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Atypical Work Hours and Metabolic Syndrome Among Police Officers

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ABSTRACT. This study examined whether atypical work hours are associated with metabolic syndrome among a random sample of 98 police officers. Shift work and overtime data from daily payroll records and reported sleep duration were obtained. Metabolic syndrome was defined as elevated waist circumference and triglycerides, low HDL cholesterol, hypertension, and glucose intolerance. Multivariate analysis of variance and analysis of covariance models were used for analyses. Officers working midnight shifts were on average younger and had a slightly higher mean number of metabolic syndrome components. Stratification on sleep duration and overtime revealed significant associations between midnight shifts and the mean number of metabolic syndrome components among officers with less sleep ($p = .013$) and more overtime ($p = .007$). Results suggest shorter sleep duration and more overtime combined with midnight shift work may be important contributors to the metabolic syndrome.

KEYWORDS: cardiovascular disease, overtime, police officers, shift work, sleep

There are approximately 861,000 police officers in the United States.[1] Shift work is an integral part of law enforcement and overtime is common in police work worldwide. Police officers have reported that shift work and overtime are among the most difficult requirements of their job.[2,3]

Despite the prevalence of atypical work hours, little research has been done regarding the potential health outcomes of such schedules on police officers. Previous research has suggested that police officers are at increased risk for cardiovascular disease (CVD),[4–14] yet the association of shift work and overtime with CVD has not been adequately explored. The present study investigated whether shift work is associated with CVD risk among police officers and whether short sleep duration and overtime further exacerbate this association. The metabolic syndrome, a cluster of CVD-related health components, has been suggested as a viable approach to defining CVD risk.[15]

The metabolic syndrome, shift work, and overtime

The National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) put forth guidelines for proposed definitions of the metabolic syndrome in adults to aid in diagnosis and suggestion of preventive interventions for this syndrome. These guidelines define metabolic syndrome as abnormalities in any 3 or more of the following clinical measures: waist circumference (abdominal obesity),

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triglycerides, HDL cholesterol, blood pressure, and fasting glucose level.[16]

Previous studies have suggested that shift work is associated with the metabolic syndrome. Knutsson and Boggild[17] reported that shift work affects a number of metabolic components such as triglycerides, cholesterol, body mass index (BMI), abdominal fat distribution, and coagulation. Karlsson, Knutsson, and Lindahl[18] found that obesity, high triglycerides, and low concentrations of HDL cholesterol seem to cluster together more often in shift workers than in day workers. Lasfargues et al[19] found night-shift workers to have significantly higher levels of triglycerides, smoking, and obesity than controls. Sookian et al.[20] concluded that shift workers had an increased risk of the metabolic syndrome independent of age and physical activity. In a review of the literature, Wolk and Somers[21] found that the weight of evidence suggested that sleep deprivation and shift work independently lead to the development of both insulin resistance and individual components of the metabolic syndrome. Other studies found the metabolic effects of shift work to include abdominal obesity, lower HDL cholesterol and higher triglycerides, and changes in glucose intolerance.[22–24]

To summarize, prevous studies have suggested that shift work and overtime may contribute to an increased risk of CVD associated with several or all components of the metabolic syndrome. Police officers are an understudied population concerning increased CVD risk. The present study examines whether shift work is associated with the metabolic syndrome among police officers and whether overtime and short sleep duration modify this association.

METHODS

Participants

A midsized urban police department was selected as the sample site. This cross-sectional study includes 115 randomly selected police officers (from a total of 934 officers), with an oversampling of women. Randomization was performed using a computer-generated random number table. No specific inclusion criteria were indicated for the study other than that the participant was a sworn police officer. Thirteen participants with missing metabolic syndrome data and 4 officers with insufficient work history data were excluded, leaving a final sample of 98 police officers (61 men and 37 women) with complete data. See Violanti et al[25] for a complete review of similar methodology used in a subsequent study.

Study measures were obtained at the Center for Preventive Medicine clinic as the research site. Participants provided a medical history and were required to fast 12 hours prior to a blood draw. A blood sample was taken from participants between 7:00 AM and 9:00 AM by a professional phlebotomist at the research site clinic. Blood parameters involved in the metabolic syndrome were measured by standard laboratory techniques. Anthropometric measures were conducted by clinic personnel trained specifically for this study. Three separate measurements of systolic and diastolic blood pressure were obtained with a standard sphygmomanometer. Quality assurance measures were conducted for blood parameters, blood pressure, and anthropometric measures on a regularly scheduled basis and were within acceptable limits. Questionnaires were administered to collect demographic and lifestyle information on education, rank, martial status, physical activity, sleep duration, smoking, and alcohol use. Shift-work and overtime data were obtained from payroll records at the city municipal records center with permission from the police department.

