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Association of Perceived Stress with Sleep Duration and Sleep Quality in Police Officers

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Abstract: The objective was to investigate associations of perceived stress with sleep duration and quality among 430 police officers. Perceived stress was assessed using the Perceived Stress Scale. Sleep duration and quality were assessed using the Pittsburg Sleep Quality Index questionnaire. Mean hours of sleep were determined across quartiles of perceived stress using ANOVA/ANCOVA. Logistic regression was used to obtain odds ratios and 95% confidence intervals for poor sleep quality across perceived stress quartiles. Mean age was 42.1 years. Perceived stress was inversely associated with sleep duration among certain groups: men ($p = 0.004$), higher-ranked officers ($p = 0.002$), those with higher depressive symptoms ($p = 0.097$), no military experience ($p = 0.006$), and higher workload ($p = 0.003$). Gender, police rank, depressive symptoms, and workload each significantly modified the association between stress and sleep duration. Prevalence of poor sleep quality increased with higher levels of perceived stress; the trend was significant among men only ($p <0.0001$), and gender significantly modified this association (interaction $p = 0.015$). Compared to those in the first quartile of perceived stress, women in the fourth quartile were almost four times and men almost six times more likely to have poor sleep quality. Perceived stress was inversely associated with sleep duration and positively associated with poor sleep quality. [International Journal of Emergency Mental Health, 2011, 13(4), pp.229-242]

Key words: *Perceived stress, sleep quality, sleep duration, police*

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Good sleep quality and adequate sleep duration (i.e., 7 to 8 hours in a 24-hour period) are necessary for good health. According to the National Sleep Foundation, few Americans get high quality sleep or at least seven hours of sleep on a regular basis (2009 Sleep in America Poll). Short sleep duration has been shown to be associated with impaired immune and metabolic function, obesity, cardiovascular disease (CVD) and other chronic diseases (Charles et al., 2011; Van Cauter, Spiegel, Tasali, & Leproult, 2008; Sabanayagam & Shankar, 2010; AlDabal & BaHammam, 2011), and increased mortality (Nielsen, Kristensen, Schnohr, & Gronbaek, 2008). Sleep restriction and deprivation are also associated with impairment of short-term memory, concentration, and higher-order cerebral processes such as decision making (McCoy & Strecker, 2011; Durmer & Dinges, 2005; Drake et al., 2001), factors which are critical in the law enforcement profession. Risk factors for sleep deprivation and poor sleep quality include personal and work-related stress.

Psychosocial stress is an unavoidable part of human life. Perceived work stress has been defined as the degree to which workers "feel strain" associated with their jobs (Karasek & Theorell, 1990). Psychosocial stress and fatigue are two factors that are inherent in police work. Police officers often experience extended work schedules, shift work, traumatic events, and job dissatisfaction due to negative interpersonal interactions with supervisors and/or coworkers and perceived organizational unfairness (Violanti & Gehrke, 2004; Barger, Lockley, Rajaratnam, & Landrigan, 2009; Gershon, Barocas, Canton, Li, & Vlahov, 2009). In addition, minority and female officers may experience additional stressors such as racism and sexual harassment (Gershon et al., 2009). Police officers are often fatigued because several of the above mentioned occupational exposures negatively affect their sleep quantity and quality (Neylan et al., 2002; Vila, 2006; Kalimo, Tenkanen, Harma, & Poppius, 2000). Higher perceived stress has been shown to be associated with a reduction in sleep duration (Heslop, Smith, Metcalfe, Macleod, & Hart, 2002) and with poor sleep quality (Tworoger, Davis, Vitiello, Lentz, & McTiernan, 2005; Burgard & Ailshire, 2009).

To our knowledge, no published studies have investigated the association between perceived stress and sleep duration or sleep quality among members of the law enforcement profession. Therefore, the objectives of our study are a) to investigate the cross-sectional associations of perceived stress with sleep duration and quality among police officers and b) to determine if any of these associations are modified by gender, police rank, depressive symptoms (Center for Epidemiologic Studies Depression [CES-D] scale score), shift work status, physical activity, social support, previous military experience, or workload. We hypothesized that higher perceived stress would be associated with shorter sleep duration and poorer sleep quality in all officers.

METHODS

Study Design and Participants

During 2004-2009, all police officers employed at the Buffalo, New York Police Department (estimated to be approximately 710 in 2004) were invited to participate in the Buffalo Cardio-metabolic Occupational Police Stress (BCOPS) study, a comprehensive examination of the health consequences of stress in law enforcement officers. Some of them had previously participated in the 1999-2000 (n = 115) and 2001-2003 (n = 100) examinations. Data were collected at The Center for Health Research, School of Public Health and Health Professions, University at Buffalo, State University of New York (Violanti et al., 2006). The State University of New York at Buffalo Internal Review Board approved the study and informed consent was obtained from all participants. The original sample size was 464. Officers who did not have complete information on perceived stress (n = 20), sleep duration (n = 24), or sleep quality (n = 36) were excluded from these analyses. The final sample size for the analyses on perceived stress and sleep duration was 430 officers (111 women and 319 men) and for perceived stress and sleep quality, 418 officers.

