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Long Work Hours and Adiposity Among Police Officers in a US Northeast City

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Abstract

Objective—To investigate the associations between long work hours and adiposity measures in police officers.

Methods—Participants included 408 officers from the Buffalo Cardio-Metabolic Occupational Police Stress study who were examined between 2004 and 2009. Total work hours were abstracted from payroll records and questionnaires. Analysis of variance and covariance models were used.

Results—Among male officers who worked the midnight shift, mean values of waist circumference and body mass index increased with longer work hours after adjustment for age, physical activity, energy intake, sleep duration, smoking status, police rank, activities after work (eg, child/family care, sports), and household income. Adiposity measures were not associated with work hours among women on any shift.

Conclusion—Working longer hours was significantly associated with larger waist circumferences and higher body mass index among male police officers working the midnight shift.

There were approximately 883,000 law enforcement officers in the United States[1] employed in the local, state, and federal governments in 2008. Officers work 24 hours a day, 7 days a week, patrolling communities, responding to emergencies, investigating cases, performing first aid at accidents, and solving problems in their communities. Many officers work long hours and difficult shiftwork schedules, and these exposures may impair their health. Adverse health effects include circadian disruption,[2] inadequate sleep,[3] psychological disorders,[4] metabolic disorders,[5,6] type 2 diabetes,[7] and cardiovascular disease.[8] The prevalence of obesity among police officers seems to be comparable with that of the general

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US population.[9] Caban and colleagues[10] showed that, for male police officers and firefighters, the obesity rate was the second highest among 41 occupational categories, and the annual change in obesity prevalence was two times higher than for the US population in the period from 1997 to 2002. A recent police cohort study[11] revealed that the prevalence of obesity was 33.6% among North American police officers. Vila,[12] in his review article, showed that police officers who were exposed to long work hours and shiftwork were pessimistic about their health and safety, and because of their fatigue, their work might have a negative impact on the communities they served.

Several recent studies[13,14] showed that obesity is more prevalent in night-shift workers than in day-shift workers. Bushnell et al[13] reported that those who worked 8- or 10-hour night shifts had significantly higher obesity rates than those working 8 hours on the day shift. Chen et al[14] concluded that working 12 hours on night shifts was associated with increased body mass index (BMI) and waist circumference among female clean-room workers for electronic semiconductor production.

In addition to shiftwork, many researchers revealed that long working hours may contribute to obesity if workers had decreased physical activity and fewer meals at home and consumed more fast food or pre-prepared processed food.[15–17] Escoto et al[17] showed that transit workers with long work hours had elevated obesity and poor dietary habits. Several studies reported that long work hours are related to heart disease. A Danish cohort study[18] revealed that men working long hours who also engaged in low (vs high) physical activity were at increased risk of ischemic heart disease. A British cohort study[19] also confirmed elevated rates of coronary heart disease among workers undertaking overtime work.

There are relatively few published studies about police work hours and health outcomes. Therefore, the main aim of this study was to investigate the relationship between long work hours and several measures of obesity among police officers working in a northeastern US metropolitan area. A secondary aim was to determine if shiftwork status modifies the association between long work hours and obesity.

METHODS

Study Setting and Population

The Buffalo Cardio-Metabolic Occupational Police Stress study was conducted to investigate associations between occupational stressors and cardiovascular disease in the high-stress occupation of police work. The total workforce in the Buffalo Police Department was approximately 710 officers who were employed when the study began in 2004. No specific inclusion criteria were used for the study other than participants being sworn police officers and willing to participate in the study.

The Center for Preventive Medicine, State University of New York at Buffalo, School of Public Health and Health Professions, Buffalo, New York, was the site of the data collection. Informed consent was obtained from all participants and the study protocol was approved by the internal review board of the State University of New York at Buffalo and the National Institute for Occupational Safety and Health Human Subjects Review Board.

Among 710 active duty officers in the Buffalo Police Department, 464 agreed to participate and were examined between 2004 and 2009 in the Buffalo Cardio-Metabolic Occupational Police Stress study. The study design and population have been described by Hartley et al.[5] Among the 464 officers, 56 were excluded: those who did not have complete payroll records (n = 34) and those who did not have any adiposity information (n = 22). Therefore, 408 participants, 300 men and 108 women, were included in this analysis.

Assessment of Adiposity

The measurements for adiposity used were waist circumference, BMI, abdominal height, and percent body fat. Waist circumference was measured at the midpoint between the lowest part of the costal margin in the mid-axillary line and the highest point of the iliac crest. The average value of two measurements rounded to the nearest 0.5 cm was used in analyses. If the two measurements had a difference of more than 0.5 cm, a third measurement was performed, then the average of the two measurements that were most similar was used. Abdominal height was measured using a sagittometer, a sliding beam caliper with a ruler, at the level of the iliac crest with participants in the supine position. The average value of the three measurements of abdominal height to the nearest 0.1 cm was used for the abdominal height. Body mass index was calculated as weight in kilograms divided by height in meters squared. Weight and height were measured without shoes and recorded to the nearest 0.25 lb and the nearest 0.5 cm, respectively. Dual energy x-ray absorptiometry was used to obtain information about bone density and body fat composition. Dual energy x-ray absorptiometry measurements were obtained using the Hologic QDR-4500A device (Hologic, Waltham, MA).[20] Duplicate measurements on 40 officers allowed calculation of coefficients of variation, which were 1.4%, 0.9%, and 0.5% for total fat mass, bone mass, and bone density, respectively. Daily manufacturer quality control phantom measurements ensured no drift. During recruitment no software upgrades occurred. Percent body fat was calculated by summing body fat mass measurements for all dual energy x-ray absorptiometry segments and dividing by total body mass.

