at least 6 hours per day. A cross-sectional study of 85 male officers, 20 to 63 years old, was completed at three Midwestern police departments. The Pittsburgh Sleep Quality Index was used to assess sleep. A questionnaire was used to collect officer demographics and work hours. Other measurements included serum CRP, height, weight, perceived stress, and vital exhaustion. The relative risk of sleeping less than 6 hours per day for officers who primarily worked non-day shifts, compared to those who worked day shifts, was 14.27 (95% confidence interval [CI], 1.98-102.95,  $p < .001$ ), and the relative risk of overall poor sleep quality for officers who slept less than 6 hours per day, compared to those who slept more hours, was 2.44 (95% CI, 1.15-5.20,  $p = .027$ ). CRP was not associated with shift or sleep duration, even when adjusted for officers' ages.

**C**hronic sleep restriction is a growing trend in America. The National Sleep Foundation (2009) reports Americans spend an average of 6 hours and 40 minutes sleeping each weeknight, significantly less than

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reported in the 1960s, when the American Cancer Society found modal sleep duration to be 8 to 9 hours (Kripke, Simons, Garfinkel, & Hammond, 1979). This loss of nightly rest is significant because research has revealed that sleep duration and quality are linked to chronic diseases, including obesity, cardiovascular disease, and diabetes; moreover, studies confirm that the workplace can have a major impact on sleep patterns (Anic, Titus-Ernstoff, Newcomb, Trentham-Dietz, & Egan, 2010; Buxton & Marcelli, 2010; Grandner, Hale, Moore, & Patel, 2010; Knutson, 2010).

Reduced sleep is an independent risk factor for weight gain and the development of obesity (Knutson, 2010; Knutson, Spiegel, Penev, & Van Cauter, 2007; Knutson & Van Cauter, 2008; Patel & Hu, 2008). Although the exact mechanism is unclear, individuals who experience short sleep are more likely to be obese, regardless of their

## Applying Research to Practice

Sleep duration and quality are linked to chronic disease, including cardiovascular disease. The workplace can have a major impact on sleep duration and quality; individuals who experience short sleep are more likely to be obese. The cascade of events that occurs with short sleep and poor sleep quality can result in inflammatory changes that further increase disease risk. Occupational health nurses are strategically positioned to identify modifiable risk factors and to intervene to improve the health of police.

sleep patterns early in life (Anic et al., 2010; Atkinson & Davenne, 2007). The Centers for Disease Control and Prevention (CDC) surveyed 87,000 American adults between 2004 and 2006 and reported that 33% who slept less than 6 hours per night were obese, compared to only 22% of those who slept the recommended 6 to 9 hours (Schoenborn & Adams, 2010).

The demands of police shift work can affect sleep duration and quality, especially by shortening nightly sleep to less than 6 hours. Short sleep may contribute to the development of chronic diseases, and officers' increased prevalence of cardiovascular disease, overweight, and obesity. Charles et al. (2011) found short and long sleep duration were associated with higher leptin levels and may have implications for obesity-related conditions. In addition, abnormal sleep patterns may be exacerbated by psychological stress and the ensuing fatigue that are typical of police work, and even further by officers' on-the-job demands outside of the work shift (e.g., the frequent requirement to testify in court) (Ramey, Welk, Franke, & Shelley, 2003; Ramey, Downing, & Franke, 2009; Ramey, Downing, Franke, Perkhounkova, & Alasagheirin, 2011; Ramey, Downing, & Knoblauch, 2008). Accordingly, this study addresses a significant gap in the literature. To date, no published studies on law enforcement have explored differences in duration and quality of sleep in the context of shift work and cardiovascular disease risk factors, including C-reactive protein (CRP).

Indeed, few studies have addressed sleep problems among police. The limited number of published studies have shown that, regardless of shift work, law enforcement officers experience affected sleep quality. Rajaratnam et al. (2011) found that, overall, 40.4% of police officers participating in a screening program had at least one sleep disorder, including obstructive sleep apnea (33.6%), moderate sleep insomnia (6.5%), and shiftwork sleep disorder (5.4%). An Italian study of police found shift workers had a higher prevalence of difficulty falling asleep and staying awake compared to non-shift workers. The shift workers more often experienced sleep disturbances that included

sleep latency exceeding 20 minutes and early awakening (Garbarino et al., 2002).