Study Measures

Perceived stress was assessed using the Perceived Stress Scale (PSS), an original 14-item self-reported questionnaire that asks about feelings and thoughts during the past month (Cohen & Willamson, 1988). The questionnaire was originally designed for use in community samples with at least a junior high school education. The questions are general in nature, do not contain content specific to any subpopulation group, and are sensitive to the nonoccurrence of events as

well as to ongoing life circumstances. Participants rated each item on a five-point scale based on the frequency with which a particular event was experienced: 0 (never), 1 (almost never), 2 (sometimes), 3 (fairly often), and 4 (often). Seven of the 14 items were designed to identify positive events and hence were reversed-coded (items 4, 5, 6, 7, 9, 10, and 13). The total PSS scores were obtained by summing across all 14 items; the scores ranged from 0 to 56, with higher scores indicating higher stress (Cohen & Willamson, 1988).

Sleep Duration and Sleep Quality

Sleep duration and quality were assessed using the Pittsburg Sleep Quality Index (PSQI) questionnaire (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). Sleep duration was obtained from officers responding to the question "How many hours of sleep did you get at night (during the past month)?" Sleep quality was obtained from 19 self-rated individual questions that assessed various sleep quality related factors over the previous one-month period. These 19 items were grouped into seven components that include subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction. Each component was scored by summing the scores of each item. Each item was weighted equally on a 0 – 3 scale. A global PSQI score was derived by summing up the seven component scores with a possible range of 0 – 21; a global score of > 5 defined poor sleep quality (Buysse et al., 1989). The PSQI global score provides a single overall assessment of sleep quality, allows direct comparisons among groups, and identifies groups that differ in the quality of sleep. Studies have shown that the PSQI has high internal homogeneity, reliability, and validity (Buysse et al., 1989; Knutson, Rathouz, Yan, Liu, & Lauderdale, 2006).

Covariates

Officers were given self-and interviewer-administered questionnaires to provide information on demographic characteristics, lifestyle behaviors, and medical history. For educational status, they checked one of eight choices from *less than 12 years of school to graduate degree.* These categories were collapsed into three levels to allow adequate numbers in each category. Rank, race/ethnicity, years of service, and marital status were self-reported. Rank was collapsed into two or three categories for the current analysis: a) patrol officer vs. all other officers and b) patrol police, sergeant/lieutenant/captain, and detective/executive/others. Officers were asked how often they consumed alcoholic beverages with one drink defined as a 12-oz. can or bottle of beer, one medium glass of wine, or one shot of liquor. The total number of drinks consumed per week was used. Officers reported their smoking status as current, former, or never.

Body mass index (BMI) was calculated as weight (in kilograms) divided by height (in meters) squared. Abdominal height was measured with the participant in a supine position. The participant was asked to gently inhale, exhale, and then relax at rest. A caliper was used to measure the mid-section, one inch above the iliac crests. The caliper slightly touched, but did not compress the abdomen. Three measurements of abdominal height (to the nearest 0.1 cm) were taken and the average value was used as the participant's abdominal height.

Physical activity during the previous seven days was obtained with the Seven-Day Physical Activity Recall questionnaire used in the Stanford Five-City Project (Sallis, Haskell, Fortmann, Wood, & Vranizan, 1986). Participants reported the duration (hours per weekday, hours per weekend) and intensity (moderate, hard, very hard) of three types of physical activity (occupational, household, sports). A total physical activity score was then computed by summing the intensities of the three types of physical activity performed during the weekday and weekend, and multiplying that number by the reported duration.

The Center for Epidemiologic Studies Depression scale (CES-D) was used to measure depression in the participants (Radloff, 1977). The CES-D is a 20-item test which has good reliability for measuring symptoms of depression and stress (Radloff, 1977). Respondents rated items on a 4-point scale based on the frequency of symptom occurrence in the previous seven days: 0 (rarely or none of the time, less than 1 day), 1 (some or little of the time, 1-2 days), 2 (occasionally or a moderate amount of time, 3-4 days), and 3 (most of the time, 5-7 days). Four of the 20 items were designed to identify positive symptoms (# 4, 'I felt that I was just as good as other people'; #8, 'I felt hopeful about the future'; #12, 'I was happy'; #16, 'I enjoyed life') and hence were reverse-coded. The CES-D score is the sum of the scores from these 20 items and ranges from 0 to 60. Respondents with scores of 6-15 are unlikely to be clinically depressed, scores of 16-21 indicate mild to moderate depression, and scores of 22 or greater are associated with major depression (Radloff, 1977).

The Social Provisions Scale was developed to assess the six provisions of social relationships which were described by Weiss (1974) and Cutrona (1986). Each provision is assessed by four items; the presence and absence of the provision are each described by two items. Twenty-four questions were answered at four levels: strongly disagree (1), disagree (2), agree (3), and strongly agree (4). For scoring purposes, the negative items were reverse coded and summed together with

the positive items to form a score for each social provision. A total global social support score was derived by summing the scores of these six provisions, with a higher score indicating higher social support. Internal consistency for the total score is relatively high, ranging from 0.85 to 0.92 across a variety of populations (Cutrona, 1986).