Body mass index is widely used for measurement of obesity. It is a rough measure of body fatness, but not an ideal measurement because the relationship between BMI and percent body fat differs among racial/ethnic groups.[21] Waist circumference and abdominal height also have been used as predictors of obesity-related health risk, metabolic syndrome,[22] coronary heart disease,[23,24] and chronic respiratory disease.[25]

Assessment of Work Hours

Total hours of work per week was estimated as the sum of work hours from two sources of activities: average hours per week for police work derived from Buffalo City daily payroll records (1994 to date of examination) and reported hours per week from a second job (if any). The work hours of police duty derived from payroll records included hours spent at regularly scheduled work time, court time, and overtime. The work hours from a second job was determined by asking each participant, “Do you work a second job? If yes, how many hours a week do you work at your second job?”

Assessment of Covariates

"Shiftwork" was defined as the dominant shift among day, afternoon, and midnight shifts from payroll records. The time participants started their shift for regular time work was used to classify each record into one of the following three shifts: day shift if the start time is between 4 AM and 11 AM; afternoon shift if the start time is between 12 PM and 7 PM; midnight shift if the start time is between 8 PM and 3 AM. Hours worked during the day, afternoon, and midnight shifts were computed for each participant by summing all records. Taking into account the length of time a participant was working from the first date of payroll records to the date of examination, the computed hours were standardized to hours worked per week and the percentage of total hours worked on each shift was calculated. The shift with the highest percentage was defined as the dominant shift.

Participants were given a self-administered questionnaire to provide information about demographic characteristics (age, sex, education, marital status, and household income) and lifestyle behaviors (smoking status, activities after work, alcohol intake, dietary habits, physical activity, and sleep duration). Participants indicated the number of years employed as a police officer and their present rank in the police force. Participants were asked how often they consumed alcoholic beverages: 12-oz can or bottle of beer, one medium glass of wine, and one shot of liquor. The total number of drinks per month (of each type) was summed and then divided by four to give the approximate number of drinks consumed per week. Annual household income was categorized into three groups: less than $70,000, $70,000 to $90,000, and $90,000 or more. Smoking status was reported as "current," "former," or "never." For activity after work, participants were asked, "What is the first thing you do after your regular shift." Most reported "caring for child/family," "leisure/ sports," or "going to sleep." Participants were asked the frequency of consumption and portion size of each food or beverage over the previous 12 to 24 months to assess individual dietary intake. Energy intake in kilocalories was calculated on the basis of the Food Frequency Questionnaire developed by the Fred Hutchinson Cancer Research Center.[26] Energy intake was calculated from the combination of dietary nutrients such as protein, fat, carbohydrate, and alcohol (energy intake = 4 * protein [g] + 9 * fat [g] + 3.75 * carbohydrate [g] + 7 * alcohol [g]). Physical activity during the previous 7 days was obtained with the Seven-Day Physical Activity Recall questionnaire used in the Stanford Five-City Project.[27] Participants reported the duration (hours per weekday and hours per weekend) and intensity (moderate, hard, and very hard) of three types of physical activity (occupational, household, and sports). The total hours of physical activity was then computed by summing the hours of the three types of physical activity performed during the weekday and weekend.

Statistical Analysis

Descriptive statistics of all variables were obtained using the *t* tests and chi-square tests. To investigate the associations of covariates with adiposity and work hours, Pearson correlation coefficients and chi-square tests were calculated. The association between total work hours and adiposity was analyzed with the generalized linear model stratified by shiftwork and sex. Potential confounders were selected based on their association with both the adiposity measures and total work hours in this study and whether they were reported as confounders in the previous investigations. The selected confounders were age, race, physical activity, energy intake, sleep duration, smoking, police rank, activities after work, and household income. Tests for interaction (criterion for significance, $P < 0.2$) were performed by including interaction terms in the model. We assessed effect modification by sex and shiftwork. All *P* values presented were two-tailed and those less than 0.05 were considered to indicate statistical significance for all analyses except effect modification. We categorized work hours into three groups: fewer than 30, 30 to 39.9, and 40 or more hours/week for male officers and fewer than 30, 30 to 34.9, and 35 or more hours/week for female officers because few female officers worked 40 or more hours per week. Analyses were performed with the use of SAS software, version 9.2 (SAS Institute, Cary, NC).

RESULTS

The study sample included 408 police officers (300 men and 108 women) with an average age of 42.8 years (Table 1). The prevalence of obesity (BMI ≥ 30 kg/m^2) was 40.0% overall, 48.3% in male officers, and 16.7% in female officers. The prevalence of current smoking among women (25.7%) was double that among men (12.7%), whereas alcohol consumption among men (6.2 drinks/week) was about twice that among women (3.4 drinks/week). The average work duration (including a second job) was 37.6 hours/week; women worked an average of 6 hours per week less than men. Nearly 40% of men had a second job compared with 15% of women ($P < 0.001$). Male officers were almost evenly distributed by shiftwork status: day shift (35.3%), afternoon shift (38.3%), and night shift (26.3%); the majority female officers worked on day shift (69.4%). As expected, most adiposity measures were significantly higher in men than in women with the exception of percent body fat. Forty percent of male officers worked more than 40 hours per week whereas only 10% of women did. Approximately half of women spent their time caring for children or helping family members after regular work, but only 23% of men did.