All participants were asked to sign a consent form if they desired to volunteer for the study and were advised that they could withdraw at any time. The study was fully explained to participants and any questions were answered. The Internal Review Board of the State University of New York at Buffalo approved the study.

Measures

Shift Work and Overtime

The research staff used daily payroll records of the police officers to develop an objective measure of shift work and overtime for this study. Shift-work and overtime information was compiled for each officer for every day of the most recent 5 years of their career. Work history data, from 1994 to date of exam at baseline (1999–2000), were available for 98 officers. All shifts worked over the 5-year period were categorized on the basis of start times of 4:00 AM to 11:59 AM for the day shift, noon to 7:59 PM for the afternoon shift, and 8:00 PM to 3:59 AM for the midnight shift. Taking into account the length of time a participant was working (i.e., from first date of work or the date when records were first available to date of exam at baseline), we standardized the computed hours on a weekly basis (hours worked per week) and calculated the percentage of total hours worked on each shift. Officers were then classified into 1 of the 3 shifts on the basis of whichever shift had the largest percentage of hours worked for a given officer. Officers' normal work shifts were 10 hours long. Thus, nearly all of the midnight shift workers were forced to sleep during the daylight hours, which would interfere with both the quality and duration of sleep.[26] Overtime was defined differently in this cohort when compared with the conventional definition of >40 hours/week; it consisted of any extra hours worked before/after assigned shifts and during the weekends and personal leave. Overtime was also dichotomized using the median of 1.7 hours per week (< 1.7 vs ≥ 1.7).

Sleep Duration

Sleep duration was measured to address the extent to which work hours may have disrupted sleep patterns. Sleep duration was ascertained by questionnaires that asked for the average hours of sleep obtained each day during the past 7 days. A dichotomous variable was created for sleep duration (< 6 vs ≥ 6 hours/day), in which poor sleep was considered as <6 hours/day.

Metabolic Syndrome

Metabolic syndrome component measures were based on the NCEP ATP III guidelines[16] with recent modifications from the American Heart Association and the National Heart, Lung, and Blood Institute.[15] Waist circumference was measured in centimeters as abdominal girth at the highest point of the iliac crest and the lowest part of the costal margin in the midaxillary line (Violanti et al, 2006).[25] Levels of triglycerides, HDL cholesterol, and glucose were measured from fasting blood specimens. The average of the second and third of 3 resting systolic and diastolic blood pressure readings was used. To satisfy the criteria for glucose intolerance and hypertension, the participant could either (1) have an elevated blood level based on set criteria or (2) report having the condition (hypertension or diabetes) and report being treated for that condition. The participant was considered to have metabolic syndrome if 3 or more of the 5 components were present. Number of syndrome components varied from 0 (*none present*) to 5 (*all present*).

Statistical methods

Descriptive statistics were used to characterize the study population. The mean number of metabolic syndrome components along with p values for differences across the 3 levels of shift work were determined using analysis of variance and analysis of covariance models. Poisson regression analyses relating shift work to individual metabolic syndrome components were used to compute estimated prevalence ratios and their 95% confidence intervals. Both unadjusted and adjusted models were examined. Multivariable adjustment included age, gender, education, marital status, smoking, alcohol intake, police rank, and physical activity. To determine if total hours of sleep and overtime modify the association between shift work and metabolic syndrome, stratification and tests for interaction were used. All analyses were conducted using the SAS software, Version 9.1 (SAS Institute, Cary NC).[27]

RESULTS

Demographic and lifestyle characteristics of the participants are shown by shift-work category in Table 1. Officers working afternoon and midnight shifts were on average younger than day-shift workers (36.9, 36.5, and 42.6 years for

