

Original Article

Associations between Psychological Distress and Body Mass Index among Law Enforcement Officers: The National Health Interview Survey 2004-2010

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Objectives: To investigate the association between psychological distress and obesity among law enforcement officers (LEOs) in the United States.

Methods: Self-reported data on psychological distress based on six key questions were obtained from LEOs who participated in the National Health Interview Survey (2004-2010). We used Prochaska's cut-point of a Kessler 6 score ≥ 5 for moderate/high mental distress in our analysis. Mean levels of body mass index (BMI) were compared across three levels of psychological distress.

Results: The average age of LEOs ($n = 929$) was 39.3 years; 25% were female. Overall, 8.1% of LEOs had moderate or high psychological distress; 37.5% were obese ($BMI \geq 30$). Mean BMI increased with increasing psychological distress (no distress, $BMI = 27.2 \text{ kg/m}^2$; mild distress, 27.6 kg/m^2 ; and moderate/high distress, 33.1 kg/m^2 ; $p = 0.016$) after adjustment for age, race, income, and education level among female officers only. Physical activity modified the association between psychological distress and BMI but only among male LEOs (interaction $p = 0.002$). Among male LEOs reporting low physical activity, psychological distress was positively associated with BMI (30.3 kg/m^2 for no distress, 30.7 for mild distress, 31.8 for moderate/high distress; $p = 0.179$) after adjustment, but not significantly. This association was not significant among males reporting high physical activity.

Conclusion: Mean BMI significantly increased as psychological distress increased among female LEOs. A longitudinal study design may reveal the directionality of this association as well as the potential role that physical activity might play in this association.

Key Words: Psychological distress, Law enforcement officers, Adiposity

Introduction

The law enforcement profession is a highly stressful occupation. Law enforcement officers (LEOs) include police officers, detectives and criminal investigators, correctional officers, bailiffs, fish and game wardens, and parking enforcement workers. Police officers are required to be constantly on alert because they are likely to experience unexpected situations at any moment such as confrontation by criminals. In addition,

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they commonly work overtime and various shift schedules, and they experience administrative and organizational pressure and demands. These stressors could adversely affect their health and their lifestyle resulting in conditions such as posttraumatic stress disorder (PTSD) [1,2], metabolic syndrome [3], cardiovascular disease [4], and alcoholism and anxiety [5]. Collins and Gibbs [6] reported that police organizational culture and workload were the key issues in officer stress in one county police force. A study on police officers in the United Kingdom showed that the prevalence of PTSD in officers was six or more times the prevalence for the community [7].

Protective service workers, police officers and firefighters, had the second highest obesity prevalence (29.8%) among 41 occupational categories, and the annual change in obesity prevalence ($2.1\% \pm 0.8$) was two times higher than that for the United States population ($0.95\% \pm 0.11$) in the period from 1997 to 2002 [8]. A recent study showed that, in an urban police population, the prevalence of obesity for male officers was 47.4%, while for female officers it was only 16.0% [9]. Obesity has been shown to be associated with certain chronic diseases and injuries (e.g., cardiovascular disease, musculoskeletal disorders, vibration-induced injury, and sleep-disorders) and with occupational safety [10].

Several studies have reported that psychological distress is associated with obesity. Psychological distress elevated body mass index (BMI) [11,12] and central obesity [13]. Many studies have reported the positive relationship between job stress and obesity in workers [13-16]. Other studies have found that stress from family concerns correlated with depression and obesity [17,18]. Very few studies have examined the association between psychological distress and obesity in law enforcement workers or military personnel. In a study conducted among Afghanistan and Iraq War veterans, Barber and colleagues [19] found that PTSD and depression were not associated with increased weight. Another study showed that depressive symptoms were associated with the metabolic syndrome among police officers [9].

Psychological factors like depression, anxiety, fatigue, and psychological trauma might be risk factors for obesity. The objective of this paper is to investigate the association between psychological distress and obesity among a cross-section of LEOs who responded over a seven-year period in the United States.

