Shift work and sleep: the Buffalo Police health study

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Abstract

Purpose – Working on the night shift is a potential source of occupational stress and has been associated with sleep disorders. The purpose of this paper is to investigate the association between shift work and sleep problems among police officers from Buffalo, New York.

Design/methodology/approach – Randomly selected officers ($n = 111$) responded to questions on sleep quality and quantity. Shift work data were obtained from daily payroll records from 1994 to the exam date (1999-2000). Prevalence ratios (PR) were obtained using Poisson regression models that examined associations of shift work with sleep quality and quantity.

Findings – Among police officers, night shift work was significantly and independently associated with snoring and decreased sleep duration.

Originality/value – Although the sleep questions were similar to those used in validated sleep questionnaires, a major strength of this study was the availability of daily work history data on all officers for up to five years prior to the current examination.

Keywords Shift work, Police, Stress, United States of America

Paper type Research paper

Introduction

Research shows that up to 20 percent of workers are not able to tolerate working at night (Scott and Ladou, 1990). This is due to the influence of the circadian rhythms, the

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disruption of which may lead to dysregulation of physiological mechanisms (Minors and Waterhouse, 1990). Working on schedules other than the regular day shift is a potential source of occupational stress (Brugere *et al.*, 1997) and the consequences include various problems such as increased risk of injuries at work (Smith *et al.*, 1994; Monk, 1990), gastrointestinal symptoms (Caruso *et al.*, 2004), disruption of family and social lives (Colligan and Rosa, 1990), and mental disorders (Scott *et al.*, 1997; Shields, 2002).

One of the most common problems related to shift work is a decrease in the quality and quantity of sleep. Certain sleep disorders may increase the risk of morbidity and mortality. For example, daytime sleepiness has been associated with impaired cognition (Foley *et al.*, 2001) and decreased sleep time has been linked with increased risk of hypertension (Gangwisch *et al.*, 2006), increased risk of Type 2 diabetes (Yaggi *et al.*, 2006), and reduced life expectancy (Yousaf and Sedgwick, 1996). A cohort study by Yaggi *et al.* found that obstructive sleep apnea significantly increased the risk of stroke or death (Yaggi *et al.*, 2005). Snoring is associated with excessive daytime sleepiness, headaches, and reduced ability to concentrate and learn new tasks (Ulfberg *et al.*, 1996a; 1996b). Poor sleep quality influences the secretion of pro-inflammatory substances and stress hormones in the body (Vgontzas *et al.*, 2004; Backhaus *et al.*, 2004). Fatigue due to moderate sleep loss affects performance similar to moderate alcohol intoxication (Williamson and Feyer, 2000; Dawson and Reid, 1997).

Shift work may affect the quality of police officers' sleep, potentially threatening their health, safety, and performance (Gabarino *et al.*, 2002; Vila, 2006; Vila *et al.*, 2002). The primary objective of this study was to examine the potential association of shift work with sleep quality and quantity among police officers in Buffalo, New York.

Methods

Study population

The Buffalo New York Police Department, a mid-sized urban police force of 934 officers at the time of sampling, was the selected site for this study. The Center for Preventive Medicine, School of Public Health and Health Professions, State University of New York at Buffalo, served as the data collection site (Violanti *et al.*, 2006). In 1999, a random sample of 115 police officers was selected from all officers in the department using a computer-generated random sample table. No specific exclusion criteria were used. All of these officers agreed to participate in the study. Informed consent was obtained from all participants. This study was approved by the State University of New York at Buffalo Internal Review Board and the National Institute for Occupational Safety and Health Human Subjects Review Board. Four officers who did not have sufficient work history data were excluded from the study resulting in a sample size of 111.

Assessment of shift work

Shift work data were obtained from city of Buffalo payroll records, which provided a day-by-day account of shift history for each officer in the present study from 1994 to the date of exam at baseline (1999-2000). The time that participants started their shift was used to classify the participants into one of the following three shifts: day shift, if the start time was between 0400 and 1159; afternoon shift, if the start time was between 1200 and 1959; and night shift, if the start time was between 2000 and 0359. The total

number of hours worked during the day, afternoon, and night shift were computed for each participant. Taking into account the length of time a participant was working (from first date of work to date of exam at baseline), the computed hours were standardized on a weekly basis (i.e. hours worked per week). In addition, the percentage of total hours worked on each shift was calculated. Two types of dichotomous shift work variables were created. In the first method, participants were classified as shift workers if the combined proportion of hours worked on the afternoon and night shifts was at least 50 percent. In the second method, participants were classified as shift workers if the proportion of hours worked on the night shift was at least 50 percent.