The stress police experience on the job likely affects sleep; and exposure to psychological and emotional stress may result in fatigue. If this fatigue persists, vital exhaustion may ensue, characterized by feelings of fatigue, irritability, and demoralization (Appels, 1997; Appels & Schouten, 1991; Kopp, Falger, Appels, & Szedmak, 1998).

Shift work likely compounds sleep problems among police. Neylan et al. (2002) examined subjective sleep quality, using the Pittsburgh Sleep Quality Index (PSQI), among 747 police officers in the San Francisco Bay area and New York City. Officers on variable shifts and stable day shifts had significantly lower quality sleep and averaged shorter sleep duration than controls; moreover, work-environment stress was strongly correlated with poor quality sleep. The effects of shortened sleep were examined in a recent study of 189 police academy recruits. In that study, psychomotor vigilance decreased proportionately with sleep loss, at a rate of 3.5% per hour of sleep missed (Neylan et al., 2010). This is significant because police make decisions that can have far-reaching impact. Indeed, police work is performed in a highly stressful environment, within the public domain, demanding that officers make safe, effective decisions. That sleep duration and quality may affect psychomotor performance is especially alarming because police carry guns.

Thus, sleep is a significant issue in law enforcement for several reasons: (1) shift work demands service and accountability from officers, 24 hours a day; (2) compared to their counterparts in the general population, police officers have higher rates of morbidity and risk factors for cardiovascular disease, including overweight and obesity; and (3) law enforcement is conducted in a high-stress environment, which may contribute to psychological stress with ensuing fatigue, both risk factors for cardiovascular disease.

### SHIFT WORK

Police shift work may impact sleep in several ways. Long work hours and rotating multiple shifts affect sleep-wake homeostasis (Olson, Drage, & Auger, 2009). Moreover, the 24-hour accountability of police work necessitates irregular shifts (e.g., 3:00 to 11:00 p.m. or 11:00 p.m. to 7:00 a.m.); also, officers frequently work elongated shifts lasting 12 hours or more, and unpredictable events necessitate overtime on a regular basis. In most agencies, shifts are assigned by seniority; thus, many officers spend several years working an irregular combination of shifts. Compared with regular shift workers, irregular shift workers show abnormal sleep patterns and short sleep duration. In particular, night-shift workers sleep during the day—the inverse of the normal circadian rhythm—and their sleep is more often interrupted by environmental factors. As a result, the sleep of night-shift workers is more often deprived (Kudielka, Buchtal, Uhde, & Wüst, 2007).

### SLEEP AND OBESITY

Night or rotating shift work is often cited as a risk factor for obesity (Di Milia & Mummery, 2009). The

degree to which a night-shift worker's body mass index (BMI) is elevated was found to be proportionate to the total number of hours worked; in addition, those working longer hours were more likely to become obese (Di Milia & Mummery, 2009). These studies are consistent with population studies that have repeatedly shown that a short average duration of sleep is associated with excess BMI (Gangwisch et al., 2007; Lauderdale et al., 2009; Schoenborn & Adams, 2010; Taheri, Lin, Austin, Young, & Mignot, 2004). Additional studies among women reported an inverse relationship between short sleep duration and central obesity (Theorell-Haglow, Berne, Janson, Sahlin, & Lindberg, 2010); among men, others reported a link between short sleep and weight gain with resultant obesity, even during the short time frame of 1 year (Marshall, Glozier, & Grunstein, 2008; Patel, Malhotra, White, Gottlieb, & Hu, 2006; Watanabe, Kikuchi, Tanaka, & Takahashi, 2010). Indeed, cross-sectional and longitudinal studies agree: the total number of sleep hours inversely correlates with weight (Marshall et al., 2008; Patel et al., 2006; Watanabe et al., 2010). The lack of sleep that contributes to overweight and obesity can significantly impair health, perpetuating other health consequences, such as greater risk for and morbidity associated with cardiovascular disease (Cappuccio, Cooper, D'Elia, Strazzullo, & Miller, 2011; Knutson, 2010). Thus, it can be argued that shift work that diminishes quality sleep may contribute to overweight and obesity. This is particularly significant for police officers because studies consistently find officers to be, on average, overweight and obese, with a high prevalence of traditional cardiovascular disease risk factors, including hypertension, hypercholesterolemia, and physical inactivity (Joseph et al., 2009, 2010; Yoo & Franke, 2011).