Electronic work history data, from 1994 to 2009, were available on a daily basis for 428 participants. The time participants started their shift was used to classify each record into one of the following three shifts: day shift, if the start time of the record is between 4 am and 11:59 am; afternoon shift, if the start time is between 12 noon and 7:59 pm; or midnight shift, if the start time is between 8 pm and 3:59 am. Total hours worked as well as hours worked at the day, afternoon, and midnight shift were computed for each participant by summing all records. Taking into account the length of time a participant was working (from first date of work history to date of current exam), the computed hours were standardized to a weekly basis (hours worked per week) and percent of total hours worked on each shift was calculated. A variable that indicates the dominant shift worked was created by assigning the participant to the shift with the highest percentage of hours worked.

Military experience was assessed by asking the question "Were you ever in the military?" For workload level in their districts, officers were asked to check one of the following: high workload (very busy, complaints, high crime area), moderate workload (moderate complaint rate, average crime), and low workload (precinct not busy, low crime area). The final workload variable was dichotomized into low and moderate/high workload to accommodate smaller sample sizes in the higher groups.

Statistical Methods

Univariate analysis was used to describe characteristics of the study participants. Variables were chosen as potential confounders and included in the multivariate models if they were significantly associated with both the independent and dependent variables. Gender, police rank (patrol officer vs. all other ranks), CES-D score (<10 vs. ≥10), physical activity, shift work status, social support (below vs. above median), previous military experience (yes vs. no), and workload (low vs. moderate/high) were assessed for effect modification in the associations of perceived stress with sleep duration and quality. CES-D score was stratified at 10 instead of at 16, the cut-point for clinical depression, to allow for ample sample sizes in both groups. The cut-point for statistical significance of the interaction terms was set at 0.20. Mean values of sleep duration were obtained across quartiles of PSS using analysis of variance and covariance (ANOVA and ANCOVA). The prevalence of sleep quality was compared across quartiles of perceived stress using the chi-square test. Logistic regression was used to obtain the odds ratios (ORs) and 95% confidence intervals (CIs) for poor quality sleep across levels of perceived stress, with the first quartile serving as the referent group. SAS version 9.2 was used to analyze these data (SAS Institute, Cary, NC).

RESULTS

The mean age of all officers in this study was 42.1 years (SD = 8.4; Table 1). Mean hours of sleep per 24-hour period was similar for women and men (6.1 hours), but the mean level of perceived stress was significantly higher in women than in men (22.2 vs. 19.3; $p = 0.003$). The prevalence of poor sleep quality was not statistically different between women and men.

Sleep duration was negatively correlated with physical activity (-0.1126; $p = 0.021$), perceived stress (-0.1517; $p = 0.002$) and depressive symptoms [i.e., CES-D score; (-0.1695; $p < 0.001$)] (Table 2). Compared to officers who were categorized as having poor sleep quality, officers with good sleep quality had significantly more hours of sleep (6.8 vs. 5.5; $p < 0.001$) and higher mean social support (84.5 vs. 82.0; $p = 0.004$). Officers with poor sleep quality had a mean CES-D score that was approximately twice that of those who had good sleep quality (10.1 vs. 5.2; $p < 0.001$). Perceived stress was positively correlated with depressive symptoms ($r = 0.6341$, $p < 0.001$) and negatively correlated with social support ($r = -0.3545$, $p < 0.001$), but was not significantly associated with any other covariate (data not shown).

Table 3 shows mean hours of subjective sleep (PSQI) by quartiles of perceived stress for all officers and also stratified by gender, police rank, CES-D score, military experience, and workload. Among all officers, mean hours of sleep significantly decreased as perceived stress increased. Assessment for effect modification showed that social support, physical activity, shift work status, and previous military experience did not significantly modify the association between perceived stress and sleep duration. However, gender, police rank, CES-D score, and workload significantly modified the association between perceived stress and sleep duration (interaction $p = 0.145$, 0.084, 0.172, and 0.037 respectively). Among men, mean hours of sleep significantly decreased as perceived stress increased before (< 0.001) and after ($p = 0.004$) adjustment for shift work status. This association among women was not statistically significant. Among officers who were at the rank of sergeant or above, mean hours of sleep significantly decreased with increasing quartiles

Table 1.
Characteristics of study participants by gender.