Materials and Methods

Source of data

The National Health Interview Survey (NHIS), developed

and administered by National Center for Health Statistics in the Centers for Disease Control and Prevention, is a nationwide survey on the health of the civilian non-institutionalized United States population [20]. The NHIS is a nationally representative in-person household interview conducted annually and based on a multi-stage clustered area probability sample. Individuals who belong to minority racial/ethnic backgrounds (e.g., Blacks, Hispanics, and Asians) and adults aged ≥ 65 years are oversampled to allow for the precise estimation of health in minority populations and elders. Data from the NHIS core questionnaires (Sample Adults, Family, Household) in 2004-2010 were analyzed for this study. Data prior to 2004 were not included since a specific occupation, law enforcement workers, was not available. Merging NHIS data files to Sample Adults file and combining NHIS data across years were performed using the NHIS guidelines: Variance Estimation and Other Analytic Issues, NHIS 1995-2005; Variance Estimation and Other Analytic Issues, NHIS 2006-2010. The total initial sample size from the Sample Adults survey (aged 18 years or older) in 2004-2010 was 187,091, with an average response rate of 79.5%. The final sample size used in our analyses was 105,862 working adults, after removing those who were not employed during the last week of the interview ($n = 75,166$) and those who were pregnant or missing any of the psychological distress and BMI variables ($n = 6,063$). This study focused on LEOs ($n = 929$) among the United States working adults ($n = 105,862$).

Outcome variable: BMI

In the Sample Adults questionnaire, participants were asked their height in inches ("How tall are you without shoes?") and their weight in pounds ("How much do you weigh without shoes?"). BMI was used to assess obesity, and was calculated as weight in kilograms divided by height in meters squared. We used BMI as both a continuous variable and a categorical variable (BMI $< 25 \text{ kg/m}^2$ for underweight/normal, 25 to $< 30 \text{ kg/m}^2$ for overweight, and $\geq 30 \text{ kg/m}^2$ for obese).

Exposure variable: psychological distress

There were six psychological distress questions for assessing the presence of a possible mental health condition that were designed for the United States NHIS, which are referred to as Kessler 6 (K6) [21]. The standard K6 has the following six questions: "During the past 30 days, how often did you feel 1) so sad that nothing could cheer you up? 2) nervous? 3) restless or fidgety? 4) hopeless? 5) that everything was an effort? 6) worthless?" Response categories are "All of the time" (score = 4), "Most of the time" (score = 3), "Some of the time" (score = 2), "A little of the time" (score = 1), and "None of the time"

Table 1. Descriptive statistics for demographic and other characteristics of law enforcement officers by gender; NHIS (2004-2010)

Covariate	All	Male	Female	p-value*	US workers
Demographics					
Race/ethnicity				< 0.001	
White (non-Hispanic)	67.7 (1.8)	69.5 (1.9)	60.2 (3.8)		69.6 (0.3)
Black (non-Hispanic)	15.6 (1.3)	12.9 (1.4)	26.9 (3.1)		11.3 (0.2)
Hispanic	13.5 (1.3)	14.5 (1.4)	9.3 (2.0)		13.8 (0.2)
All other (non-Hispanic)	3.2 (0.7)	3.1 (0.8)	3.8 (1.8)		5.3 (0.1)
Marital status				< 0.001	
Single	18.7 (1.4)	15.6 (1.5)	31.4 (3.6)		26.5 (0.3)
Married	66.3 (1.7)	71.3 (1.8)	45.5 (4.0)		57.8 (0.3)
Divorced	15.1 (1.3)	13.1 (1.4)	23.1 (3.4)		15.7 (0.1)
Education				0.996	
≤ High School/GED	24.5 (1.8)	24.5 (2.0)	24.5 (3.3)		37.2 (0.3)
Some college	39.1 (2.0)	39.0 (2.2)	39.3 (4.0)		27.3 (0.2)
≥ 4 years college	36.4 (1.9)	36.5 (2.1)	36.2 (3.7)		35.5 (0.3)
Annual income (USD)				0.040	
< 35,000	26.1 (1.9)	23.9 (2.0)	35.3 (4.4)		52.2 (0.3)
35,000-65,000	42.7 (2.1)	43.3 (2.4)	40.2 (4.5)		30.5 (0.2)
> 65,000	31.2 (1.8)	32.8 (2.2)	24.5 (4.1)		17.3 (0.2)
Age (year)	39.3 ± 0.4	39.3 ± 0.5	39.7 ± 0.7	0.682	41.1 ± 0.1
Duration of service (year)	9.7 ± 0.3	9.8 ± 0.4	9.2 ± 0.6	0.409	7.8 ± 0.0
Lifestyle					
Smoking status				0.225	
Never	64.8 (1.9)	65.8 (2.1)	60.7 (4.2)		59.8 (0.2)
Former	20.4 (1.6)	20.7 (1.9)	18.9 (3.3)		19.0 (0.2)
Current	14.8 (1.4)	13.5 (1.5)	20.4 (3.5)		21.2 (0.2)
Second job				< 0.001	
Yes	12.3 (1.3)	14.1 (1.5)	5.2 (1.6)		8.6 (0.1)
No	87.7 (1.3)	85.9 (1.5)	94.8 (1.6)		91.4 (0.1)
BMI (kg/m ²)				< 0.001	
Normal/lean (< 25)	20.4 (1.5)	16.1 (1.7)	38.3 (3.7)		37.5 (0.2)
Overweight (25-29)	42.1 (1.9)	45.0 (2.2)	29.9 (3.8)		36.5 (0.2)
Obese (> 30)	37.5 (1.8)	38.9 (2.1)	31.7 (3.6)		26.0 (0.2)
Alcohol status				0.219	
Never/former	22.0 (1.6)	21.6 (1.9)	23.5 (3.2)		28.9 (0.2)
Current ≤ 3 drinks/week	56.2 (1.8)	55.2 (2.1)	60.1 (4.0)		48.1 (0.2)
Current > 3 drinks/week	21.9 (1.6)	23.2 (1.9)	16.4 (3.3)		22.9 (0.2)
Hours of sleep (per day)	6.8 ± 0.1	6.8 ± 0.1	6.9 ± 0.1	0.671	7.0 ± 0.0
Numbers of drinks on days drank	3.8 ± 0.5	4.0 ± 0.6	2.8 ± 0.6	0.170	3.1 ± 0.0
BMI (kg/m ²)	29.3 ± 0.2	29.7 ± 0.2	27.8 ± 0.5	0.001	27.4 ± 0.0
Physical activity (hours/week)	4.8 ± 0.3	5.1 ± 0.3	3.6 ± 0.3	< 0.001	3.6 ± 0.0
Psychological distress					
So sad				0.059	
All/most/some of the time	4.7 (0.7)	4.0 (0.8)	7.7 (1.9)		8.0 (0.1)
A little of the time	6.3 (1.0)	5.5 (1.0)	9.9 (2.6)		12.1 (0.1)
None of the time	88.9 (1.2)	90.5 (1.3)	82.4 (3.1)		80.0 (0.2)