## **SLEEP AND CARDIOVASCULAR DISEASE RISK AND MORBIDITY**

Shortened sleep has been associated with cardiovascular disease morbidity and risk factors, including hypertension and diabetes (Knutson, 2010). Shortened sleep, for even one night, can induce insulin resistance, thus contributing to the pathology of diabetes (Morselli, Leproult, Balbo, & Spiegel, 2010; Zizi et al., 2010). Violanti et al. (2009) found that shorter sleep duration or additional overtime when working the midnight shift were potential contributors to metabolic syndrome. These data may be particularly relevant for police officers because, overall, they have a particularly high risk for and morbidity related to cardiovascular disease (Joseph et al., 2010).

Lack of sleep likely contributes to low-level inflammation, a newly recognized marker for cardiovascular disease (Miller & Cappuccio, 2007; Sabanayagam & Shankar, 2010). This association can be monitored through CRP, which has been associated with sleep deprivation and obesity (Emerging Risk Factors Collaboration et al., 2010; Mehta & Farmer, 2007). CRP is maintained at low levels in the body at baseline, but levels rise during an acute inflammatory response (Pepys & Hirschfield, 2003). CRP is known to be elevated in obese individuals (Visser, Bouter, McQuillan, Wener, & Harris, 1999;

Wee et al., 2008). Several studies of healthy, lean adults showed acute total sleep loss, as well as recurrent partial sleep deprivation, triggered a rise in CRP levels (Meier-Ewert et al., 2004; van Leeuwen et al., 2009).

Clearly, sleep is a modifiable risk factor for cardiovascular disease and obesity. Although infrequently studied, changes in sleep duration and quality may be key factors in preventing these chronic diseases. Therefore, this study examined the differences in sleep duration and quality, CRP levels, stress, fatigue, and BMI for police officers who were grouped according to work shift and sleep duration. In particular, the researchers were interested in comparing (1) officers who work primarily day shifts to officers who work primarily evening or night shifts, and (2) officers who sleep less than 6 hours per day to officers who sleep at least 6 hours per day.

## **METHODS**

### ***Design and Sample***

This cross-sectional study sought participation of 140 officers employed by three police departments in Iowa. Police officers ( $n = 95$ ) representing approximately 73% of eligible officers participated. This study focused on male police officers ( $n = 85$ ) who were 22 to 63 years old. All participants completed surveys querying (1) sleep duration and quality, (2) stress, and (3) vital exhaustion. Height was measured with a stadiometer, and participants were weighed on an electronic scale while wearing light clothing but no shoes. Overweight and obesity were determined using BMI. High-sensitive serum CRP was measured from one blood draw obtained at random times throughout the day (Ridker & Libby, 2007). Sera were stored at  $-86^{\circ}\text{C}$  and assayed in batches to determine CRP concentration. Serum CRP concentrations were determined in duplicate, using a high-sensitivity sandwich enzyme immunoassay (EIA).

### ***Variables and Their Measures***

Sleep duration and quality were assessed using the PSQI, a 19-item questionnaire designed to assess sleep disturbances during the past month using seven domains: sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medication, and daytime dysfunction. The PSQI global score ranges from 0 to 21 points, with higher scores reflecting more sleep disturbances. This is a well-validated self-report instrument with a Cronbach's alpha of 0.83 (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). Sleep duration was defined as total sleep hours in one sleep session. No data on interruption during sleep were collected. Six hours as a measurement demarcation was used in previous studies (e.g., Violanti et al., 2009).

General stress was measured by the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983), a 14-item, Likert-type questionnaire that determines to what degree individuals perceive situations in their lives as stressful. This instrument has been 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 is 0.75 (Cohen et al., 1983; Cohen & Williamson, 1988; Ramey, Downing, et al., 2011; Ramey, Perkhounkova, Downing, & Culp, 2011). Vital exhaustion was assessed using a nine-item version of Form B of the Maastricht Questionnaire, which is 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 is 0.83 (Appels, 1997; Appels & Schouten, 1991; Kopp et al., 1998).

Other measurements included BMI, calculated from measured height and weight values as weight in kilograms divided by height in meters squared. Normal weight was defined as a BMI of less than 25.0; overweight and obesity were defined as BMI greater than or equal to 25.0, according to the criterion for classification by the World Health Organization (WHO, 2010). Serum CRP levels were drawn at random times and assayed using sandwich EIA techniques.