	All officers (n = 430)	Women (n = 111)	Men (n = 319)	
	Mean ± SD	Mean ± SD	Mean ± SD	p-value
Age (years)	42.1 ± 8.4	41.2 ± 6.4	42.5 ± 8.9	0.104
Sleep duration (hours)	6.1 ± 1.2	6.1 ± 1.1	6.1 ± 1.2	0.744
Physical Activity score	21.3 ± 18.1	21.4 ± 17.3	21.3 ± 18.5	0.928
Alcohol intake (drinks/wk)	5.6 ± 9.5	3.8 ± 6.1	6.2 ± 10.4	0.005
Perceived stress (PSS-14)	20.0 ± 7.9	22.2 ± 9.2	19.3 ± 7.2	0.003
CES-D score	7.7 ± 7.0	8.7 ± 8.1	7.4 ± 6.5	0.108
BMI (kg/m²)	29.2 ± 4.8	26.1 ± 4.7	30.3 ± 4.2	<0.0001
Social support	83.2 ± 8.9	83.8 ± 8.7	83.0 ± 9.0	0.418
Race/ethnicity	N (%)	N (%)	N (%)	
Caucasian	332 (78.3)	79 (71.2)	253 (80.8)	0.010
African American	84 (20.1)	32 (28.8)	53 (16.9)	
Hispanic	7 (1.7)	0 (0)	7 (2.2)	
Education				
High school/GED	47 (11.0)	5 (4.5)	42 (13.2)	0.039
College < 4 years	237 (55.2)	67 (60.4)	170 (53.5)	
College ≥ 4 years	145 (33.8)	39 (35.1)	106 (33.3)	
Rank				
Patrol police	298 (70.0)	86 (77.5)	212 (67.3)	0.132
Sergeant/Lieut/Captain	67 (15.7)	13 (11.7)	54 (17.1)	
Det/Executive/Other	61 (14.3)	12 (10.8)	49 (15.6)	
Shift Work				
Day	174 (42.4)	75 (70.1)	99 (32.7)	<0.001
Afternoon	139 (33.9)	18 (16.8)	121 (39.9)	
Night	97 (23.7)	14 (13.1)	83 (27.4)	
Smoking Status				
Current	70 (16.4)	28 (25.9)	42 (13.2)	0.001
Former	107 (25.1)	32 (29.6)	75 (23.5)	
Never	250 (58.6)	48 (44.4)	202 (63.3)	
Perceived stress				
1-14	101 (23.5)	25 (22.5)	76 (23.8)	<0.001
15-19	120 (27.9)	23 (20.7)	97 (30.4)	
20-24	106 (24.7)	21 (18.9)	85 (26.7)	
25-46	103 (24.0)	42 (37.8)	61 (19.1)	
Sleep quality				
Good	201 (48.1)	50 (45.9)	151 (48.9)	0.590
Poor	217 (51.9)	59 (54.1)	158 (51.1)	
Sleep (hours per 24-hr)				
0-5.9	135 (31.4)	38 (34.2)	97 (30.4)	0.269
6.0-6.9)	139 (32.3)	29 (26.1)	110 (34.5)	
≥ 7.0	156 (36.3)	44 (39.6)	112 (35.1)	
CES-D score				
< 10	308 (71.6)	77 (69.4)	231 (72.4)	0.540
≥ 10	122 (28.4)	34 (30.6)	88 (27.6)	
Social support				
Low (< mediam)	231 (53.7)	55 (49.6)	176 (55.2)	0.306
High (≥ median)	199 (46.3)	56 (50.5)	143 (44.8)	

Table 1 (cont.): Characteristics of study participants by gender				
	All officers (n = 430)	Women (n = 111)	Men (n = 319)	
	Mean ± SD	Mean ± SD	Mean ± SD	p-value
Military Experience				
Yes	109 (25.4)	14 (12.6)	95 (29.8)	<0.001
No	321 (74.7)	97 (87.4)	224 (70.2)	
Workload				
Low	263 (64.0)	57 (53.8)	206 (67.5)	0.011
Medium/High	148 (36.0)	49 (46.2)	99 (32.5)	

P-values for continuous variables comparing women and men are from Student's t-tests.
P-values for categorical variables comparing women and men are from chi-square or Fisher's exact tests.

of perceived stress before (< 0.001) and after (p = 0.002) adjustment for shift work status. In contrast, the association between sleep duration and perceived stress among patrol police officers was not significant. Sleep duration was inversely associated with perceived stress among officers with higher depressive symptoms (CES-D score ≥ 10) but this association did not reach statistical significance. No association was evident among officers with a CES-D score of less than10. Perceived stress was not associated with sleep duration among officers with previous military experience (p = 0.534), but was inversely associated with sleep duration among those without such experience (p = 0.006). Mean hours of sleep decreased with increasing quartiles of perceived stress among officers with moderate or high workload (p = 0.003), with the mean values showing a relatively steep decline across perceived stress. In an alternative analytical procedure, senior officers in the fourth quartile of perceived stress were almost four times more likely (OR = 3.68; 95% CI = 1.12-12.12) to have short sleep duration (≤ 5 hours) compared to those senior officers in the first quartile of perceived stress after adjustment for shift work. Also, among officers who reported experiencing moderate and high workloads, those in the highest quartile were three times as likely to have short sleep duration compared to those in the first quartile (OR = 3.01; 95% CI = 1.03-8.87).