Table 2 shows the unadjusted associations for selected covariates with adiposity measures and hours of work. Age was positively correlated with waist circumference ($r = 0.181$; $P < 0.001$), abdominal height ($r = 0.177$; $P < 0.001$), and BMI ($r = 0.100$; $P = 0.044$), but was not significantly correlated with work hours. Results for years of service and energy intake were similar to those for age. Waist circumference, abdominal height, and BMI were strongly correlated with each other ($r > 0.8$; $P < 0.001$), and each of these parameters was less strongly correlated with percent body fat (*r* values ranged from 0.214 to 0.357; $P < 0.001$) (data not shown). Smoking status was strongly associated with waist circumference ($P < 0.001$), abdominal height ($P < 0.001$), and BMI ($P < 0.001$); never and former smokers tended to have larger adiposity levels. The officers who worked afternoon and night shifts had larger waist circumference ($P = 0.020$), whereas day-shift officers had higher percent body fat. Afternoon shift officers had the longest work hours (40.6 hours/week; $P < 0.001$). Activities after work were significantly associated with most adiposity measures and work hours; the officers who took care of children or family members had smaller waist circumference and BMI, larger percent body fat levels, and fewer work hours.

Table 3 shows the association between work hours and adiposity measures stratified by sex. As mentioned earlier, only 10% of women officers worked 40 or more hours per week. We categorized women's work hours differently from men's (fewer than 30, 30 to 34.9, and 35 or more hours/week) to allow for a more equal distribution in the three categories. In the unadjusted models, work hours were inversely associated with waist circumference among women (mean waist circumference measurements were 84.1 ± 12.7 cm for fewer than 30 hours/week, 80.8 ± 13.2 cm for 30 to 34 hours/week, and 76.2 ± 7.9 cm for 35 or more hours/week; $P = 0.020$). Nevertheless, no significant association was observed between work hours and adiposity measures after adjustment for all covariates.

The associations between work hours and adiposity measures stratified by shiftwork are shown in Table 4 for male officers; the number of female officers in these stratified analyses was limited. Among male officers who worked the midnight shift, mean values of waist circumference significantly increased with longer hours of work (90.4 ± 4.7 cm for fewer than 30 hours/week, 96.8 ± 3.5 cm for 30 to 39 hours/week, and 102.1 ± 3.9 cm for 40 or more hours/week; $P = 0.006$) after adjusting for age, race, physical activity, food intake, sleep duration, smoking status, activities after work, police rank, and household income; whereas the associations were not statistically significant for day- and afternoon-shift officers. Similar results were observed for BMI. Among male officers who worked the midnight shift, mean values of BMI significantly increased with longer work hours (28.1 ± 1.3 kg/m^2 for fewer than 30 hours/week, 30.5 ± 1.1 kg/m^2 for 30 to 39 hours/week, and 32.4 ± 1.3 kg/m^2 for 40 or more hours/week; $P = 0.001$) after risk factor adjustment. Figure 1 shows the relationship for work hours with waist circumference and BMI stratified by shiftwork. Abdominal height and percent body fat were positively associated with work hours among male officers who worked the midnight shift after adjustment for potential confounding from all covariates, but the results did not reach statistical significance (Table 4). There was no association between work hours and adiposity for male officers who worked the day and afternoon shifts. Among male officers, shiftwork significantly modified the associations between work hours and waist circumference (P value for interaction = 0.017) and work hours and BMI (P value for interaction = 0.006).

DISCUSSION

The results of this study indicate that among male police officers who worked the midnight shift, working longer hours was significantly associated with larger waist circumferences and higher BMI. These associations were observed after adjustment for demographic and lifestyle factors such as age, household income, physical activity, energy intake, sleep duration, smoking status, activities after work, and household income. These findings are somewhat consistent with previous studies. Several investigators[17,28,29] have reported that male workers with long work hours had higher BMI. In this study, we did not observe a statistically significant association between shiftwork and adiposity. This is in contrast with several studies[6,13,14] that have found significantly higher levels of adiposity among night-shift workers compared with those working other shifts.

One plausible explanation for the positive association between long work hours and obesity is unhealthy behaviors such as regularly consuming an unhealthy diet. Police officers, especially those working on midnight shifts, may only have available less-than-optimal eating environments such as convenience stores or fast-food shops where high-fat, high-carbohydrate, and high-caloric foods are served.[30] During the past 30 years, the number of fast-food restaurants has increased, and many are open 24 hours a day, 7 days a week. Therefore, police patrol officers on night shifts have easy access to fast foods and fewer alternatives at night. Nocturnal eating may elevate serum total cholesterol levels.[31] In some studies,[15,18,32] low physical activity was associated with overweight and obesity in individuals who worked long hours; however, we adjusted for physical activity. Having a less-than-optimal dietary intake could have contributed to night-shift officers being overweight or obese.