Information on working back-to-back shifts was collected by asking how often the officer needed to return to work in the early morning after working the evening shift ("never," "occasionally," or "frequently"). This variable was limited to only returning to work in the early morning after working the evening shift because this scenario allows little time for officers to rest and recuperate between shifts. Back-to-back shifts represent a phenomenon whereby officers do not have an opportunity to restore and recuperate before returning to work. It is common for researchers to assess back-to-back shifts and appreciate the potential for negative health and safety consequences. Biologically, officers do not have time to allow for natural biorhythms to reset; back-to-back shifts are different from working an extra shift or overtime on a day off. The back-to-back shifts variable was dichotomized by collapsing the categories of "occasionally" and "frequently."

The researchers collected information about work shifts by asking the question, "What shifts do you work?" The choices were 1 (mainly days), 2 (mainly evenings), 3 (mainly nights), 4 (evenings and nights), 5 (days and nights), and 6 (days and evenings). The first four options were grouped into two categories: day ("mainly days") and non-day ("mainly evenings," "mainly nights," or "evenings and nights"). For the analysis comparing work shifts, the researchers deleted four participants who selected options 5 and 6.

### Data Analysis

Officers were classified in two ways. First, officers who reported working primarily evening and night (non-day) shifts were compared to officers working primarily day shifts. Then, officers who reported sleeping less than 6 hours per day were compared to officers sleeping at least 6 hours per day. Independent groups *t* test and chi-square test were used to determine significant differences between groups. For selected statistically significant comparisons, relative risk was calculated as a ratio

of the probabilities of something happening in one group versus the other group.

## RESULTS

Among the participants, 40 reported working mainly day shifts and 41 reported working evenings or nights. Information on shifts worked in the past month was also collected by asking participants to provide the number of day, evening, and night shifts worked. Based on these data, the researchers calculated that (1) officers in the "day" category worked, on average, 19 day shifts and 0.6 night or evening shifts; and (2) officers in the "non-day" category worked, on average, 0.9 day shifts and 19.9 evening or night shifts during the past month. For these calculations, the researchers excluded officers who reported working less than 5 shifts during that month ( $n = 9$ ), as they apparently were on leave or vacation (Table).

Officers who worked primarily non-day shifts were significantly younger than officers who worked day shifts ( $M = 34.9$ ,  $SD = 7.1$  vs.  $M = 44.4$ ,  $SD = 8.5$ ;  $p < .001$ ) and also reported sleeping less hours ( $M = 6.4$ ,  $SD = 1.5$  vs.  $M = 7.2$ ,  $SD = 0.9$ ;  $p = .007$ ). Because the non-day officers tended to be significantly younger, the researchers used logistic regression to investigate if an adjustment for age would affect the findings. It was found that, for the majority of the variables, adjusting for age had negligible effect. However, age was statistically significant ( $p = .003$ ) when back-to-back shift work was compared for officers who slept less than 6 hours per day versus those who slept at least 6 hours per day. Although without adjusting for age the difference in percentages was statistically significant ( $p = .025$ ), the coefficient for sleep duration (less than 6 hours vs. at least 6 hours) in the logistic regression model that also included age as a predictor was not statistically significant ( $p = .057$ ).

Although not statistically significant at the .05 level, it may be noteworthy that more than half of the officers working the day shift (53%) reported working overtime frequently, compared to 32% of non-day officers. (Overall, the officers in the study reported working almost 46 hours per week on average.) Also important was the finding that 83% of the non-day officers reported being asked to return to work in the early morning at least occasionally, after working the evening shift.

Compared to officers who worked day shifts, a greater percentage of officers who primarily worked evening and night shifts reported sleeping less than 6 hours per day (37% vs. 3%,  $p < .001$ ). The relative risk of sleeping less than 6 hours per day for evening and night officers, compared to day officers, was 14.27 (95% confidence interval [CI], 1.98-102.95). Moreover, those who slept less than 6 hours and those who slept at least 6 hours per day differed in how they rated their sleep quality ( $p = .027$ ). The relative risk of overall poor sleep quality for officers who slept less than 6 hours per day, compared to those who slept more hours, was 2.44 (95% CI, 1.15-5.20). Of the officers who slept less than 6 hours per day, BMI classified 88% as overweight or obese, compared to 78% of officers who slept at least 6 hours; however, the