The prevalence of poor sleep quality is shown across quartiles of perceived stress in Table 4. The results are stratified by selected variables. The prevalence of poor sleep quality significantly increased across each quartile of perceived stress among men: 1st quartile = 32.4%; 2nd quartile = 41.5%; 3rd quartile = 58.5%; and 4th quartile = 80.0% (p < 0.001). Among women, there was some evidence of a positive association of poor sleep quality with perceived stress but the results were not statistically significant (p = 0.128). Gender significantly modified the association between perceived stress and sleep quality (interaction p = 0.015). No other variable was found to significantly modify the association between perceived stress and sleep quality. The prevalence of poor sleep quality increased significantly with higher perceived stress among officers with higher depressive symptoms (i.e., CES-D ≥10) but not among those with lower depressive symptoms.

In Table 5, the ORs and 95% CIs are shown for poor sleep quality with increasingly higher levels of perceived stress. In the fourth quartile of perceived stress, women were almost four times more likely (OR = 3.72; 95% CI = 1.14-12.13) and men were almost six times more likely (OR = 5.94; 95% CI = 2.50-14.13) to have poor sleep quality compared to those officers in the first quartile of perceived stress, after adjustment for social support, physical activity, and shift work status. In addition, the ORs for poor sleep quality showed a statistically significant linear trend across increasing quartiles of perceived stress.

DISCUSSION

Perceived stress and sleep duration

In this cohort of law enforcement workers, we investigated the association of perceived stress with sleep quantity and quality. We found that mean hours of sleep significantly decreased as perceived stress increased. Our overall finding of an inverse association is consistent with previous studies. Authors of a recent cross-sectional study reported that participants in the high-stress group (defined as PSS ≥ 23) had significantly shorter sleep duration than did the low-stress group (Kashani, Eliasson, & Vernalis, 2011).

Table 2.
Association of covariates with sleep duration and sleep quality.

		Sleep quality		
	Sleep Duration	Good (n = 201)	Poor (n = 217)	p-value
Age (years)	-0.0156, 0.747	42.1 ± 9.1	42.0 ± 7.8	0.849
Sleep duration (hours)	na	6.8 ± 1.0	5.5 ± 1.0	<0.0001
Physical Activity score	-0.1126, 0.021	19.2 ± 15.7	22.8 ± 19.8	0.043
Alcohol intake (drinks/w)	-0.0073, 0.881	4.8 ± 8.6	6.5 ± 10.4	0.067
Perceived stress (PSS-14)	-0.1517, 0.002	17.7 ± 7.1	22.3 ± 8.0	<0.0001
CES-D score	-0.1695,<0.001	5.2 ± 4.7	10.1 ± 7.9	<0.0001
BMI (kg/m²)	-0.0387, 0.426	29.0 ± 4.2	29.2 ± 5.1	0.593
Abdominal Height (cm)	-0.0320, 0.511	20.7 ± 3.2	20.8 ± 3.7	0.731
Waist Circumference (cm)	0.0008, 0.986	94.0 ± 13.5	94.7 ± 15.0	0.625
Social Support	0.0579, 0.241	84.5 ± 8.7	82.0 ± 9.0	0.004
Race/ethnicity				
Caucasian	6.2 ± 1.2	155 (77.9)	169 (79.3)	0.866
African American	5.9 ± 1.1	40 (20.1)	41 (19.3)	
Hispanic	6.1 ± 0.6	4 (2.0)	3 (1.4)	
p-value†	0.065			
Education				
High school/GED	6.4 ± 1.3	24 (11.9)	21 (9.7)	0.705
College < 4 years	6.1 ± 1.1	108 (53.7)	123 (56.9)	
College ≥ 4 years	6.1 ± 1.1	69 (34.3)	72 (33.3)	
p-value*	0.139			
Rank				
Patrol police	6.2 ± 1.2	140 (70.7)	150 (69.4)	0.364
Sergeant/Lieut/Captain	5.9 ± 1.0	27 (13.6)	39 (18.1)	
Det/Executive/Other	6.3 ± 1.1	31 (15.7)	27 (12.5)	
p-value†	0.234			
Shift Work				
Day	6.2 ± 1.1	92 (49.7)	75 (35.2)	0.007
Afternoon	6.1 ± 1.3	59 (31.9)	77 (36.2)	
Night	5.9 ± 1.1	34 (18.4)	61 (28.6)	
p-value†	0.096			
Smoking Status				
Current	6.1 ± 1.1	32 (16.1)	37 (17.1)	0.965
Former	6.2 ± 1.1	50 (25.1)	54 (24.9)	
Never	6.1 ± 1.2	117 (58.8)	126 (58.1)	
p-value†	0.931			
Sleep quality				
Good	6.8 ± 1.0	na	na	na
Poor	5.5 ± 1.0			
p-value†	<0.0001			
Social support				
Low	6.1 ± 1.2	96 (47.8)	128 (59.0)	0.022
High	6.2 ± 1.1	105 (52.2)	89 (41.0)	
p-value†	0.676			

Table 2 (cont.): Association of covariates with sleep duration and sleep quality.				
		Sleep quality		*p*-value
	Sleep duration	Good (*n* = 201)	Poor (*n* = 217)	
Military experience				
Yes	6.2 ± 1.2	51 (25.4)	53 (24.4)	0.823
No	6.1 ± 1.1	150 (74.6)	164 (75.6)	
p-value†	0.676			
Workload				
Low	6.1 ± 1.1	120 (64.2)	138 (64.2)	0.998
Medium/High	6.1 ± 1.2	67 (35.8)	77 (35.8)	
p-value†	0.744			

Values between continuous variables and sleep duration are Pearson's correlation coefficients and associated p-values.