Table 1.—Demographic and Lifestyle Characteristics, by Shift Work

	Day				Afternoon				Midnight				Total			
Characteristic	*n*	*M*	*SD*	%	*n*	*M*	*SD*	%	*n*	*M*	*SD*	%	*n*	*M*	*SD*	%
Age (years)	46	42.6	8.1		32	36.9	6.3		20	36.5	5.8		98	39.5	7.6	
Sex																
Female	27			58.7	7			21.9	3			15.0	37			37.8
Male	19			41.3	25			78.1	17			85.0	61			62.2
Education																
≤ High school/GED	9			19.6	6			18.7	4			20.0	19			19.4
College < 4 years	12			26.1	11			34.4	7			35.0	30			30.6
College 4+ years	25			54.3	15			46.9	9			45.0	49			50.0
Marital status																
Single	10			21.7	5			15.6	6			30.0	21			21.4
Married	27			58.7	24			75.0	12			60.0	63			64.3
Divorced	9			19.6	3			9.4	2			10.0	14			14.3
Smoking status																
Current	8			17.4	6			18.8	6			31.6	20			20.6
Former	15			32.6	11			34.4	5			26.3	31			31.9
Never	23			50.0	15			46.8	8			42.1	46			47.4
Alcoholic drinks/week																
None	12			26.1	6			18.8	6			30.0	24			24.5
Mild	12			26.1	8			25.0	2			10.0	22			22.5
Moderate	15			32.6	15			46.9	12			60.0	42			42.8
High	7			15.2	3			9.3	0			0	10			10.2
Physical activity	46	9.1	12.3		32	11.3	13.0		20	16.0	28.9		98	11.2	17.2	
Total hours of sleep	46	6.1	2.0		32	6.1	1.6		20	6.1	1.0		98	6.1	1.7	
Hours overtime	46	2.5	1.9		32	2.1	1.6		20	2.3	2.0		98	2.3	1.8	
Rank																
Police officer	24			53.3	22			68.8	17			85.0	63			64.9
Sergeant/Lieutenant	9			20.0	4			12.5	2			10.0	15			15.5
Captain/Detective	12			26.7	6			18.7	1			5.0	19			19.6

Table 2.—Criteria and Prevalence of Metabolic Syndrome and Its Components

Syndrome component	n	%
Elevated waist circumference (≥ 102 cm in men, ≥ 88 cm in women)	30	30.6
Elevated triglycerides (≥ 150 mg/dL)	15	15.3
Reduced HDL cholesterol (< 40 mg/dL in men, < 50 mg/dL in women)	3	38.8
Glucose intolerance (fasting glucose ≥ 100 mg/dL or diabetic medication use)	21	21.4
Hypertension (systolic blood pressure ≥ 130 mm Hg, diastolic blood pressure ≥ 85 mm Hg, or antihypertensive medication use)	15	15.3
Metabolic syndrome		
0 components	37	37.8
1 component	30	30.6
2 components	15	15.3
3 or more of 5 components	16	16.3

afternoon-, midnight-, and day-shift workers, respectively). The majority of those working afternoon and midnight shifts were male (78.1% and 85%, respectively) and at the rank of police officer (68.8% and 85.0%, respectively) compared with smaller percentages of day-shift workers who were male (41.3%) and at the rank of police officer (53.3%).

Table 2 presents the prevalence and number of metabolic syndrome components among this police sample. The most prevalent individual component was reduced HDL cholesterol (38.8%), followed by elevated waist circumference (30.6%) and glucose intolerance (21.4%).

Table 3 presents the mean number of unadjusted and adjusted metabolic syndrome components by shift type. Officers working the midnight shift had the highest mean number of unadjusted metabolic syndrome components (1.70; SD 1.34) compared with officers working the day (0.97; SD 1.27) and afternoon (1.25; SD 1.37) shifts. Although the differences among these means were not statistically significant, this result suggests that the highest mean number of metabolic syndrome components occurred on midnight shiftsin this sample. Adjustments for multiple lifestyle and demographic variables did not appreciably attenuate the magnitude of this difference.