Table

## Descriptive Statistics

	Work Shift		Sleep Duration		Total (n = 85)	Range
	Day (n = 40)	Non-Day (n = 41)	≥ 6 Hours (n = 68)	< 6 Hours (n = 17)		
Overtime days past month	6.6 ± 5.3	5.7 ± 4.0	6.1 ± 4.8	7.2 ± 4.2	6.3 ± 4.7	0-20
Hours worked per week	47.3 ± 7.1	44.2 ± 7.8	46.0 ± 7.9	45.2 ± 6.0	45.9 ± 7.5	8-70
Age	44.4 ± 8.5	34.9 ± 7.1	40.1 ± 9.0	37.0 ± 8.7	39.6 ± 9.0	22.4-63.3
Sleep time (hours)	7.2 ± 0.9	6.4 ± 1.5	7.3 ± 0.8	4.7 ± 0.8	6.8 ± 1.3	3.5-9.5
Pittsburgh Sleep Quality Index (0-21)	5.8 ± 3.0	6.1 ± 2.6	5.4 ± 2.7	7.6 ± 3.0	5.9 ± 2.9	2-13
Vital exhaustion (3-27)	15.6 ± 4.3	15.6 ± 4.2	14.9 ± 4.3	17.0 ± 3.4	15.4 ± 4.3	9-26
Perceived Stress Scale (0-56)	19.5 ± 6.6	18.6 ± 6.3	18.6 ± 6.3	19.8 ± 6.3	19.0 ± 6.3	8-38
	%	%	%	%	%	
Work overtime frequently	53	32	44	38	44	
Work back-to-back shifts	40	83	57	88	64	
Have difficulty falling asleep > 1 per week	23	29	24	38	26	
Have overall poor sleep quality	15	29	18	44	23	
Sleep < 6 hours per day	3	37	0	100	19	
BMI ≥ 25.0	85	73	78	88	80	
CRP > 3.0 mg/L	31	24	24	38	27	
	p	p	p	p	p	
	.417	.065	.001	.223	.075	
	.007	.029	.006	.006	.006	
	.955	.955	.504	.504	.504	
	.058	.025	.025	.027	.379	
	.523	.172	.267	.267	.267	

Note. BMI = body mass index; CRP = C-reactive protein.

difference was not statistically significant ( $p = .379$ ). Similarly, overweight and obesity rates did not differ between day shift and non-day shift officers; and CRP levels did not significantly differ by shift or sleep duration.

The mean score on the PSQI was significantly higher for officers who reported sleeping less than 6 hours per day compared to officers who slept at least 6 hours ( $M = 7.6$ ,  $SD = 3.0$  vs.  $M = 5.4$ ,  $SD = 2.7$ ;  $p = .006$ ), indicating more sleep disturbances for the former group. Summary scores for the measures of vital exhaustion and perceived stress did not vary significantly by shift worked or sleep duration. However, vital exhaustion scores were higher, on average, for officers sleeping less than 6 hours compared to officers sleeping at least 6 hours ( $M = 17.0$ ,  $SD = 3.4$  vs.  $M = 14.9$ ,  $SD = 4.3$ ;  $p = .075$ ).

## DISCUSSION

Law enforcement requires 24-hour accountability (much like nursing) and shift work. The number of hours worked per day and the way those hours translate into shifts at different times during the day, evening, or night may affect officers' health (CDC, 2011; Olson et al., 2009).

According to other studies (CDC, 2011; Kivimaki et al., 2011), working more than 11 hours per day is associated with an increased risk of cardiovascular disease; this risk was 67% greater than for those who worked 7 to 8 hours per day. Although most officers in this study worked more than 40 hours per week and frequently reported overtime, the hours worked per week were a conservative estimate because time spent in secondary employment (beyond primary employment in law enforcement) was not reported here.

In this study, police officers frequently reported working (1) long days; (2) overtime; and (3) back-to-back shifts,

which allowed little time to recuperate from short and different sleep cycles. Although the PSQI primarily captured sleep duration and quality and some of the results were expected, a more interesting finding was that for those who primarily worked evenings or nights, the risk for sleeping less than 6 hours was 14 times greater than for day-shift officers; also, compared to officers sleeping at least 6 hours, officers sleeping less than 6 hours showed more than a twofold increase in risk for poor quality sleep. These data are supported by other studies associating shift work with short sleep duration and poor sleep quality (Harma, Sallinen, Ranta, Mutanen, & Muller, 2002; Pilcher, Lambert, & Huffcutt, 2000) and corroborate Kudielka et al. (2007) finding that the sleep of night-shift workers was often more deprived.