P-*values between continuous variables and sleep quality are from t tests.*

P-*values between categorical variables and sleep quality are from the chi-square tests.*

†P-values are for any differences between the groups.

**P-values are from linear contrasts.*

However, this association was only significant among men, among officers of higher rank (i.e., sergeant and above), among officers with no previous military experience, and those reporting moderate or high workload. We had expected to see similar inverse associations between perceived stress and sleep duration among both men and women. In fact, we had expected to find strong inverse associations among women. Police work has been shown to be more stressful to women because they are sometimes exposed to additional stressors to which men are not usually exposed. A study on workplace stress conducted among a diverse group of police officers from the Milwaukee Police Department found that female officers (White, Latina, and African American) were exposed to more sexually offensive behaviors and that African American females experienced more ridicule than white male officers (Hassell & Brandl, 2009). Female officers in our study had a higher mean perceived stress score compared to male officers which was consistent with findings from other studies (Cohen & Willamson, 1988; Yoo & Franke, 2011; Kashani et al., 2011). In a previous study conducted on a smaller sample of Buffalo police officers, Andrew and colleagues (2008) reported higher levels of hardiness commitment and hardiness control among men compared to women, even though they also found that mean psychological distress was higher for women than for men. Individuals with higher levels of hardiness are thought to be more resilient to stressors.

Similarly, it was somewhat unexpected to find that higher perceived stress was associated with fewer hours of sleep among the more experienced officers who we surmised would be less affected because of their additional years of experience in dealing with stressful situations. Patrol officers are directly exposed to more traumatic events on a regular basis and that, plus their relative inexperience, could have increased their stress levels with more negative consequences to their sleep. In contrast, it was understandable to find that higher levels of perceived stress were associated with shorter sleep duration among persons with no prior military experience and with higher workload. This association was particularly strong among officers with higher workload.

Sleep duration was inversely associated with perceived stress among officers with higher depressive symptoms (CES-D score ≥ 10) although the association was not statistically significant. The lack of a significant association may be partly due to the selection of the cut-point. The ideal cut-point would be 16, since persons with a CES-D score greater than16 have been shown to have clinical depression. Due to the small sample size for officers with CES-D above 16, we chose to dichotomize at the lower cut-point of 10. Thus the group above 10 may have included some non-depressed with depressed officers, thus potentially diluting the association. Gender, police rank, CES-D score, and workload significantly modified the associations between perceived stress and sleep duration.

Perceived stress and sleep quality

Our study showed that the prevalence of poor sleep quality significantly increased across higher quartiles of perceived stress among all officers but the association was significant

Table 3.
Mean hours of sleep by quartiles of perceived stress
for all officers, stratified by selected variables.