The prevalence of each metabolic syndrome component is presented across the 3 shifts in Table 4. Prevalence of elevated waist circumference, low HDL cholesterol, hypertension, and the composite metabolic syndrome tended to be highest for midnight-shift officers. Prevalence ratios comparing afternoon and midnight to day shift are also presented for each of the metabolic syndrome components. Significantly elevated prevalence ratios (PR) were observed for elevated waist circumference, with the highest value for midnight shifts (PR = 2.30; 95% confidence interval (CI) = 1.20–4.41). Adjustment for age, gender, and other demographic and lifestyle variables increased the prevalence ratio indicating a nearly 4-fold greater prevalence of elevated waist circumference among officers working the midnight shift compared with those on the day shift (PR = 3.98; 95% CI = 1.72–9.22; $p = .001$). Prevalence ratios for low HDL cholesterol comparing midnight versus day shift were significantly higher (PR = 2.07; $p = .047$) after adjustment for age and gender and were slightly attenuated with further adjustment. A nearly significant prevalence ratio was observed for metabolic syndrome (PR = 2.76; $p = .062$) comparing the midnight with the day shift, although this was attenuated with adjustment for demographic and lifestyle characteristics.

Table 3.—Mean Number of Metabolic Syndrome Components, by Shift Work

	Day (n = 46)		Afternoon (n = 32)		Midnight (n = 20)		
Variable	M	SD or SE	M	SD or SE	M	SD or SE	p
Unadjusted	0.97	1.27	1.25	1.37	1.70	1.34	.127
Sex adjusted	1.15	0.19	1.12	0.23	1.51	0.29	.523
Age and sex adjusted	1.04	0.21	1.20	0.24	1.62	0.30	.328
Multivariable adjusted[a]	0.79	0.26	1.00	0.28	1.48	0.34	.213

Note. Values are means standard deviations for the unadjusted model and means and standard errors for the adjusted models; p value is for differences among means.
[a]Adjusted for gender, age, smoking status, alcohol intake, education, marital status, rank, and physical activity score.

Table 4.—Prevalence and Prevalence Ratios of Metabolic Syndrome Components, by Shift Work

			Unadjusted			Sex and age adjusted			Multivariable adjusted		
MS components and shift	*n*	%	PR	*p*	95% CI	PR	*p*	95% CI	PR	*p*	95% CI
Elevated waist circumference				.012			.050			.001	
Day	46	23.9	1.00		Referent	1.00		Referent	1.00		Referent
Afternoon	32	25.0	1.05		0.47–2.31	1.04		0.45–2.40	1.34		0.60–2.98
Midnight	20	55.0	2.30		1.20–4.41	2.23		1.00–4.97	3.98		1.72–9.22
Low HDL cholesterol				.116			.047			.079	
Day	46	30.4	1.00		Referent	1.00		Referent	1.00		Referent
Afternoon	32	43.8	1.44		0.79–2.59	1.76		0.91–3.39	1.70		0.92–3.14
Midnight	20	50.0	1.64		0.88–3.05	2.07		1.01–4.24	1.90		0.93–3.88
High triglycerides				.831			.516			.202	
Day	46	13.0	1.00		Referent	1.00		Referent	1.00		Referent
Afternoon	32	18.8	1.44		0.51–4.06	0.91		0.33–2.54	0.62		0.19–2.03
Midnight	20	15.0	1.15		0.32–4.15	0.68		0.21–2.20	0.37		0.08–1.70
Glucose intolerance				.341			.639			.363	
Day	46	15.2	1.00		Referent	1.00		Referent	1.00		Referent
Afternoon	32	28.1	1.85		0.77–4.45	1.53		0.68–3.43	1.51		0.62–3.65
Midnight	20	25.0	1.64		0.59–4.56	1.26		0.48–3.32	1.69		0.55–5.20
Hypertension				.341			.988			.867	
Day	46	15.2	1.00		Referent	1.00		Referent	1.00		Referent
Afternoon	32	9.4	0.62		0.17–2.20	0.41		0.09–1.71	0.37		0.09–1.54
Midnight	20	25.0	1.64		0.59–4.56	1.01		0.29–3.48	0.91		0.30–2.76
Metabolic syndrome				.062			.199			.510	
Day	46	10.9	1.00		Referent	1.00		Referent	1.00		Referent
Afternoon	32	15.6	1.44		0.45–4.56	1.13		0.36–3.55	0.88		0.27–2.84
Midnight	20	30.0	2.76		0.95–8.00	2.01		0.69–5.84	1.57		0.41–5.95

Note.% = prevalence; PR = prevalence ratio; CI = confidence interval; *p* values tested whether PRs for the midnight shift are significantly different from the day shift (referent group). Multivariable adjusted was adjusted for gender, age, smoking, education, alcohol intake, education, marital status, police rank, and physical activity.