Another possible explanation is dysregulation of the circadian rhythm, which would not be uncommon in police officers who are exposed to a prolonged period of sleep deprivation. Changes in the natural rhythms of the body may reduce the metabolic rate. Changes in the sleep–wake pattern and circadian rhythm disruption could be responsible for the increased adiposity among night workers. Magee et al[28] reported that short sleep mediated the association between long work hours and BMI in male workers. In several recent studies, abnormal sleep patterns and abnormal circadian rhythms were significantly associated with changes in metabolism.[29,33–35]

In other studies, night-shift workers' sleep times were not synchronized to melatonin rhythms, and they had more disruptive sleep and hormonal changes that lead to increased risk of diabetes, obesity, and heart disease.[36,37] This study found that the mean of hours of sleep per day for night-shift officers was significantly lower than for that on the day or afternoon shift. Sleep deprivation could change endocrine hormones that control the hypothalamus and lead to weight gain and obesity. One study[38] revealed that men who restricted night sleep had lower leptin levels, a hormone that suppresses appetite, and had higher ghrelin levels, a hormone that promotes eating. A study by Schmid et al[39] showed similar results as reported in the previous study,[38] indicating that those with short sleep had higher ghrelin levels. A study conducted on the same cohort of police officers by Charles et al[40] observed a U-shaped pattern of leptin levels across sleep duration categories with officers who slept 5.0 to 5.9 hours having the lowest leptin levels. A Canadian study[41] revealed that there was a U-shaped relation between sleep hours and obesity. It is possible that the officers who chronically work on midnight shifts may have a collection of problems: shorter sleep, abnormal leptin and ghrelin levels, increased hunger, less energy expenditure, and lower metabolic rate, which may contribute to overweight and obesity.

Other studies reported that workers exposed to long hours were more stressed,[42–44] and people tend to eat as a way to handle stress.[45–48] In a review article Torres and Nowson[48] concluded that lifetime stress was probably associated with a food consumption behavior oriented toward high calories. Wardle et al[49] reported that workers with high stress and long work hours consumed more energy-dense foods than workers with low stress. Police duty is one of the most stressful of all occupations. Common stressors among police are shiftwork, working overtime, overabundance of paperwork, effects on human relationships involving coworkers and family, danger associated with enforcing the law, and exposure to people in distress and pain.[50–52] Emotional and physical stressors are associated with elevated cortisol levels. Police officers with high levels of post-traumatic stress disorder had higher mean awakening cortisol levels,[53] and cortisol deregulation was found in male officers with metabolic syndrome.[54] Previous studies[55–57] have shown that chronic stress was positively associated with abdominal fat. Thus it is possible that officers who work long hours and also work the night shift may have more psychological stress, which is associated with greater obesity.

About 40% of male officers on midnight shift had a second job. The duration of the second job directly contributes to longer total work hours, which could have adverse consequences on their working environment and health. A study[58] revealed that moonlighting among police officers was associated with higher levels of stress.

Female officers had significantly fewer work hours than male officers. Most female officers (almost 70%) worked on the day shift, and 90% of female officers on day shift worked 40 or fewer hours per week. Previous studies[17,59,60] have shown a U-shaped relationship between work hours and obesity among women where women with full-time employment and longer work hours had increased BMI or weight gain, but women with less than full-time work and fewer work hours also had increased BMI or weight gain. In the present study, no significant associations were observed among women. Schulte et al[61] revealed that long work hours were associated with obesity in men but not in women.

This study has several strengths and limitations. Because it is cross-sectional, we cannot infer causality. In addition, the estimate of total work hours used as our primary predictor may have been inaccurate because it included work hours from a second job, which was self-reported. The small number of female officers in afternoon and night shift may have limited the power to detect the shift-stratified association. The data of this study included some detectives and executive officers (15.1%) who normally work during the day and their experiences might not reflect the experience of solely patrol police officers.

Officers may have been exposed to job stress through lack of support from supervisors, excessive paperwork, interpersonal confrontations, and conflict involving family or friends.[62,63] Future investigations should include measurement of work-related factors and family concerns. Additional research is needed to investigate nutrient factors that could be involved in the elevated adiposity levels of officers, such as meal time and length, frequency of fast-food intake, use of vending machines, and snack or beverage preference. More than 90% of male officers were overweight (BMI $\geq$ 25 kg/m^2) or obese (BMI $\geq$ 30 kg/m^2), and further study should focus on identifying successful weight-control programs in this population.

One of the strengths of this study is that both the actual hours worked and the shift worked were obtained on a daily basis over a minimum of 10 years. It is likely that this provided more objective and accurate measures than would be the case for self-reported measures that are subject to recall. A second strength of the study is that we used four adiposity measurements as outcomes: waist circumference, BMI, abdominal height, and percent body fat. These data confirmed the results of a previous study[64] that reported that BMI, waist circumference, and abdominal height are more highly correlated with each other than with percent body fat (Table 2). Percent body fat provides a more accurate assessment of fat content than the other three measurements. Nevertheless, it has been infrequently used in research studies because of the high cost and time involved in measurement and the need for highly trained personnel. A recent study[65] used percent body fat as a predictor of obesity-related cardiovascular disease risk factors in Korean adults. Using data from the third National Health and Nutrition Examination Survey, Menke and colleagues[66] reported that waist circumference showed the strongest association with cardiovascular disease risk factors among the five adiposity measurements (BMI, total body fat, percent body fat, skin-fold thickness, waist circumference). All adiposity measurements in this study were obtained by trained staff and, therefore, less measurement error would be expected. If information bias in adiposity measures does exist in this study, it would be nondifferential. Most research conducted on police officers has focused on job stress and health outcomes such as depression, anxiety, hypertension, and cardiovascular disease. To our knowledge, this is the first study to focus on the association of work hours with multiple measures of adiposity in police.