		Quartiles of perceived stress					
		1st quartile	2nd quartile	3rd quartile	4th quartile		
Stratification		1.0-14.0	15.0-19.0	20.0-24.0	25.0-46.0	*p*-value†	*p*-value*
All officers		*n = 101*	*n = 120*	*n = 106*	*n = 103*		
	Model 1	6.3 ± 1.2	6.2 ± 1.1	6.2 ± 1.2	5.8 ± 1.2	0.002	
	Model 2	6.3 ± 0.1	6.2 ± 0.1	6.2 ± 0.1	5.8 ± 0.1	0.002	
	Model 3	6.2 ± 0.1	6.2 ± 0.1	6.1 ± 0.1	5.8 ± 0.1	0.007	
Gender	*Women*	*n = 25*	*n = 23*	*n = 21*	*n = 42*		0.145
	Model 1	6.2 ± 1.1	6.0 ± 1.4	6.0 ± 1.0	6.1 ± 1.1	0.639	
	Model 3	6.2 ± 0.3	6.0 ± 0.3	6.0 ± 0.3	6.1 ± 0.2	0.657	
	Men	*n = 76*	*n = 97*	*n = 85*	*n = 61*		
	Model 1	6.4 ± 1.2	6.2 ± 1.1	6.2 ± 1.2	5.7 ± 1.2	<0.001	
	Model 3	6.2 ± 0.1	6.2 ± 0.1	6.2 ± 0.1	5.7 ± 0.1	0.004	
Police Rank	*Patrol officer*	*n = 70*	*n = 85*	*n = 72*	*n = 71*		0.084
	Model 1	6.3 ± 1.2	6.1 ± 1.2	6.3 ± 1.2	5.9 ± 1.1	0.090	
	Model 3	6.2 ± 0.2	6.2 ± 0.1	6.3 ± 0.1	5.9 ± 0.1	0.204	
	Sergeant & above	*n = 31*	*n = 35*	*n = 34*	*n = 32*		
	Model 1	6.5 ± 1.0	6.3 ± 1.0	5.9 ± 1.0	5.7 ± 1.2	<0.001	
	Model 3	6.3 ± 0.2	6.3 ± 0.2	5.8 ± 0.2	5.7 ± 0.2	0.002	
CES-D score	*Low CES-D (<10)*	*n = 93*	*n = 109*	*n = 76*	*n = 30*		0.172
	Model 1	6.3 ± 1.2	6.2 ± 1.1	6.3 ± 1.1	6.3 ± 1.2	0.772	
	Model 3	6.2 ± 0.1	6.2 ± 0.1	6.3 ± 0.1	6.2 ± 0.2	0.869	
	High CES-D (≥10)	*n = 8*	*n = 11*	*n = 30*	*n = 73*		
	Model 1	6.1 ± 0.8	6.4 ± 1.0	5.7 ± 1.2	5.7 ± 1.1	0.102	
	Model 3	6.1 ± 0.4	6.4 ± 0.3	5.7 ± 0.2	5.7 ± 0.1	0.097	
Military	*Yes*	*n = 25*	*n = 31*	*n = 32*	*n = 21*		0.510
	Model 1	6.6 ± 1.4	6.0 ± 1.1	6.2 ± 1.2	6.1 ± 1.2	0.317	
	Model 3	6.4 ± 0.3	6.0 ± 0.2	6.1 ± 0.2	6.0 ± 0.3	0.534	
	No	*n = 76*	*n = 89*	*n = 74*	*n = 82*		
	Model 1	6.2 ± 1.1	6.3 ± 1.1	6.2 ± 1.2	5.8 ± 1.1	0.002	
	Model 3	6.2 ± 0.1	6.3 ± 0.1	6.2 ± 0.1	5.8 ± 0.1	0.006	
Work Load	*Low*	*n = 61*	*n = 78*	*n = 64*	*n = 60*		0.037
	Model 1	6.1 ± 1.0	6.2 ± 1.1	6.1 ± 1.1	6.0 ± 1.2	0.422	
	Model 3	6.0 ± 0.1	6.2 ± 0.1	6.2 ± 0.1	6.0 ± 0.1	0.540	
	Moderate/High	*n = 31*	*n = 38*	*n = 40*	*n = 39*		
	Model 1	6.6 ± 1.4	6.2 ± 1.2	62 ± 1.3	5.7 ± 1.1	0.004	
	Model 3	6.5 ± 0.2	6.1 ± 0.2	6.0 ± 0.2	5.6 ± 0.2	0.003	

Results are mean ± SD for unadjusted models and mean ± SE for adjusted models.

†P-values are for trends from linear regression models (perceived stress used as a continuous variable).

**P-values are for interaction by the stratified variables in the association between perceived stress and sleep duration.*

Model 1: Unadjusted.
Model 2: Adjusted for gender.
Model 3: Adjusted for shift work status.

Table 4.
Prevalence of poor sleep quality by quartiles of perceived stress, stratified by gender, social support, CES-D score, and shift work status.

		Quartiles of perceived stress					
		1st quartile	2nd quartile	3rd quartile	4th quartile		
Satisfaction		1.0-14.0	15.0-19.0	20.0-24.0	25.0-46.0	*p*-value*	*p*-value†
Gender	Women	9 (37.5)	12 (54.5)	10 (47.6)	28 (66.7)	0.128	0.020
	Men	24 (32.4)	39 (41.5)	48 (58.5)	47 (80.0)	<0.001	
Social Support	Low social support	(34.2)	26 (54.2)	31 (50.0)	58 (76.3)	<0.001	0.809
	High social support	20 (33.3)	25 (36.8)	27 (65.9)	17 (68.0)	<0.001	
CES-D score	Low CES-D (<10)	29 (23.8)	44 (36.1)	33 (27.1)	16 (13.1)	0.161	0.814
	High CES-D (≥10)	4 (4.2)	7 (7.4)	25 (26.3)	59 (62.1)	0.096	
Shift Work Status	Day	10 (13.3)	17 (22.7)	20 (26.7)	28 (37.3)	0.004	0.927
	Afternoon	9 (11.7)	18 (23.4)	23 (29.9)	27 (35.1)	0.007	
	Night	14 (23.0)	15 (24.6)	12 (19.7)	20 (32.8)	0.016	
Military	Yes	7 (13.2)	13 (24.5)	19 (35.9)	14 (26.4)	0.017	0.678
	No	26 (15.9)	38 (23.2)	39 (23.8)	61 (37.2)	<0.0001	
Workload	Low	23 (16.7)	38 (27.5)	33 (23.9)	44 (31.9)	0.001	0.524
	Medium/High	10 (13.0)	13 (16.9)	25 (32.5)	29 (37.7)	<0.001	

Results are n (%).

