Safety and Health at Work 8 (2017) 36–41

Contents lists available at ScienceDirect

Safety and Health at Work

journal homepage: www.e-shaw.org

Original Article

Associations Between Body Fat Percentage and Fitness among Police Officers: A Statewide Study

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ARTICLE INFO

Article history:
Received 11 September 2015
Received in revised form
26 May 2016
Accepted 13 July 2016
Available online 3 August 2016

Keywords:
body fat
fitness
police
sex

ABSTRACT

Background: Police work is generally sedentary although there may be situations that require physical endurance and strength, such as foot chases and arresting suspects. Factors such as excessive body fat can impede an officer's physical ability to deal with such occurrences. Our objective was to examine associations between officers' body fat percentage (BF%) and performance on a standardized fitness protocol.
Methods: Data were obtained from fitness screening among 1,826 male and 115 female officers in a large US police agency. The screening consisted of a 2.4-km run, push-ups, sit-ups, and sit-and-reach test. Sex-specific body fat percentages were estimated from skinfold thickness measured using calipers. Linear regression models were used to examine unadjusted and adjusted mean scores of fitness tests across BF% tertiles.
Results: The prevalence of overall fitness was 4.3 times greater in male officers and 3.6 times greater in female officers having the lowest BF% tertile compared with the highest tertile (30.3% vs 7.1% and 46.0% vs 12.8%, respectively). BF% was linearly and positively associated with the time of 2.4-km run ($p < 0.001$), and linearly and inversely associated with the number of push-ups ($p < 0.001$), sit-ups ($p < 0.001$), and the distance of sit-and-reach ($p < 0.001$) in men. Similar associations were observed in women with the exception of sit-and-reach ($p = 0.122$). Associations were independent of age, race/ethnicity, rank, and duty station.
Conclusion: Overall, BF% was inversely associated with fitness levels in male and female officers. Future longitudinal studies should be initiated to explore the potentially causal relationship between BF% and fitness in law enforcement officers.

1. Introduction

Those who work in the occupation of policing face a physical fitness predicament. On the one hand, police officers experience unexpected physical challenges that require strength, dexterity, and good physical conditioning. Examples are subduing or foot chasing a suspect, climbing fences, or conducting critical life-saving activities. On the other hand, the majority of work time involves sitting in patrol cars, writing reports, or interviewing persons placing the officer at a higher risk for obesity. A large US cohort study of women has shown that each 2-hour increment in sitting time at work is associated with a 7% increase in type 2 diabetes [1]. Mummery et al [2] found that occupational sitting time was independently associated with overweight and obesity in men.

Despite the fact that the preponderance of police work is sedentary, it is essential that officers be prepared for those types of activity that require good physical conditioning. Bullock [3] found that an officer who was more physically fit was more likely to achieve better work performance. Nabeel et al [4] explored the association between fitness and injury among police officers and found that the officers who reported the highest fitness level were less likely to experience sprains, back pain, and chronic pain than

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2093-7911/$ – see front matter
http://dx.doi.org/10.1016/j.shaw.2016.07.004

those who reported the lowest level of fitness. Sassen et al reported an inverse association between fitness level and the prevalence of metabolic syndrome [5]. Researchers from the Cooper Institute for Aerobics Research selected a random sample of about 1,700 officers from different law enforcement agencies across the USA to compare the officers' fitness levels with the general population [6]. The researchers found that the officers had lower than average scores in aerobic fitness and abdominal strength tests, and were at the same level in upper body strength and lower-back flexibility. Then they concluded that the law enforcement officers were less fit than at least half of all the population despite the fact that the policing occupation requires the officers to be more fit than the general population.

However, previous studies have reported that police officers do not maintain an optimal fitness level. The work of Lagestadt and van den Tillaar [7] found that the maximal strength training and bodybuilding decreased significantly after 3 years of police service. In a 15-year follow-up study on Finnish police officers, Sorensen et al [8] found that police officers' muscular performance declined with years of service and they gained 0.5 kg of weight per year. Lagestad et al [9] compared police officers' physical fitness test results at academy graduation with the results from the same type of test taken after 16 years of work as police officers. The police officers' fitness levels decreased approximately 10–32% on all four physical tests (bench press, pull-ups, standing long jump, and 3,000-m run) for male officers, and the bench press and standing long-jump for women after 16 years of service.

Body fat percentage (BF%) has been related to physical conditioning in previous studies and may be a better indicator than body mass index (BMI) of health status and fitness [10]. BMI is often used as criterion for physical fitness during police work entry assessments. However, there are some individuals who have high BMI scores due to heavy muscle content and others who have BMI scores within the normal range and yet have a high BF% [11]. A study of college students by Pribis et al [12] found that on average in the last 13 years, BF% was increasing 0.513% per year for men and 0.654% per year for women. BF% among students increased approximately 6% on average over a period of 13 years. There was a significant association between students' BF% and decline in VO_{2max}—the highest rate of oxygen consumption attainable during maximal or exhaustive exercise. Nikolaidis [13] examined young soccer players and found an inverse relationship between BF% and aerobic power and muscular endurance. Miller et al [14] explored the effects of body composition on performance among college football players. Their study found that increased BF% is a valid predictor of a decline in performance among players.