CONCLUSIONS

Longer work hours were associated with larger waist circumference and higher BMI among male officers working the midnight shift, but not in male officers who worked the day or afternoon shift. Among female officers, there was no association between long work hours and adiposity for any shift. The results may implicate factors linked with night-shift work such as poor dietary intake, disrupted circadian rhythm, and increased work stress as potential causes of the undesirable levels of adiposity, which in turn might increase the risk of chronic disorders such as hypertension, diabetes, metabolic syndrome, stroke, and coronary heart disease. The positive association of work hours and adiposity in male officers should be confirmed in longitudinal studies, studies with larger sample sizes, and investigations of other populations.

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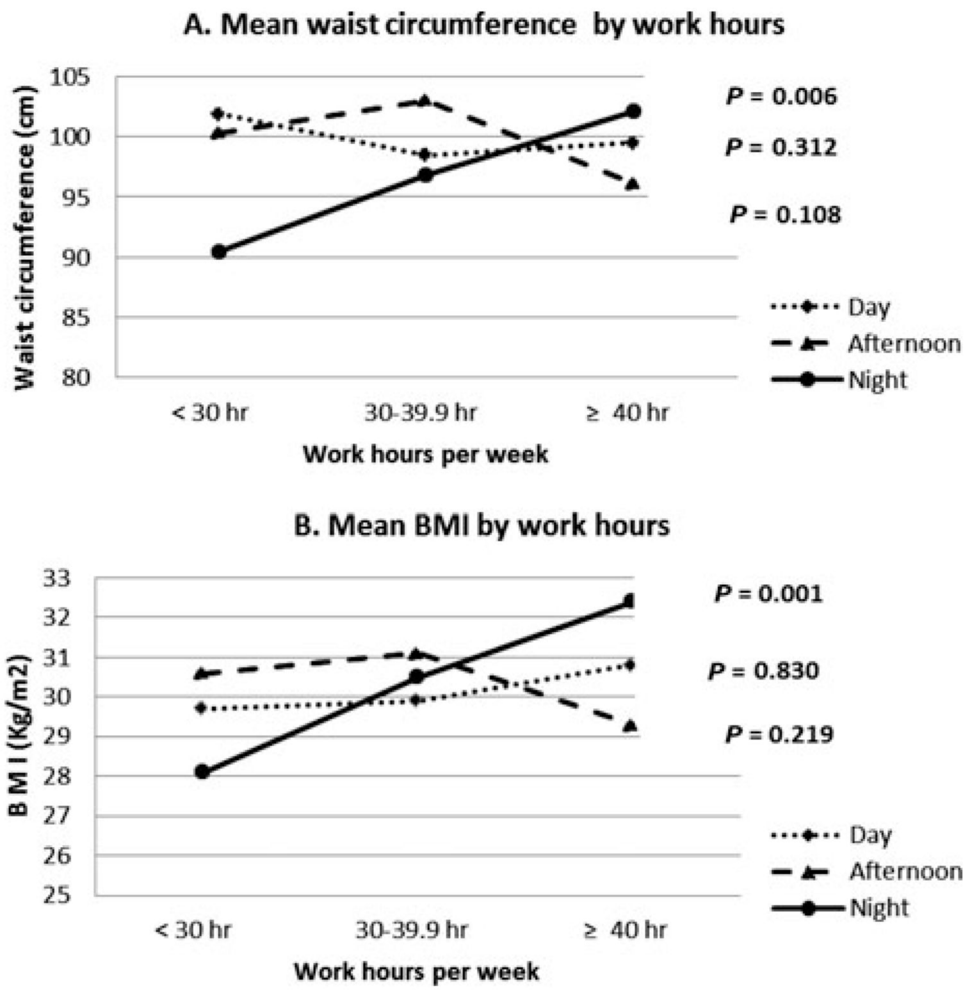

FIGURE 1.

Adjusted mean waist circumference (*A*) and body mass index (BMI) (*B*) across work hours per week by shiftwork among male officers.