Table 1. Continued

Covariate	All	Male	Female	p-value*	US workers
Nervous				0.016	
All/most/some of the time	9.3 (1.1)	7.7 (1.0)	15.9 (3.1)		13.5 (0.2)
A little of the time	12.9 (1.2)	12.2 (1.4)	15.5 (2.8)		19.0 (0.2)
None of the time	77.8 (1.6)	80.1 (1.7)	68.6 (4.0)		67.5 (0.2)
Restless/fidgety				0.752	
All/most/some of the time	12.3 (1.2)	12.1 (1.3)	13.2 (2.8)		15.4 (0.2)
A little of the time	14.7 (1.3)	15.1 (1.6)	13.1 (2.3)		15.7 (0.2)
None of the time	73.0 (1.7)	72.9 (1.9)	73.8 (3.3)		68.9 (0.2)
Hopeless				0.112	
All/most/some of the time	1.9 (0.5)	1.4 (0.5)	4.2 (1.5)		4.1 (0.1)
A little of the time	2.1 (0.5)	1.8 (0.5)	3.3 (1.1)		4.9 (0.1)
None of the time	96.0 (0.7)	96.9 (0.8)	92.5 (2.0)		91.0 (0.1)
Everything was an effort				0.167	
All/most/some of the time	7.7 (1.1)	7.3 (1.2)	9.2 (2.6)		10.8 (0.1)
A little of the time	7.0 (0.9)	6.0 (1.0)	11.0 (2.7)		10.3 (0.1)
None of the time	85.3 (1.3)	86.6 (1.4)	79.8 (3.5)		78.9 (0.2)
Worthless				0.147	
All/most/some of the time	1.5 (0.4)	1.1 (0.4)	3.0 (1.2)		3.0 (0.1)
A little of the time	1.8 (0.5)	2.1 (0.6)	0.9 (0.6)		3.5 (0.1)
None of the time	96.7 (0.6)	96.8 (0.7)	96.1 (1.3)		93.5 (0.1)
Psychological distress level				0.044	
Moderate/high (K6 ≥ 5)	8.1 (1.0)	7.3 (1.1)	11.3 (2.7)		14.7 (0.2)
Mild (1 ≤ K6 ≤ 4)	32.4 (1.9)	31.1 (2.1)	37.9 (4.0)		33.8 (0.2)
No (K6 = 0)	59.5 (2.0)	61.7 (2.2)	50.7 (4.0)		51.6 (0.3)
Serious psychological distress (K6 ≥ 13)	0.91 (0.33)	0.56 (0.33)	2.03 (0.93)	0.138	1.57 (0.04)
Total psychological distress score	1.32 ± 0.10	1.19 ± 0.10	1.82 ± 0.25	0.020	1.96 ± 0.02

Values are presented as percentage (standard error) or mean ± standard error.