Assessment of sleep

The outcomes were sleep quality and sleep quantity. The questions on sleep quality are shown in Table I. Several of these questions have been validated in instruments such as the Pittsburgh Sleep Quality Index questionnaire (PSQI) (Buysse *et al.*, 1989) and the sleep apnea screen used by Maislin *et al.* (1995). These questions were evaluated on a six-point frequency scale and the response choices were "not sure/don't know/not applicable", "strongly disagree/never", "disagree/less than once per week", "somewhat agree/1–2 times per week", "agree/3–4 times per week", and "strongly agree/5–7 times per week". All sleep problems were re-categorized and analyzed as: a) "yes" versus "never"; and b) "3-7 times per week", " < 1-2 times per week", and "never". Participants were also asked how many hours, on average, they slept each 24-hour

Sleep conditions	All workers			Night shift workers			Day and afternoon shift workers		
	N	No. of cases	%	*N*	No. of cases	%	*N*	No. of cases	%
At night, my sleep disturbs my bed partner's sleep	75	57	76.0	14	10	71.4	61	47	77.1
I am told I snore in my sleep	90	75	83.3	17	17	100.0	73	58	79.5
I am told I stop breathing in my sleep	79	9	11.4	15	1	6.7	64	8	12.5
I suddenly wake up gasping for breath during the night	95	17	17.9	18	1	5.6	77	16	20.8
I have or have been told that I have restless legs	81	28	34.6	17	7	41.2	64	21	32.8
I feel tired upon awakening and want to go back to sleep	99	89	89.9	18	16	88.9	81	73	90.1
I am very sleepy during the daytime and struggle to stay awake	100	72	72.0	18	12	66.7	82	60	73.2
Hours of sleep per 24-hour period during the previous week*	111			20			91		
0–4.5		13	11.7		1	5.0		12	13.2
5–6.5		53	47.8		15	75.0		38	41.8
≥ 7		45	40.5		4	20.0		41	45.1

Note: *p-values for difference between night and day/afternoon shift workers < 0.05
Source: Charles *et al.* (1999)

Table I.
Prevalence of sleep problems and duration among police officers by shift work

period during the previous five weekdays (i.e. Sunday through Thursday) and during the previous weekend (i.e. Friday and Saturday nights). We averaged the hours of sleep reported for the two periods to give the average total hours of sleep per 24-hour period during the previous seven days. Due to the small sample size in some groups, sleep duration was re-categorized as 0–4, 5–6, and ≥ seven hours for analysis of variance (ANOVA) and as < 7 and ≥ seven hours for Poisson regression analyses.

Assessment of covariates

Participants completed questionnaires (self- and interviewer-administered) to provide information on demographic characteristics, lifestyle behaviors and medical history. Police officers reported their highest level of education that ranged from "less than 12 years of school" to "graduate degree". Participants indicated the number of years employed as a police officer and their present rank in the police force (e.g. police patrol officer, lieutenant, detective, etc.). Participants were asked how often they consumed alcoholic beverages where one drink consisted of a 12 oz can or bottle of beer, one medium glass of wine, or 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 total number of drinks consumed per week. Participants reported their smoking status as current, former, or never. Body mass index (BMI) was calculated as kilogram per meter squared. 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 (Chronbach alpha of 0.85) (Radloff, 1977). Respondents rated items on a four-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 and hence were reverse-coded. The CES-D score is the sum of the scores from these 20 items and range 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).

Respondents reported the duration (hours per week, hours per weekend) and intensity (moderate, hard, very hard) of three types of physical activity (occupational, household, and sports) that they engaged in during the previous seven days. A total physical activity score was then computed by summing the intensities of the three types (i.e. occupational, household, and sports) of physical activity performed during the weekday and the weekend. Intensity score was computed as the product of number of hours and intensity of physical activity, where moderate, hard, and very hard levels were assigned intensities of 1, 2, and 3, respectively.