The potential effect modification of sleep duration and overtime on the association between shift work and the metabolic syndrome is shown in Table 5. Among officers reporting less than 6 hours of sleep per night, the mean number of metabolic syndrome components was significantly higher for those officers who worked midnight shifts compared with those who worked day shifts (2.65 and 0.59, respectively; $p = .013$). After adjustment for gender, age, and demographic and lifestyle variables, the mean number of metabolic syndrome components was also significantly higher for officers who worked the midnight shift compared with those working the day shift, yet only among those who worked more than the median number of overtime hours per week (> 1.7 hours). Adjustment for age, gender, and demographic and lifestyle characteristics revealed a more than 4-fold greater number of metabolic syndrome components in officers classified as working the midnight versus the day shift (2.88 and 0.65, respectively; $p = .007$). Tests for interaction were not statistically significant for sleep duration, yet were of borderline significance for overtime.

COMMENT

The results suggest that police officers working midnight shifts combined with either shorter sleep duration or increased overtime may be at an increased risk for metabolic syndrome. The prevalence of metabolic syndrome among officers working the midnight shift was higher than that found in the National Health and Nutrition Examination Survey (NHANES III) 1988–1994.[28] NHANES III overall prevalence of metabolic syndrome was 21.8%, whereas officers in our sample working midnight shifts had an overall prevalence of 30%. In addition, officers who worked the midnight shift were on average younger than those officers who worked the day shift (36.5 and 42.6 years, respectively). The NHANES national prevalence of metabolic syndrome was 24% for those in this younger comparable age range (30–39 years). This slightly higher prevalence at a younger age coincides with police mortality cohort studies, which found a higher risk of CVD among younger officers,[13] an infrequent result in healthy worker populations. Officers on the other 2 shifts had a lower prevalence of metabolic syndrome compared with the population sample reflected in NHANES data. One potential explanation for this unusual finding is that midnight-shift officers were most likely to be sleep deprived because of difficulties associated with day sleeping,[26] and sleep debt has been shown to have a harmful impact on carbohydrate metabolism and endocrine function that could contribute to metabolic disorders.[29]

Table 5.—Adjusted Mean Values of MS Components by Shift Work, Stratified by Sleep Duration and Overtime Work

	< 6 hours of sleep/day							≥ 6 hours of sleep/day							
	Day ($n = 13$)		Afternoon ($n = 10$)		Night ($n = 8$)			Day ($n = 33$)		Afternoon ($n = 22$)		Night (n 12)			Interactive
	M	*SE*	*M*	*SE*	*M*	*SE*	*p*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*p*	*p*
Sex adjusted	1.18	0.39	1.64	0.43	2.04	0.48	.430	1.13	0.23	0.88	0.27	1.19	0.37	.715	.692
Sex and age adjusted	1.13	0.41	1.67	0.43	2.08	0.50	.388	1.02	0.25	0.98	0.29	1.32	0.39	.747	.784
Multivariable adjusted	0.59	0.54	0.99	0.53	2.65	0.60	.013	0.68	0.35	0.85	0.41	0.96	0.44	.863	.595

	Overtime (hours/week) < Median (1.7)							Overtime (hours/week) ≥ Median (1.7)							
	Day ($n = 24$)		Afternoon ($n = 17$)		Night ($n = 10$)			Day ($n = 22$)		Afternoon ($n = 15$)		Night ($n = 10$)			Interactive
	M	*SE*	*M*	*SE*	*M*	*SE*	*p*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*p*	*p*
Sex adjusted	1.37	0.26	1.07	0.31	0.79	0.40	.493	0.91	0.29	1.18	0.34	2.21	0.41	.046	.067
Sex and age adjusted	1.18	0.27	1.24	0.30	0.97	0.40	.847	0.78	0.32	1.29	0.35	2.36	0.43	.030	.055
Multivariable adjusted	0.84	0.37	0.79	0.44	0.88	0.47	.978	0.65	0.47	1.23	0.49	2.88	0.60	.007	.200

Note. Multivariable adjustment for gender, age, smoking status, alcohol intake, education, martial status, physical activity, and rank.