Sample number/estimated population: all, 929/1,180,440; male, 698/950,237; female, 231/237,203; US workers, 105,862/131,822,554.

*p-values are for differences between women and men from Student's t-tests or χ^2 tests for independence.

NHIS: National Health Interview Survey, GED: General Educational Development Test, BMI: body mass index; K6: Kessler 6.

(score = 0). The total psychological distress score was the sum of the six items with a range of 0-24. Since the number of participants in the serious psychological distress category (K6 ≥ 13) for the LEOs was very small, we used Prochaska's cut-point of K6 ≥ 5 as moderate/high mental distress in our analyses [22].

Covariates

The NHIS Sample Adult module collected socio-demographic information including age (≥ 18 years), gender, race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic all other race groups), marital status (single/never married, married, separated/divorced/widowed), highest level of education completed (from never attended/kindergarten to doctoral degree), income earned last year (11 levels from USD

0 to USD 75,000 or more), having more than one job (yes, no), and number of years in the law enforcement profession. Lifestyle information included smoking status (never, former, current), alcohol status (never/former, current [≤ 3 drinks/week], current [> 3 drinks/week]), hours of sleep per day, and leisure-time physical activity (hours per week). To assess leisure-time physical activity, participants were asked to summarize their usual physical activity both in terms of frequency and duration while engaging in aerobic physical activity or muscle-strengthening activity. Hours of leisure-time physical activity per week was calculated based on the frequency and duration. The term "physical activity" in our study refers to leisure-time physical activity. After we assessed effect modification by physical activity and found that it was significant, we examined the

association between psychological distress and obesity while stratifying on physical activity which was dichotomized at the median.

Statistical analysis

In order to more accurately represent the population of the United States, all analyses were performed using a weighting variable, which was divided by seven to take into consideration the seven survey years 2004-2010. Statistical comparisons of cross-tabulated prevalence and mean estimates were analyzed using chi-square tests or the Student's t-tests, respectively. We also investigated whether characteristics of the LEOs varied by survey year. After performing bivariate analysis, regression analyses were used to determine if psychological distress was associated with obesity. We assessed effect modification by gender due to the fact that women and men may process psychological distress in different ways and also tend to have different levels of BMI. We also assessed effect modification by physical activity because physical activity may influence both psychological distress and obesity. Since age, race, annual income, and education level were strongly associated with both psychological distress and BMI, we included them in the multivariate analysis as confounders. We also included age as confounder because it has been strongly related to psychological distress and BMI in previous studies [23,24]. All data that we used met the standard of statistical reliability, i.e., relative standard error (standard error/mean) < 30% which is found in the guidelines of the National Center for Health Statistics [25]. To attain unbiased estimates from the NHIS data, all analyses were weighted to account for the complex survey design and survey non-response using the SAS-callable SUDAAN 10.0 software (Research Triangle Institute, Research Triangle Park, NC, USA) with Taylor series linearization methods for NHIS variance estimation. The cut point for statistical significance was $p < 0.05$.

Results

Table 1 shows descriptive statistics for demographics and other selected characteristics for LEOs and the United States workers. The average age of all LEOs ($n = 929$) was 39.3 years. The prevalence of current smoking was higher (though not statistically significant) in women than in men (20.4% vs. 13.5%). As expected, male and female LEOs differed with respect to BMI ($p < 0.001$). For example, the prevalence of being overweight ($25 \leq \text{BMI} < 30 \text{ kg/m}^2$) or obese ($\text{BMI} \geq 30$) was significantly higher among male LEOs than among female LEOs (83.9% vs. 71.7%), however, male officers spent more time in physical

activity compared to female officers (5.1 hours/week vs. 3.6 hours/week; $p < 0.001$). The mean total psychological distress score among all LEOs was 1.32. Female LEOs had significantly higher mean levels of psychological distress score than male LEOs (1.82 vs. 1.19; $p = 0.020$). The score for "restlessness" was highest among the male LEOs, followed by "nervousness" and "high effort" (Fig. 1). Among female LEOs, "nervousness" had the highest score. The mean level of "nervousness" was almost twice as high in female compared with male LEOs, and female LEOs also reported higher scores for "sadness", "hopelessness", and "worthlessness" than the male LEOs.