Statistical methods

Descriptive statistics were used to characterize the study population. ANOVA models were used to examine trends in mean values of selected covariates across ordinal categories of sleep problems. Orthogonal contrast coefficients were used to compute the p-values assessing linear trend. Prevalence of each sleep problem was compared across shift work categories. Poisson regression analyses relating shift work to each sleep problem were performed and estimates of prevalence ratios and the

corresponding 95 percent confidence intervals (CIs) were computed (Zou, 2004). Unadjusted and multivariable-adjusted prevalence ratios were also estimated. Prevalence ratios were used instead of odds ratios because they are the preferred effect measure for use in epidemiologic studies when the outcome event is common (i.e. > 10 percent prevalence) (Zou, 2004; Checkoway *et al.*, 2004). Effect modification of the association between shift work and sleep problems was assessed for gender, age, smoking status, alcohol consumption, education, physical activity, and BMI. All analyses were conducted using the SAS system, version 9.1 (SAS Institute, 2001).

Results

Participants in this study, 63.1 percent of who were men, ranged in age from 26 to 61 years old (mean ±S.D. = 39.4 ± 7.5 years) (Table II). A total of 53 officers (47.8 percent) worked the day shift and 20 officers (18 percent) worked the night shift.

Covariates	All officers N	All officers Mean ± SD	Night shift workers ($n = 20$) N	Night shift workers ($n = 20$) Mean ± SD	Day and afternoon shift workers ($n = 91$) N	Day and afternoon shift workers ($n = 91$) Mean ± SD
Age (years)	111	39.4 ± 7.5	20	36.4 ± 5.6	91	40.1 ± 7.8*
Years of service	111	13.5 ± 8.7	20	8.0 ± 6.2	91	14.8 ± 8.7*
BMI (kg/m^2)	107	27.9 ± 4.4	19	28.3 ± 4.3	88	27.8 ± 4.4
Alcohol (number of drinks/wk)	111	2.9 ± 3.7	20	2.0 ± 2.4	91	3.1 ± 3.9
Depression score (CES-D)	105	7.2 ± 6.8	16	5.9 ± 3.9	89	7.5 ± 7.2
Physical activity score	111	11.3 ± 16.6	20	15.2 ± 28.6	91	10.5 ± 12.7
Gender:						
Women	41	36.9	4	20.0	37	40.7
Men	70	63.1	16	80.0	54	59.3
Education (%):						
≤ High school/GED	21	18.9	3	15.0	18	19.8
College < four years	59	53.2	13	65.0	46	50.6
College ≥ four years	31	27.9	4	20.0	27	29.7
Rank (%):						
Police officer	73	65.8	17	85.0	56	61.5
Sergeant/lieutenant/captain	18	16.2	3	15.0	15	16.5
Detective	19	17.1	0	0.0	19	20.9
Other	1	0.9	0	0.0	1	1.1
Smoking status (%):						
Current	22	20.0	7	36.8	15	16.5
Former	35	31.8	5	26.3	30	33.0
Never	53	48.2	7	36.8	46	50.5
Marital status (%):						
Single	25	22.5	7	35.0	18	19.8
Married	70	63.1	12	60.0	58	63.7
Divorced	15	14.4	1	5.0	15	16.5

Note: *p-values for difference between night and day/afternoon shift workers < 0.05
Source: Charles *et al.* (1999)

Table II.
Characteristics of the study population and mean values and standard deviation (SD) of selected covariates by shift work

Compared to day and afternoon shift workers, night shift workers were significantly more likely to be younger (36.4 vs. 40.1 years; $p = 0.047$) and to have fewer years of service (8.0 vs. 14.8 years; $p = 0.001$). Women were twice as likely to work the day and afternoon shift (40.7 percent) as the night shift (20.0 percent). The majority of officers had completed at least some college education (81 percent), and 65.8 percent of the officers reported their rank as police patrol officer. Although not statistically significant, current smoking was more prevalent in night shift workers (36.8 percent) than in day and afternoon workers (16.5 percent).

The prevalence of sleep problems varied widely (Table I). The majority of officers reported feeling tired upon awakening (89.9 percent) and snoring (83.3 percent). In contrast, only nine officers (11.4 percent) reported having sleep apnea (stop breathing during sleep) and 17 officers (17.9 percent) said that they wake up gasping for breath during the night. This prevalence is based on the subset of officers who answered these specific questions. Only one of the officers who reported sleep apnea problems worked the night shift. Overall, 45 officers (40.5 percent) reported getting $\geq$ seven hours of sleep in a 24-hour period during the previous week and only four (20.0 percent) of these were night shift workers.