TABLE 1

Descriptive Statistics for Demographic and Other Characteristics by Sex

Covariates	All (*N* = 408)	Men (*n* = 300)	Women (*n* = 108)	*P*
Age, yrs	42.8 ± 7.9	43.3 ± 8.4	41.5 ± 6.1	0.018
Years of service	16.1 ± 8.0	16.8 ± 8.4	14.0 ± 6.5	<0.001
Alcohol, no. drinks/wk	5.4 ± 13.4	6.2 ± 10.3	3.4 ± 4.6	<0.001
Physical activity, hr/wk	15.4 ± 13.4	14.8 ± 13.1	16.9 ± 14.1	0.157
Energy intake, kcal	1814.1 ± 790.3	1896.6 ± 821.2	1583.4 ± 645.9	<0.001
Hours of sleep (per 24 hr)	6.2 ± 1.1	6.2 ± 1.1	6.3 ± 1.2	0.427
Waist circumference, cm	94.3 ± 13.7	99.3 ± 10.5	80.3 ± 12.0	<0.001
Abdominal height, cm	20.8 ± 3.3	21.7 ± 2.8	18.1 ± 3.1	<0.001
Body mass index, kg/m^2	29.1 ± 4.4	30.2 ± 3.7	26.1 ± 4.8	<0.001
% body fat	25.8 ± 6.2	24.0 ± 5.1	30.9 ± 6.0	<0.001
Hours worked (per week)	37.6 ± 9.6	39.1 ± 9.9	33.3 ± 7.0	<0.001
	No. (%)	No. (%)	No. (%)	
Race				0.019
White	323 (79.2)	246 (82.0)	77 (71.3)	
African American	85 (20.8)	54 (18.0)	31 (28.7)	
Education				0.017
≤High school/GED	50 (12.3)	45 (15.0)	5 (4.6)	
<4 yrs of college	226 (55.5)	159 (53.2)	67 (62.0)	
≥4 yrs of college	131 (32.2)	95 (31.8)	36 (33.4)	
Marital status				<0.001
Single	47 (11.5)	23 (7.7)	24 (22.2)	
Married	304 (74.7)	240 (80.3)	64 (59.3)	
Divorced	56 (13.8)	36 (12.0)	20 (18.5)	
Household income, $				0.035
<70,000	97 (24.9)	62 (21.8)	35 (33.0)	
70,000–90,000	114 (29.2)	91 (32.0)	23 (21.7)	
≥90,000	179 (45.9)	131 (46.1)	48 (45.3)	
Smoking status				0.001
Current	65 (16.0)	38 (12.7)	27 (25.7)	
Former	104 (25.7)	71 (23.7)	33 (31.4)	
Never	236 (58.3)	191 (63.7)	45 (42.9)	
Shiftwork				<0.001
Day	181 (44.4)	106 (35.3)	75 (69.4)	
Afternoon	133 (32.6)	115 (38.3)	18 (16.7)	
Night	94 (23.0)	79 (26.3)	15 (13.9)	
Rank				0.084
Patrol police officer	276 (68.3)	193 (65.2)	83 (76.9)	
Sergeant/Lieutenant/Captain	67 (16.6)	54 (18.2)	13 (12.0)	
Detective/executive/Other	61 (15.1)	49 (16.6)	12 (11.1)	

Covariates	**All (*N* = 408)**	**Men (*n* = 300)**	**Women (*n* = 108)**	***P***
Activities after work				<0.001
Care child/family	120 (30.2)	67 (23.0)	53 (49.5)	
Leisure/sports	66 (16.6)	50 (17.2)	16 (15.0)	
Sleep	120 (30.2)	104 (35.7)	16 (15.0)	
Others	92 (23.1)	70 (24.1)	22 (20.6)	
Second job				<0.001
Yes	132 (32.4)	115 (38.3)	17 (15.7)	
No	276 (67.6)	185 (61.7)	91 (84.3)	
Work hours				<0.001
<30	70 (17.2)	42 (14.0)	28 (25.9)	
30–39.9	206 (50.5)	137 (45.7)	69 (63.9)	
>40	132 (32.3)	121 (40.3)	11 (10.2)	

Values provided as mean ± SD or *n* (%).

P values are for differences between women and men from *t* tests or chi-square tests of independence. GED, general educational development.