The association between selected characteristics and psychological distress is presented in Table 2. There was a slightly higher prevalence of officers with less education in the highest distress category. Similarly, a larger proportion of officers in the moderate and high distress group had low annual income (< USD 35,000) than for those in the mild and no distress categories. Officers with high distress reported a significantly lower mean sleep duration compared to those with mild and no distress (6.5 hours/week, 6.8 hours/week, 6.9 hours/week respectively; $p = 0.003$).

Table 3 shows the association between psychological distress and BMI, stratified by gender. Among female officers, mean BMI increased significantly with increasing psychological distress (no distress, $\text{BMI} = 27.2 \text{ kg/m}^2$; mild distress, 27.6 kg/m^2 ; and moderate/high distress, 33.1 kg/m^2 ; $p = 0.016$) after adjustment for age, race, annual income, and education level. There was no association between psychological distress and BMI among male officers. Survey year was not shown to be a confounder so it was excluded from the final models of Tables 3, 4.

Physical activity was a significant effect modifier in the

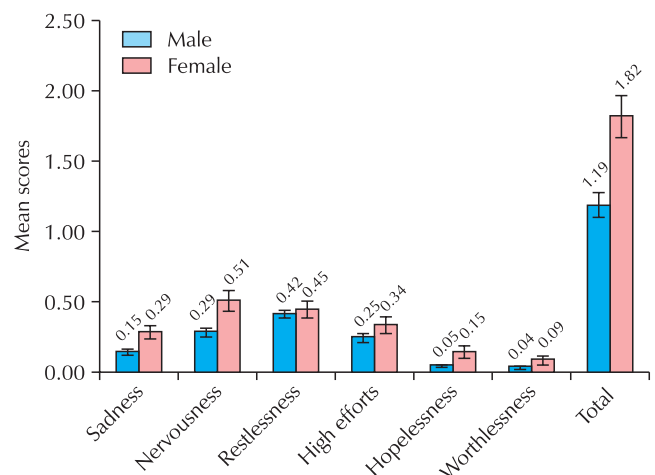


Fig. 1. Mean psychological distress scores in law enforcement officers by gender. "I" bar indicates the standard error.

Table 2. Associations between psychological distress and selected characteristics in law enforcement officers: NHIS (2004-2010)

Covariate	Psychological distress			p-value*
	None (K6 = 0; n = 554)	Mild (1 ≤ K6 ≤ 4; n = 320)	Moderate/high (K6 ≥ 5; n = 55)	
Gender				0.021
Male	83.4 (1.8)	77.2 (2.4)	72.6 (6.3)	
Female	16.6 (1.8)	22.9 (2.4)	27.4 (6.3)	
Race/ethnicity				0.029
White (non-Hispanic)	62.7 (2.5)	78.1 (2.5)	62.6 (6.3)	
Black (non-Hispanic)	17.4 (1.8)	13.3 (2.0)	12.2 (3.8)	
Hispanic	16.4 (2.0)	7.3 (1.5)	17.3 (5.8)	
All other (non-Hispanic)	3.5 (1.0)	1.3 (0.6)	7.9 (3.2)	
Marital status				0.470
Single	18.2 (1.9)	17.5 (2.3)	26.6 (5.6)	
Married	65.8 (2.5)	69.3 (2.7)	58.0 (6.4)	
Divorced	16.0 (1.9)	13.2 (1.7)	15.4 (3.7)	
Education				0.074
≤ High school/GED	22.9 (2.2)	25.4 (3.0)	32.5 (6.5)	
Some/associate college	39.8 (2.7)	37.1 (3.4)	41.4 (7.2)	
≥ 4 years college	37.3 (2.3)	37.4 (3.4)	26.0 (6.0)	
Annual income (USD)				0.037
< 35,000	25.9 (2.7)	22.2 (2.7)	43.9 (6.7)	
35,000-65,000	42.7 (2.8)	44.7 (3.4)	34.7 (7.2)	
> 65,000	31.5 (2.6)	33.1 (3.2)	21.4 (5.7)	
Smoke status				0.303
Never	66.7 (2.5)	61.7 (3.4)	63.4 (7.0)	
Former	20.0 (2.2)	22.2 (3.1)	15.9 (5.1)	
Current	13.3 (1.8)	16.1 (2.4)	20.7 (5.5)	
Alcohol status				0.785
Never/former	22.6 (2.0)	20.7 (2.7)	22.4 (5.9)	
Current-light (≤ 3 drinks/week)	57.7 (2.4)	53.5 (3.3)	55.3 (6.6)	
Current-heavy (> 3 drinks/week)	19.7 (2.0)	25.8 (3.1)	22.3 (6.4)	
Second job				0.335
Yes	10.4 (1.5)	16.5 (2.6)	9.9 (3.6)	
No	89.6 (1.5)	83.5 (2.6)	90.1 (3.6)	
Age (year)	39.0 ± 0.5	40.1 ± 0.7	39.0 ± 1.3	0.460
Duration of service (year)	9.5 ± 0.4	10.1 ± 0.5	9.4 ± 1.1	0.972
Hours of sleep (per day)	6.9 ± 0.1	6.8 ± 0.1	6.5 ± 0.1	0.003
Physical activity (hours/week)	4.4 ± 0.3	5.3 ± 0.5	5.4 ± 1.0	0.342