The mean values of selected covariates were obtained for three levels of sleep problems (data not shown). No association between years of service and sleep problems was observed. Overall, mean CES-D score (depression) increased with increasing frequency of most sleep problems; the associations were significant for restless leg syndrome (p for trend = 0.024) and tiredness upon awakening (p for trend = 0.015). BMI was positively and significantly associated with snoring (p for trend < 0.001). A positive trend also was observed between BMI and waking up gasping for breath but the association was not statistically significant. Although none of the trends for physical activity scores were statistically significant, lower scores were more likely to be seen in officers with more frequent sleep problems. An inverse trend between physical activity and tiredness upon awakening was evident but the association was only borderline significant (p for trend = 0.059).

Univariate and multivariate models of the association between night shift work and sleep problems are shown in Table III. Night shift work was significantly associated with snoring. The prevalence of snoring was 26 percent higher in night shift workers compared to the other workers (PR = 1.26; 95 percent C.I. = 1.12 – 1.41). Adjustment for years of service (PR = 1.21; 95 percent C.I. = 1.06 – 1.38) and other risk factors (depression, BMI, physical activity, and gender) did not alter this significant association appreciably (PR = 1.16; 95 percent C.I. = 1.00 – 1.33). Among officers with BMI $< 30\,kg/m^2$, the prevalence of snoring was 22 percent higher among night shift workers compared to other workers (PR = 1.22; 95 percent C.I. = 1.02-1.46) after adjustment for years of service, depression, and physical activity. The association between shift work and snoring among officers with BMI $\geq 30\,kg/m^2$ was not statistically significant. BMI was a significant effect modifier in the association between shift work and snoring but not with other sleep problems. After risk factor adjustment, the prevalence of short sleep duration (< = 6.5 hours) per 24-hour period during the previous week was 44 percent higher among night shift workers compared to other workers (PR = 1.44; 95 percent C.I. = 1.00 – 2.06; $p = 0.047$). Age was omitted from the final models since it was strongly correlated with years of service.

Sleep quality/quantity	Model 1 PR	95% C.I.	Model 2 PR	95% C.I.	Model 3 PR	95% C.I.
At night, my sleep disturbs my bed partner's sleep	0.93	0.65-1.33	0.99	0.68-1.45	0.94	0.62-1.43
I am told I snore in my sleep	1.26	1.12-1.41	1.21	1.06-1.38	1.16	1.00-1.33
I am told I stop breathing in my sleep	0.53	0.07-3.95	0.67	0.08-5.68	0.59	0.02-14.3
I suddenly wake up gasping for breath during the night	0.27	0.04-1.89	0.25	0.03-1.89	0.27	0.03-2.67
I have or have been told that I have restless legs	1.26	0.64-2.45	0.91	0.46-1.80	1.02	0.53-1.95
I feel tired upon awakening and want to go back to sleep	0.99	0.83-1.18	0.97	0.82-1.16	0.97	0.81-1.16
I am very sleepy during the daytime and struggle to stay awake	0.91	0.64-1.30	0.83	0.58-1.19	0.90	0.62-1.32
Hours of sleep per 24-hour period during the previous week (<7 hr vs. ≥ 7 hr)	1.46	1.09-1.94	1.35	0.99-1.85	1.44	1.00-2.07

Notes: PR=prevalence ratio; C.I.=confidence interval. Results obtained from Poisson regression models; Model 1 – unadjusted; Model 2 – adjusted for years of service; Model 3 – adjusted for years of service, depression, BMI, physical activity, and gender.
Source: Charles *et al.* (1999)

Table III.
Association of sleep quality and quantity in police officers who work night shifts compared to those who work day and afternoon shifts

The association between shift work and sleep was stratified by gender, age, alcohol consumption, smoking status, education, and physical activity to determine whether these factors might modify the association between shift work and sleep (data not shown). Among women, the prevalence of restless leg syndrome was 134 percent higher among night shift workers compared to workers on other shifts (PR = 2.34; 95 percent C.I. = 1.05-5.24). After adjustment for years of service, depression, BMI, and physical activity, the prevalence among women was still elevated but no longer statistically significant (PR = 1.99; 95 percent C.I. = 0.69-5.78). No association was observed among men. Among officers who had a high school diploma or less, the prevalence of daytime sleepiness was 37 percent higher among night shift workers compared to other workers after risk factor adjustment (PR = 1.37; 95 percent C.I. = 1.01-1.86). Gender, smoking status, education, and physical activity were not found to be significant effect modifiers.