TABLE 2

Associations for Selected Covariates With Adiposity Measures and Work Hours

	Adiposity Measures									
	Waist Circumference		Abdominal Height		Body Mass Index		% Body Fat		Work Hours	
Covariates	***r***	***P***	***r***	***P***	***r***	***P***	***r***	***P***	***r***	***P***
Age, yr	0.181	<0.001	0.177	<0.001	0.100	0.044	0.074	0.137	0.072	0.148
Years of service	0.228	<0.001	0.221	<0.001	0.107	0.032	0.027	0.591	0.048	0.333
Alcohol, no. drinks/wk	0.134	0.007	0.122	0.010	0.040	0.419	−0.039	0.432	0.038	0.442
Physical activity, hr/wk	−0.053	0.289	−0.078	0.118	−0.069	0.164	−0.068	0.880	0.058	0.242
Energy intake, kcal	0.201	<0.001	0.151	0.002	0.117	0.019	−0.025	0.619	0.043	0.385
Hours of sleep	−0.030	0.550	−0.046	0.362	−0.073	0.141	0.026	0.597	−0.083	0.097
	Mean ± SD		**Mean ± SD**		**Mean ± SD**		**Mean ± SD**		**Mean ± SD**	
Sex		<0.001		<0.001		<0.001		<0.001		<0.001
Women	80.3 ± 12.0		18.1 ± 3.1		26.1 ± 4.8		30.9 ± 6.0		33.3 ± 7.0	
Men	99.3 ± 10.5		21.7 ± 2.8		30.2 ± 3.7		24.0 ± 5.1		39.1 ± 9.9	
Race		0.331		0.376		0.067		0.770		0.876
White	94.6 ± 14.0		20.7 ± 3.4		28.9 ± 4.4		25.7 ± 5.9		37.5 ± 9.4	
African American	93.0 ± 12.8		21.1 ± 3.1		29.9 ± 4.5		26.0 ± 7.2		37.7 ± 10.1	
Education		0.048		0.144		0.121		0.942		0.919
≤High school/GED	98.4 ± 12.0		21.5 ± 2.8		30.0 ± 4.2		25.4 ± 5.7		38.3 ± 8.8	
<4 yrs of college	93.6 ± 14.2		20.6 ± 3.3		29.0 ± 4.4		26.1 ± 5.8		37.0 ± 9.4	
≥4 yrs of college	93.9 ± 13.5		20.7 ± 3.5		28.6 ± 4.5		25.5 ± 7.0		38.4 ± 10.1	
Marital status		<0.001		0.001		0.044		0.385		0.836
Single	86.6 ± 13.5		19.2 ± 2.9		27.6 ± 4.4		25.1 ± 5.9		38.3 ± 9.1	
Married	95.5 ± 13.4		21.0 ± 3.4		29.2 ± 4.4		25.7 ± 6.1		37.5 ± 9.8	
Divorced	93.7 ± 13.7		20.6 ± 3.0		29.4 ± 4.7		26.8 ± 6.9		37.2 ± 9.0	
Household income, $		0.534		0.585		0.795		0.074		<0.001
<70,000	92.9 ± 14.7		20.5 ± 3.4		29.1 ± 5.1		26.3 ± 6.4		35.5 ± 7.9	
70,000–90,000	93.8 ± 12.9		20.6 ± 3.3		28.8 ± 3.9		24.7 ± 6.0		40.2 ± 9.7	
≥90,000	94.8 ± 13.7		20.9 ± 3.2		29.2 ± 4.3		26.3 ± 6.1		37.2 ± 9.9	
Smoking status		0.001		<0.001		<0.001		0.172		0.077

	Adiposity Measures									
	Waist Circumference		Abdominal Height		Body Mass Index		% Body Fat		Work Hours	
Covariates	***r***	***P***	***r***	***P***	***r***	***P***	***r***	***P***	***r***	***P***
Current	88.8 ± 14.7		19.5 ± 3.7		27.4 ± 5.1		25.8 ± 6.2		35.4 ± 8.7	
Former	93.3 ± 13.5		20.4 ± 3.4		28.8 ± 4.2		26.7 ± 6.0		37.3 ± 9.9	
Never	96.4 ± 13.0		21.3 ± 3.0		29.7 ± 4.2		25.3 ± 6.2		38.4 ± 9.5	
Shiftwork		0.020		0.130		0.088		<0.001		<0.001
Day	92.2 ± 14.6		20.4 ± 3.5		28.6 ± 4.7		27.2 ± 6.6		35.4 ± 8.8	
Afternoon	96.4 ± 13.1		21.2 ± 3.3		29.6 ± 4.1		24.5 ± 5.4		40.6 ± 9.7	
Night	95.3 ± 12.5		20.9 ± 2.9		29.3 ± 4.2		24.9 ± 5.7		37.6 ± 9.7	
Activities after work		0.025		0.312		0.004		0.005		<0.001
Care child/family	91.2 ± 13.7		20.4 ± 3.5		28.1 ± 4.4		27.1 ± 6.4		34.0 ± 7.7	
Leisure/sports	93.9 ± 13.6		20.6 ± 3.5		28.8 ± 4.3		25.0 ± 6.1		37.7 ± 9.4	
Sleep	95.6 ± 12.9		20.8 ± 3.0		29.3 ± 4.2		24.4 ± 5.4		39.1 ± 10.2	
Others	96.2 ± 14.3		21.2 ± 3.3		30.3 ± 4.6		26.5 ± 6.8		40.1 ± 9.6	
Rank		0.001		0.002		0.168		0.364		0.022
Patrol police officer	92.6 ± 13.3		20.4 ± 3.2		28.8 ± 4.4		25.6 ± 6.3		37.4 ± 9.8	
Sergeant/Lieutenant/Captain	98.3 ± 12.3		21.7 ± 3.2		29.9 ± 4.2		26.3 ± 6.3		36.1 ± 7.3	
Detective/executive/other	97.7 ± 16.2		21.5 ± 4.0		29.4 ± 4.9		26.7 ± 5.5		40.5 ± 9.6	

Pearson correlation coefficients (*r*) and associated *P* values.

P value for education was obtained from polynomial orthogonal linear contrasts.

P values for nominal variables (sex, marital status, race, smoking status, shiftwork, rank) were for any differences between the means. GED, general educational development.