Values are presented as percentage (standard error) or mean ± standard error.

NHIS: National Health Interview Survey, K6: Kessler 6, GED: General Educational Development Test.

*For nominal variables (gender, race, marital status, smoke status, alcohol status, second job), the p-values were obtained from Cochran-Mantel-Haenszel analysis of variance-type test (SUDAAN 10 Example Manual, 2008). For continuous or ordinal variables (age, education, income, years of service, sleep duration, physical activity), the p-values were obtained from linear association.

Table 3. Mean BMI by psychological distress and gender; NHIS (2004-2010)

	Psychological distress			p-value*
	No distress (K6 = 0)	Mild (1 ≤ K6 ≤ 4)	Moderate/high (K6 ≥ 5)	
Men (n)	434	215	49	
Model 1	29.6 ± 0.3	29.9 ± 0.5	30.0 ± 0.9	0.291
Model 2	29.5 ± 0.3	29.9 ± 0.5	30.0 ± 0.9	0.239
Model 3	29.6 ± 0.3	30.0 ± 0.5	30.2 ± 0.9	0.304
Women (n)	120	85	26	
Model 1	27.2 ± 0.5	27.4 ± 0.6	31.7 ± 3.1	0.064
Model 2	27.1 ± 0.6	27.3 ± 0.5	32.5 ± 3.1	0.013
Model 3	27.2 ± 0.7	27.6 ± 0.6	33.1 ± 3.2	0.016

Values are presented as mean ± standard error.

Model 1: unadjusted; Model 2: adjusted for age, race/ethnicity; Model 3: adjusted for age, race/ethnicity, annual income, and education.

*The p-values are from linear regression.

Interaction p-value = 0.192 for psychological distress*gender.

BMI: body mass index, NHIS: National Health Interview Survey, K6: Kessler 6.

Table 4. Unadjusted and adjusted mean BMI across psychological distress categories stratified by physical activity among male law enforcement officers, NHIS (2004-2010)

	Psychological distress			p-value*
	No distress (K6 = 0)	Mild (1 ≤ K6 ≤ 4)	Moderate/high (K6 ≥ 5)	
Low PA (0-<3.25 hours/week)	214	110	N=23	
Model 1	30.1 ± 0.4	30.5 ± 0.6	32.1 ± 1.5	0.094
Model 2	30.1 ± 0.4	30.5 ± 0.6	32.2 ± 1.5	0.079
Model 3	30.3 ± 0.5	30.7 ± 0.6	31.8 ± 1.6	0.179
High PA (3.25+ hours/week)	219	105	26	
Model 1	29.0 ± 0.4	29.3 ± 0.7	28.5 ± 1.2	0.873
Model 2	29.1 ± 0.4	29.2 ± 0.7	28.4 ± 1.0	0.665
Model 3	29.1 ± 0.4	29.2 ± 0.7	28.8 ± 1.0	0.861

Values are presented as number or mean ± standard error.

Model 1: unadjusted; Model 2: adjusted for age, race/ethnicity; Model 3: adjusted for age, race/ethnicity, annual income, and education.

*The p-values are from linear regression models.