Discussion

This study was one of the few to investigate shift work related sleep problems among police officers. Unlike the one previous study of police officer sleep problems that compared day, evening and midnight shift officers (Vila *et al.*, 2002), our study compared the sleep problems of officers who worked night shifts with those who worked both day and afternoon shifts. We think this dichotomy is more appropriate because several factors make nightshift work much more likely to have an adverse effect on sleep quality than either day or afternoon shifts. First, night shifts are more disruptive to the circadian system because workers must frequently rotate between diurnal and nocturnal sleep patterns to accommodate family and social activities (Monk, 2000; Sack *et al.*, 1992). This is not the case with afternoon shift workers whose later bedtime hours are seldom a problem biologically (Monk, 2000). In fact, they may even get more sleep than day shift workers (Monk, 2000). Second, the pattern of melatonin secretion and its synchronization with sleep is drastically altered in night

shift workers (Sack *et al.*, 1992). Melatonin, a substance that is primarily secreted by the pineal gland, is produced during the night and promotes sleep (Pandi-Perumal *et al.*, 2006). Thus, night shift workers may face a greater frequency of sleep disruption compared to evening shift workers.

In a random sample of police officers in the city of Buffalo, New York, we found a statistically significant independent association between snoring and night vs. day/afternoon shift workers. There was a 16 percent greater prevalence of snoring among night shift workers compared to workers on day and afternoon shifts. Snoring is an important indicator of sleep problems that may be more readily noticeable by subjects than other measures associated with apnea. We also found a 44 percent higher prevalence of less than seven hours of sleep among night shift workers compared with other workers. Our study did not reveal significant associations for night shift work with any of the other sleep problems.

We were unable to find any previous studies reporting an association between night shiftwork and snoring. Furthermore, the epidemiologic literature on shift work and sleep problems shows inconsistent results. Several studies, conducted among various occupational groups, found no associations between shiftwork and sleep problems (Portela *et al.*, 2004; Klawe *et al.*, 2005; Hui *et al.*, 2002), while others reported significantly more sleep problems for workers on the night and/or afternoon shifts compared to the day shifts (Burch *et al.*, 2005; Harma *et al.*, 1998). These apparently contradictory results may be caused by differing definitions of shift work (e.g. night shift, night plus afternoon shift, rotating shifts); sleep assessment instruments (e.g. polysomnography, the Sleep & Health Questionnaire (SHQ), the Epworth Sleepiness Scale (ESS), a global Sleep Disorder Score (SDS)); and sleep questions as well as the wide range of sample sizes employed. Garbarino *et al.* found no association between shift work and sleep when sleep was assessed by the ESS score, but found a significantly higher prevalence of sleep disorders among shift workers when the global SDS was used (Garbarino *et al.*, 2002).

We expected to discover even more significant associations between night shift work and sleep problems than snoring and the 44 percent increased prevalence of sleeping $<$ seven hours per night because night work generally is characterized by increased subjective and objective sleepiness. One reason for night shift sleepiness is that an individual is exposed to work at the nadir (low point) of the well-established circadian pattern (Akerstedt, 2003). For the night shift worker, the period of maximum alertness (late afternoon) will strongly interfere with sleep, whereas the nadir (early morning) will similarly strongly promote sleep during work hours.

Investigating associations with shift work presents unique problems because officers who remain on the night shift often tend to be younger and/or better able to adequately tolerate the demands and stresses of working nights (Burch *et al.*, 2005). This especially tends to be the case in departments where officers with more job seniority are given precedence in work-shift selection so that older officers, who tend to tolerate night shift work less well and take longer to recover from sleep disruption, are better able to migrate to shifts that they tolerate better (Vila *et al.*, 2002). Those who are not as easily able to adapt would have to change to other shifts but may still experience sleep problems since the effects of working at night may persist for some time after the shift change (Dumont *et al.*, 1997). Burch *et al.* found no differences in the prevalence of fatigue or mental symptoms between workers on the night and day shifts suggesting

some degree of adaptation among night workers participating in their study (Burch *et al.*, 2005). In addition, it has been shown that satisfaction with the shift schedule influences shift workers' ability to cope with their schedule (Axelsson *et al.*, 2004). Information regarding satisfaction with night shift was not collected and so we were unable to assess its influence on our results. In our study, the association between shift work and sleep problems may have been under-estimated.