TABLE 3

Mean Values of Adiposity Measures by Work Hours, Stratified by Sex

	Work Hours for Men (n = 300)				Work Hours for Women (n = 108)			
	<30 (n = 42)	**30–39.9 (n = 137)**	**≥40 (n = 121)**	***P***	**<30 (n = 28)**	**30–34.9 (n = 47)**	**≥35 (n = 33)**	***P***
Waist circumference, cm								
Model 1	97.9 ± 10.1	99.9 ± 10.6	99.1 ± 10.5	0.725	84.1 ± 12.7	80.8 ± 13.2	76.2 ± 7.9	0.020
Model 2	97.9 ± 1.8	100.0 ± 1.2	99.0 ± 1.4	0.975	80.9 ± 3.2	79.7 ± 2.4	76.5 ± 2.5	0.255
Abdominal height, cm								
Model 1	21.2 ± 2.5	22.0 ± 2.9	21.7 ± 2.8	0.760	18.4 ± 3.3	18.4 ± 3.4	17.2 ± 2.2	0.103
Model 2	20.8 ± 0.5	21.8 ± 0.3	21.4 ± 0.4	0.852	19.5 ± 0.8	18.3 ± 0.6	17.4 ± 0.7	0.584
Body mass index, kg/m^2								
Model 1	29.6 ± 3.9	30.3 ± 3.7	30.2 ± 3.7	0.698	26.8 ± 5.1	26.4 ± 5.5	25.0 ± 3.1	0.056
Model 2	29.6 ± 0.7	30.4 ± 0.4	29.9 ± 0.5	0.867	28.5 ± 1.1	27.3 ± 0.9	25.9 ± 0.9	0.189
% Body fat								
Model 1	22.9 ± 4.3	24.3 ± 5.4	24.0 ± 5.2	0.597	32.0 ± 6.4	31.4 ± 5.7	29.1 ± 5.7	0.107
Model 2	23.3 ± 0.9	24.7 ± 0.6	24.5 ± 0.7	0.475	30.9 ± 1.6	30.7 ± 1.3	29.5 ± 1.3	0.198

P values were obtained from multiple linear regression models.

Model 1, unadjusted (Mean ± SD); Model 2, adjusted for age, physical activity, energy intake, hours of sleep, smoking, police rank, activities after work, household income (Mean ± SE).

TABLE 4

Mean Values of Adiposity Measures by Work Hours, Stratified by Shift Among Male Officers

	Shift Work for Men (*n* = 300)											
	Work Hours for Day Shift (*n* = 106)				Work Hours for Afternoon shift (*n* = 115)				Work Hours for Midnight Shift (*n* = 79)			
	<30 (*n* = 18)	30–39.9 (*n* = 54)	≥40 (*n* = 34)	*P*	<30 (*n* = 11)	30–39.9 (*n* = 46)	≥40 (*n* = 58)	*P*	<30 (*n* = 13)	30–39.9 (*n* = 37)	≥40 (*n* = 29)	*P*
Waist circumference, cm												
Model 1	101.1 ± 10.0	99.4 ± 10.5	100.3 ± 10.2	0.606	98.4 ± 10.5	102.1±10.3	97.4 ± 11.2	0.394	93.1 ± 8.5	98.0 ± 10.8	101.2 ± 9.1	0.005
Model 2	101.9 ± 3.3	98.5 ± 2.4	99.5 ± 3..1	0.312	100.3 ± 3.5	103.0 ± 2.2	96.1 ± 2.1	0.108	90.4 ± 4.7	96.8 ± 3.5	102.1 ± 3.9	0.006
Abdominal height, cm												
Model 1	22.1 ± 2.6	22.0 ± 3.0	21.9 ± 2.8	0.316	20.6 ± 2.4	22.3 ± 3.1	21.4 ± 3.0	0.678	20.3 ± 2.2	21.5 ± 2.5	21.9 ± 2.2	0.155
Model 2	21.6 ± 1.0	21.9 ± 0.8	21.9 ± 0.9	0.495	20.7 ± 1.1	21.7 ± 0.7	20.8 ± 0.7	0.951	20.1 ± 0.8	21.6 ± 0.7	22.1 ± 0.8	0.095
Body mass index, kg/m^2												
Model 1	30.3 ± 4.8	29.7 ± 3.7	30.5 ± 3.9	0.663	30.2 ± 3.2	31.5 ± 4.0	29.4 ± 3.6	0.181	28.2 ± 2.8	29.8 ± 3.2	31.2 ± 3.5	0.002
Model 2	29.7 ± 1.5	29.9 ± 1.2	30.8 ± 1.4	0.830	30.6 ± 1.4	31.1 ± 0.9	29.3 ± 0.9	0.219	28.1 ± 1.3	30.5 ± 1.1	32.4 ± 1.3	0.001
% Body fat												
Model 1	23.2 ± 4.9	24.4 ± 5.5	24.7 ± 5.1	0.726	23.0 ± 4.4	24.5 ± 5.4	23.2 ± 5.2	0.873	22.4 ± 3.5	23.8 ± 5.3	24.6 ± 5.1	0.252
Model 2	24.4 ± 2.0	25.2 ± 1.6	26.1 ± 1.8	0.978	23.9 ± 1.9	24.7 ± 1.2	23.7 ± 1.1	0.874	22.6 ± 1.8	23.5 ± 1.5	25.5 ± 1.8	0.087

P values were obtained from multiple linear regression models.

Model 1, unadjusted (Mean ± SD); Model 2, adjusted for age, physical activity, energy intake, hours of sleep, smoking, police rank, activities after work, household income (Mean ± SE).

P values for interaction of shift work and work hours on adiposity measures based on model 3 were 0.017 for waist circumference, 0.258 for abdominal height, 0.006 for body mass index, and 0.647 for % body fat.