As few as six consecutive nights of poor sleep can precipitate biological changes, including mild inflammation linked to cardiovascular disease (Frey, Fleshner, & Wright, 2007; Spiegel et al., 2004). Moreover, DiMilia and Mummery (2009) found BMI was significantly higher for day workers than those who rotated shifts ( $p < .001$ ). These data indeed show officers displayed elevated levels of CRP ( $> 3.0$  mg/L); the researchers hypothesized that elevated CRP levels are, in part, caused by poor sleep combined with overweight and obesity, which is consistently demonstrated among police officers (Windgassen, Funtowicz, Lunsford, Harris, & Mulvagh, 2011). Nevertheless, the researchers found that BMIs did not significantly correlate with shift worked. Although day-shift officers had higher BMIs than those on other shifts, this difference was not statistically significant. These unexpected results might be affected by the number of senior officers opting for placement on the day shift and the fact that weight correlated with age. In this study, the average age of day-shift officers was 44.4 years ( $SD = 8.5$ ), compared to 34.9 years ( $SD = 7.1$ ) for non-day-shift officers. Finally, on average, vital exhaustion summary scores were higher for officers sleeping less than 6 hours per day. This finding is supported by other studies that suggested poor sleep and short sleep (with resultant fatigue) may be related to psychological stress (Ramey et al., 2003, 2008, 2009; Ramey, Downing, et al., 2011). As measured by the Vital Exhaustion Scale, poor sleep and short sleep can cause extreme fatigue. Although vital exhaustion did not differ statistically between the groups in this study, it remains important to consider because vital exhaustion can predict up to 30% of first cardiac events (Kop, Hamulyak, Pernot, & Appels, 1998; Prescott et al., 2003; von Kanel, Frey, & Fischer, 2003).

#### LIMITATIONS AND FUTURE DIRECTION

Several limitations may affect study findings. First, sleep data were extracted from self-reported measures, which may not be specific and accurate. Also, the direction of causality among variables was not studied. Further, those who volunteered for the study may not represent the population as a whole because some officers with known health risks may have elected not to participate (Sepulveda, Goetz, & Grana, 1994). The participation

rate, however, exceeded 70%, so the study sample likely represented the departments' membership in its entirety, thus reducing bias. The researchers limited analysis to male officers because data were collected on a group of only 10 female officers; the number 10 was judged insufficient to compare results to those for male officers. Also, the analysis was limited to descriptive statistics and bivariate correlations. In the future, a multivariate analysis could include indirect as well as direct causal influences of variables such as physical activity, smoking, age, and diet. This study also did not query additional employment outside of law enforcement, so hours worked per week may have been underestimated. Another possible limitation is that the officers in this study worked in a relatively low crime area, which might restrict the range of some variables (e.g., stress and vital exhaustion) (U.S. Census Bureau, 2011). Indeed, in metropolitan areas in 2008, the violent crime rate per 100,000 population was approximately twice that of non-metropolitan counties (U.S. Census Bureau, 2011). Finally, the sample size for this study may have affected the significance of some variables; perhaps significance could be reached with a larger sample size.

#### IMPLICATIONS FOR PRACTICE

Police work long days, overtime, and multiple shifts. Compared to day-shift officers, non-day-shift officers were more likely to sleep less than 6 hours per day, and those who slept less than 6 hours per day were more than twice as likely to experience poor sleep than those who slept more hours. Non-day officers also worked back-to-back shifts more often. In this group of officers, CRP, overweight and obesity, perceived stress, and vital exhaustion did not correlate significantly with sleep duration or shift worked.

Short and poor sleep might be precursors to obesity and inflammatory changes that lead to cardiovascular disease. Studies should be considered with larger sample sizes to better understand the relationship among sleep, obesity, cardiovascular disease, and biomarkers (e.g., CRP). Additional data would be useful in developing strategic nursing interventions that encourage 7 to 8 hours of sleep per night (Buxton & Marcelli, 2010). This study further confirmed the impact of shift work on law enforcement officers and the importance of sleep as a modifiable risk factor for police. In the future, experimental studies should determine if a causal link exists between sleep patterns and disease risk.

The role and scope of the occupational health nurse working with law enforcement and correctional facilities is changing. Occupational health nurses must be aware of this study's findings because they are expected to develop interventions to address modifiable risk factors such as sleep. Further, occupational health nurses may make recommendations to employers based on evidence-based assessments.

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