We found a high prevalence of tiredness upon awakening. We could not definitively determine the prevalence of sleep apnea for several reasons. Symptomatic obstructive sleep apnea includes symptoms such as snoring and/or temporary cessation of breathing during sleep, with the usual consequence being hypersomnolence during waking hours (Victor, 1999). We obtained a wide range of responses to each of these questions. The very low response rate to "stop breathing during sleep" may be due to the fact that a number of individuals, especially those without a bed partner, are not aware that they have this problem. Although we collected information on marital status, we did not ask about bed partners nor did we survey the spouses or partners of the participants. In addition, we were unable to assess asymptomatic sleep apnea, which is more common than the symptomatic type (Victor, 1999).

In annual surveys of randomly selected American adults, the National Sleep Foundation (NSF) found that increasing numbers of American adults are experiencing sleep problems on a regular basis (National Sleep Foundation, 2005). Of the NSF respondents, 57 percent reported sleeping more than seven hours per night during the workweek as compared to only 45 percent of police officers in our study.

Several covariates were significantly associated with sleep problems. For example, BMI showed a significantly positive trend with snoring, and was significantly and positively associated with restless leg syndrome and tiredness upon awakening. Results from previous studies are consistent with this association between BMI and snoring (Yaggi *et al.*, 2005; Lindberg *et al.*, 1998). Our study also found that lower physical activity scores were more likely to be seen in officers with more frequent sleep problems although none of the trends were statistically significant. Previous studies have provided evidence that regular physical activity has a protective effect on sleep-disordered breathing (Peppard and Young, 2004; Marchesini *et al.*, 2004).

There are several limitations in this study. The sample size of 111 is relatively small and we cannot rule out misclassification of sleep problems in this study. The information on sleep was obtained by subjective reporting with no objective means of validating the responses and so the possibility exists that sleep problems may have been overstated or understated. Such bias would likely have been non-differential, with a tendency to weaken any association that may have existed. Also, officers were asked to report the duration of sleep only during the previous seven days and this number may not have been representative of their true average sleep duration. In addition, the sleep of shift workers tends to be fragmented and if they did not accurately tabulate their hours of sleep at various times during the 24-hour period, a differential bias would have exaggerated the association between shift work and sleep duration. However, the use of self-reported sleep duration has shown good congruency with those obtained through actigraphic monitoring (Lockley *et al.*, 1999; Kushida *et al.*, 2001). Another limitation pertains to the cross-sectional design of the study which precludes inferences regarding causality. We were not able to investigate the influence of chronotype (i.e. morningness or eveningness) on the shift work-sleep association. Chronotype affects

sleep quality and quantity and does so in a sex-specific manner in young adults (Mongrain *et al.*, 2005).

A major strength of the study was the availability of daily work history data on all officers for up to five years prior to the current examination. The work history data included hours of overtime as well as regular work, and this objective measure removed any possibility of information bias. The study was conducted on a stratified random sample of officers with a high (100 percent) response rate. In addition, we were able to assess potential effect modification and confounding on a fairly wide range of sleep problems. Finally, our sleep questions were similar to those used in validated sleep questionnaires.

In summary, this study found that night shift work was independently and significantly associated with snoring and short sleep duration. Additional findings indicated that BMI may also be a risk factor for snoring and that physical activity may be protective for several sleep problems. In addition to the many health problems that are associated with snoring (and insufficient sleep), snoring also affects the quality of life of the snorer's bed partner (Ulfberg *et al.*, 2000). Interventions, such as a worksite exercise program (Atlantis *et al.*, 2006), to alleviate the sleep problems associated with night shift work will reduce the associated health problems and safety issues among police officers and will also improve the quality of life for their bed partners, thus improving the lives of a larger proportion of the population. Future studies investigating the association between shift work and sleep problems may be strengthened by increasing the sample size, utilizing more objective methods to assess sleep quality, and by using a prospective study design.

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