The prevalence of an elevated waist circumference for women and men in NHANES III was nearly 50% and 30%, respectively. In our police sample, the combined prevalence of elevated waist circumference was 55% for those working midnight shifts, higher than NHANES III levels and day- or afternoon-shift workers. Prevalence of low HDL cholesterol levels was approximately 38% in women and 35% in men in NHANES, whereas low HDL prevalence in our combined police sample was 50% among those working midnight shifts. Prevalence of hypertension and glucose intolerance for officers working midnight shifts was also higher than found in NHANES.[28,30]

The significantly elevated prevalence ratio for abdominal obesity, comparing midnight to day shifts found in this study, may be indicative of future health problems among officers. Ford et al[28] predicted that the increase in obesity in the United States since the NHANES data were collected (1988–1994) would lead to a higher prevalence estimate of metabolic syndrome. Ford further commented that even if obesity prevalence remained unchanged, the total number of individuals in the United States with metabolic syndrome would increase because of population growth in the 1990s.[28]

After adjustment for gender, age, and demographic and lifestyle variables, the mean number of metabolic syndrome components was significantly higher for officers who worked the midnight shift and an increased median number of overtime hours per week (> 1.7 hours). Overtime is thought to involve the same metabolic mechanisms suggested for shift work and CVD. Falger and Shouten[31] found that self-reported overtime led to a 2-fold excess risk for acute myocardial infarction after adjusting for smoking, age, education, and self-reported exhaustion. Sokejima and Kagamimori[32] reported a significant increased risk for heart attacks with a larger increase in working hours during the year prior to the event. Liu et al[33] reported that 61 or more hours of work per week and less than 2 days off a month increased the odds of CVD 2-fold or more. Sokejima and Kagamimori[32] observed a U-shaped relationship: as compared with 7 to 9 hours of work per day, higher risk was associated with both shorter hours (less than 7 hours per day) and longer hours (more than 11 hours per day). Iwasaki et al[34] reported significantly elevated systolic blood pressure in salesmen whose combined commute and work hours exceeded 61 hours per week. Hayashi et al[35] observed increased blood pressure in groups of white collar employees working 84 to 96 mean hours of overtime per month.

Officers who worked midnight shifts and had less than 6 hours sleep had a significantly higher mean number of metabolic syndrome components than did those who worked day shifts (multivariate adjusted). This finding concurs with other research concerning sleep deprivation and shift work. Karlsson et al[18] found that sleep deprivation is a common denominator in most forms of shift work and has serious metabolic and cardiovascular consequences. Hall et al[36] found that adults between the ages of 30–54 years with 6 or fewer hours of sleep were at increased risk for cardiovascular disease and components of the metabolic syndrome (hypertension, weight increase, and adverse changes in glucose metabolism). Sleep duration was significantly related to waist circumference, BMI, percentage of body fat, serum levels of insulin and glucose, and insulin resistance.

Strengths of the present study include the standardized collection of medical data performed at a single clinic site by trained staff using standardized protocols and equipment. Use of standard criteria for the metabolic syndrome enabled comparisons with other populations. Objective shift work and overtime data were collected from actual work records instead of from self-reported information. Limitations of this study include a restricted sample size and its cross-sectional study design, which precludes the possibility of establishing directional or causal relationships. The choice of a unique healthy working population (police officers) somewhat reduces generalizability to the population at large; however, this sector is representative of a large component of the US workforce.

We were unable to sufficiently examine female police officers in a separate analysis because of the small number of women who worked midnight shifts ($N = 3$). There is a paucity of research on policewomen and the effects of atypical work hours on their health and well-being. Results from the 1999–2000 NHANES study indicated a sharp increase in the prevalence of metabolic syndrome among women, the age-adjusted prevalence rate increasing by 23.5%. Corresponding increases in men were much smaller and not statistically significant.[37] Future work with a larger sample size of female police officers would address the need for research in this area.

Determining the presence or absence of metabolic syndrome components in a high-risk occupational cohort of police officers provides beneficial information on a workforce that is self-selected into their occupation based on good overall physical and mental health. Exploring specific associations such as these involving shift work and CVD adds to the benefit of such investigations. Preventing future diabetes and CVD through efforts focused on the metabolic syndrome and its components could be a worthwhile strategy. Information gained through this study may be useful to aid further investigation of not only police officer health, but also the health of those in other first-responder occupations. Examples are firefighters, emergency medical technicians, nurses, physicians, air traffic controllers, and the military. Results of this study and possible future prospective studies may add to existing knowledge of associations between shift work and cardiovascular health in high-risk occupations.

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