Interaction p-value <0.002 for psychological distress*physical activity among male law enforcement officers.

BMI: body mass index, NHIS: National Health Interview Survey, K6: Kessler 6, PA: Physical Activity.

relationship between the psychological distress and obesity among male LEOs (interaction p-value = 0.002) but not among female LEOs (interaction p-value = 0.860). Table 4 shows the association between psychological distress and BMI, stratified by physical activity for male LEOs. Among male officers reporting low physical activity, mean levels of BMI slightly increased as levels of psychological distress increased, but the

trend was not statistically significant. This association was less striking and also not significant among male officers who reported high physical activity.

Discussion

This study shows that psychological distress was positively as-

sociated with BMI in female LEOs. There are few published studies that have investigated the association between psychological distress and obesity among LEOs. However, many more studies have been identified that have investigated the association between work-related stress and obesity. Findings regarding the association between high work distress and obesity among workers show mixed results. One study found no significant association between work stress and obesity [26]. Authors of a British cohort study [14] reported that job stress was a risk factor for weight gain depending on the baseline weight. Among workers with a BMI of $< 22 \text{ kg/m}^2$ at baseline, job stress resulted in weight loss, whereas among workers with a BMI of $> 27 \text{ kg/m}^2$ at baseline, it was associated with weight gain [14]. A longitudinal study conducted in the United States showed that increased psychosocial stress related to job-related demands was a risk factor for weight gain among adult males [11]. Other studies have reported that workplace stress is associated with higher uncontrolled eating [16] and increased obesity [13,27].

The current study found that the prevalence of serious psychological distress ($K6 \geq 13$) among all LEOs was much lower (0.91%) compared to the average prevalence of United States working adults (1.57%). This result may suggest that LEOs are mentally healthy because good mental and physical health are pre-requisites for acceptance into the profession. Our study showed that female LEOs had more than triple the prevalence of serious psychological distress (i.e., $K6 > 13$) than male LEOs (2.03% vs. 0.56%, respectively) although overall prevalence was low. It is possible that female LEOs may experience greater occupational stress in the male-dominated profession of law enforcement [28-30]. Yoo and Franke [28] reported that female officers had significantly higher scores on perceived stress, job strain, vital exhaustion, and effort reward imbalance than male officers. Examples of work-related stressors that may be more likely to affect female officers are confronting death, violence, work schedule, gender discrimination, relationship with coworkers, and workload [29,30]. Recent studies [9,28] have reported that stressors among female officers, such as organizational problems and lack of support, were associated with more adverse cardiovascular risk factor levels and certain chronic diseases (metabolic syndrome, hypercholesterolemia, and diabetes). In our study, nervousness, restlessness/fidgeting, and high effort were associated with the most psychological distress regardless of gender. Our study also showed that female officers had a higher prevalence of nervousness than male officers. Psychological distress may operate through various factors (including several lifestyle behaviors such as levels of physical activity, dietary habits, and sleep habits) to influence weight. According

to the American Psychological Association [31], sedentary behaviors (e.g., watching television, drinking, smoking, playing too many video games and surfing the internet) could have serious implications for weight gain. After stratification by physical activity, mean BMI increased with increasing psychological distress among male LEOs with low levels of physical activity, but the association was not significantly significant.

Some individuals may use food as a means of coping with distress. Those with high levels of distress may change their food choices from healthy foods (e.g., low fat) to unhealthy foods (e.g., high hydrogenated fat) and may also increase their food consumption [32,33]. Torres and Nowson [34] reviewed several studies and concluded that chronic stress was associated with higher consumption of high-sugar and high-fat foods and was related to weight gain in men. Fernandez and colleagues [15] reported that chronic and acute occupational stressors increased BMI among workers in upstate New York. We were unable to find published studies that investigated the association of distress with dietary changes or food intake among LEOs. However, a study conducted among transit workers suggest that dietary changes may be related to long work hours and shift work [35]. Persons who are scheduled to work on the night shift are known to have limited access to healthy restaurants, and they may be more likely to eat fast foods which contain high levels of fat and sugar [35]. Emotional and stress-related eating is associated with increased food intake which can lead to overweight and obesity [27,36,37].