**P-values are for the differences between the stratified groups (from chi-square tests).*

†P-values are for tests for interaction by the stratified variables in the association between perceived stress and sleep quality.

Table 5.
ORs (95% CI) for poor sleep quality across quartiles of perceived stress, stratified by gender.

	Quartiles of perceived stress				
	1st quartile	2nd quartile	3rd quartile	4th quartile	
	1.0-14.0	15.0-19.0	20.0-24.0	25.0-46.0	P-value
Women	*n = 24*	*n = 22*	*n = 21*	*n = 42*	
Model 1	1.00	2.00 (0.62-6.49)	1.52 (0.46-4.98)	3.33 (1.17-9.49)	0.054
Model 2	1.00	1.70 (0.45-6.49)	1.28 (0.35-4.62)	3.72 (1.14-12.13)	0.023
Men	*n = 74*	*n = 94*	*n = 82*	*n = 59*	
Model 1	1.00	1.48 (0.78-2.79)	2.94 (1.53-5.67)	8.16 (3.67-18.15)	<0.0001
Model 2	1.00	1.34 (0.67-2.68)	2.29 (1.10-4.76)	5.94 (2.50-14.13)	<0.0001

Model 1: Unadjusted.

Model 2: Adjusted for social support, physical activity, and shift work status.

P-values are for trends of ORs across quartiles.

only among men. In addition, female and male officers in the fourth quartile of perceived stress were almost four and six times, respectively, more likely than those in the first quartile to report poor sleep quality after risk factor adjustment. Gender significantly modified the association between perceived stress and sleep quality. Our results are consistent with those of other studies. A cross-sectional study conducted among women reported positive associations between the perceived stress score and poor sleep quality (Tworoger et al., 2005). Kashani and colleagues (2011) reported that highly stressed (PSS $\geq$ 23) persons experienced poorer sleep quality, greater daytime sleepiness, and greater fatigue. Organizational job stressors have been shown to be positively associated with poor sleep quality (Kalimo et al., 2000; De Lange et al., 2009; Knudsen, Ducharme, & Roman, 2007). Using data collected via telephone interviews from a nationally representative random sample of American full-time employees, Knudsen and colleagues (2007) found that work overload was positively associated with the frequency of poor sleep quality, role conflict was positively associated with difficulty falling asleep and sleep that was not refreshing, and repetitive tasks were associated with more days of insomnia.

There is evidence to suggest that perceived stress may be associated with shorter sleep duration and poorer sleep quality through cardiac autonomic changes. Studies have shown that stress is associated with increased heart rate reactivity, increased systolic blood pressure, and reduced 24-hour vagal tone (Vrijkotte, van Doormen, & de Geus et al., 2000; Sloan et al., 1994). Reduced vagal tone has been shown to be associated with increased sleep disruptions and poor sleep quality (El-Sheikh, Erath, & Keller, 2007; Irwin, Valladares, Motivala, Thayer, & Ehlers, 2006).

Limitations and Strengths

Due to the cross-sectional study design, we are not able to determine the temporal sequence of exposure to perceived stress and sleep duration or sleep quality. Another limitation is that our assessment of sleep duration and quality were from self-reported data and may have resulted in some bias. However, any bias would be expected to be non-differential and dilute any associations seen. Polysomnography is considered the gold standard but this was not available. In addition, the relatively small sample size of women prevents stratified analyses within gender. However, there are several strengths to this study. To the best of our knowledge, no other studies have been published on the association between perceived stress and sleep problems in police officers or first responders. The use of the PSS has several advantages (Cohen, Kamarck, & Mermelstein, 1983). This questionnaire was designed for use in community samples with at least a junior high school education, and so the questions and the response alternatives are easy to understand. The PSS questions are of a general nature, are not specific to particular situations or populations, and are sensitive to the nonoccurrence of events as well as to ongoing life circumstances. Most importantly, the PSS was found to be a good instrument for measuring appraised stress (Cohen et al., 1983). There are also advantages to using the PSQI. Components of the PSQI were chosen from clinical information including physicians' experience with sleep disorder patients, therefore findings from this study may also be applicable to clinical practice. In addition, the PSQI has been used in a wide variety of studies involving occupational stress (Neylan et al., 2002). The results of this study may be generalizable to law enforcement officers employed in departments having similar characteristics (size, workload, etc.).

Conclusions

In summary, our results showed that higher levels of perceived stress were significantly associated with shorter sleep duration among men, officers of higher rank, those with higher depressive symptoms, no previous military experience, and higher workload. Significant positive associations were observed between perceived stress and poor sleep quality among men only. Since sleep problems are associated with cardiovascular disease, other chronic diseases, and increased mortality, police management should consider implementing tested interventions to reduce the levels of stressors that can be changed, thereby mitigating the long-term health effects associated with sleep problems in these workers. They also should establish policies and training programs that minimize sleep loss and disruption (Vila & Samuels, 2011). Future research should implement longitudinal studies and larger sample sizes of female and minority officers.

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