Some officers may drink alcohol to cope with the strains and pressures of their work or in socialization with coworkers. Davey et al. [38] reported that 30% of officers in an Australian state police service were at risk of harm from excessive alcohol consumption. Heavy alcohol drinking, which is associated with increased caloric intake, has been linked to an increased BMI [39,40]. Previous research [41], however, found that among police officers in Mississippi, those with the greatest risk of drinking problems were young, white, and unmarried day-shift officers. Also, the prevalence of drinking among Mississippi officers was similar to that of the United States general population [41]. Our study confirmed that the prevalence of drinking > 3 drinks/week (21.9%) among LEOs was similar to that of NHIS United States workers (22.9%), but the average number of drinks per occasion (3.8) for LEOs was slightly higher than that of United States workers (3.1). Studies have shown that those with hazardous drinking behaviors had fewer occasions for drinking than the non-hazardous group, but consumed more drinks per occasion [39,41]. Lindsay [41] also reported that officers on the day shift were at greater risk for alcohol problems since most alcohol drinking occurs during the eve-

nings. Gu and colleagues [42] showed alcohol drinking was positively correlated with waist circumference and abdominal height. Therefore, if officers drink excessively to cope with the challenges of their duties, this practice may adversely affect body weight and BMI.

A recent study conducted on a sample of the United States police officers reported significant inverse associations between perceived stress and sleep duration [43]. The authors also found that, in the fourth quartile of perceived stress, female officers were almost four times more likely and male officers were about six times more likely to experience poor sleep quality compared to officers in the first quartile of perceived stress. These findings have public health implications for obesity since studies have shown short sleep duration to be positively associated with metabolic syndrome and obesity [44,45].

One biological mechanism through which psychological stress may be associated with obesity is through increased cortisol production. Cortisol, a hormone which is secreted by the adrenal glands and is responsible for maintaining homeostasis, may be a physiological measure of stress. Chronic psychological stress prolongs high levels of cortisol, which have negative health effects such as hyperglycemia [46], elevated blood pressure and diminished heart rate variability [47], increased abdominal obesity [48,49], and metabolic syndrome [50]. Dallman [36] reported that persons who experience stress typically choose foods with high fat and sugar content even if they are neither hungry nor have a homeostatic need for calories, and concluded that stress and the brain stress networks promoted personal eating behaviors that may lead to obesity. Police studies reported that officers with post-traumatic stress disorder had higher awakening salivary cortisol levels [51], and cortisol dysregulation was apparent in male officers with metabolic syndrome [52]. In the highly stressful work environment of law enforcement, it is quite possible that LEOs may be experiencing chronic stress. Therefore the higher levels and prolonged elevation of cortisol may result in increased blood sugar and body fat.

Limitations and strengths

There are several limitations in this study. First, information bias may be present regarding BMI values due to the fact that height and weight were self-reported. Under-reporting weight and over-reporting height in the survey may have caused BMI to be underestimated, especially among obese women [53]. However, this type of bias would tend to influence the results toward the null (i.e., weaker or no significant association). In addition, use of self-reported information for BMI has been shown to be highly correlated with measured BMI in a previous

study [54]. Second, this cross-sectional study design precludes inferences of cause and effect. For instance, the statement that the higher psychological distress was associated with higher BMI does not imply causality nor does it indicate the temporal nature of the association. It is not possible to determine the temporal sequence with this study design. Although we do not know the temporal relationship between psychological distress and obesity, we have analyzed psychological distress as though it were the exposure and obesity as the outcome based on previous studies. Two studies [55,56] have shown that psychological stress or worksite stress had a negative influence on obesity. Another study [57] found that psychological well-being was associated with weight loss and with improved nutritional behaviors. Third, since the psychological distress questionnaires were designed for the national survey, the six items (i.g., sadness, nervousness, restlessness, high efforts, hopelessness, and worthlessness) may not be sufficient to cover all stressors inherent in the law enforcement profession. In addition these questionnaires were used to assess general psychological distress and were not designed to measure work-related stress specifically.

There are also strengths to this study. To our knowledge, this study is the first to investigate the association between psychological distress and obesity in current LEOs. The sample size allowed for adequate power even after stratification by gender and physical activity. Another major strength of this study is that it was conducted in a nationally representative sample of the United States population.

In summary, our study showed that psychological distress was positively associated with BMI in female LEOs. In the highly stressful work environment of law enforcement, it is quite possible that LEOs may be experiencing chronic stress. Identifying interventions to control stress or decrease its effect on overweight and obesity may be critical in female LEOs. A longitudinal study design may reveal the directionality of the association between psychological distress and BMI as well as the potential role that physical activity might play in this association.

Conflict of Interest

No potential conflict of interest relevant to this article was reported. The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

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