BF% has been reported to increase with increasing years of police service. Boulos et al found that among 286 police officers body composition increased significantly over a 12 years for both sexes. Boyce et al [16] reported that police officers had developed increasing amounts of body fat over a period of 12 years regardless of race or sex. The percentage of officers who became obese was markedly greater in the highest percent fat group. McCartney et al found that both BMI and BF% affected performance on a physical ability test. Linear regression analysis revealed that 44% of the variance in performance time was attributed to BF% and BMI. Ciulla et al [18] examined physical fitness differences in police and firefighters. Male officers weighed more and had higher BF% than male firefighters. There was a considerable difference between the percentage of obese women and obese men with women having a higher percentage of obesity than men.

The objective of the present study was to examine whether BF% is associated with physical fitness among police. The present study is unique in several ways: (1) the sample size is larger than most studies on this topic and covers a wide geographical area; (2) male and female officers' BF% were compared across all fitness tests and adjusted for covariates; and (3) BF% was assessed at distinct levels (tertiles) in association with physical fitness standards.

2. Materials and methods

2.1. Source of data

A northeastern state police agency in the USA recognized that it was urgent to address the issue of a low level of physical fitness in police officers as well as their health status, weight management, nutrition, and stress management. The agency took two steps to address these issues. The first was to redesign the entrance tests given to trooper candidates. The Cooper tests that consisted of push-ups, sit-ups, sit-and-reach, and the 2.4-km run, established by Dr Kenneth H. Cooper, were chosen by the agency. The 50th percentile of the Cooper Standard [19] was set as the criterion to measure a candidate's physical fitness level in each test. If a candidate reached the 50th percentile in all the four tests, he/she might be considered for future employment. The Cooper Standards were generated from 25,000 US adults; therefore, the qualified candidates were considered as at the average fitness level of the US general population. Once accepted for employment, the candidates would be required to reach the 70th percentile of the standard as a condition of employment during basic training at the academy. The rationale for this was that troopers were expected to perform independently in the field with little support. A fitness educational curriculum was also recommended to teach potential troopers how to maintain an individual fitness program after they leave the academy. The second step was for active duty officers. The statewide Police Fitness Incentive Program was implemented in 1998. The base incentive levels varied by police rank and started at the 50th percentile, then went up in 5% increments to the 90th percentile.

Data for the present study were obtained from the Fitness Incentive Program. The fitness screening participation was voluntary. All officers ($n = 3,019$) in the police agency were invited and 2,611 (86%) of them participated in the incentive program. The present analysis excluded 670 officers who did not have BF% measured, generating a sample size of 1,941 including 1,826 men and 115 women. The tests took place at police headquarter stations within 10 regions in the state and a majority of participants were tested at their duty station.

2.2. Fitness screening

The fitness screening consisted of four tests: a 2.4-km run, push-ups, sit-ups, and sit-and-reach. The timed 2.4-km run assessed the officer's cardiorespiratory fitness. The number of push-ups and sit-ups completed within one minute assesses a police officer's dynamic strength. The sit-and-reach test measures an officer's flexibility. Police officers who received fitness training from the Cooper Institute for Aerobics Research administered the test procedures. All procedures followed the fitness screening protocol developed by the Cooper Institute [20]. Each participant's test results were recorded. The shorter the time in 2.4-km run, the higher the level of cardiorespiratory fitness for a participant; while the larger the number of push-ups and sit-ups, the higher the level of fitness in terms of dynamic strength; and similarly, the larger the number for sit-and-reach, the higher level of fitness in terms of flexibility.

2.3. Body fat assessment

Body fat was estimated from skinfold thickness measurements obtained using skinfold calipers, which were purchased from the

Cooper Institute (Dallas, TX, USA). Sex-specific skinfolds from three locations (chest and abdomen for men, triceps and suprailium for women, and thigh for both sexes) were measured from the right side of the body. If scar tissue was present at any of the locations, all measurements for that participant were taken on their left side. Three measurements were obtained from each location and the most frequent reading was selected. If the first three measurements were not consistent, the next location would be measured and then the observer would return to the previous location to repeat the procedure. The measurements were rounded to the nearest 0.1 mm.

Previously published statistical approaches were used to estimate a participant's body fat percentage from the measured skinfold thickness [21]. Specifically, the following two steps were taken in the computation. First, we estimated the age-specific body density (BD) separately for men and women. Then we applied Siri's equation, i.e. $BF\% = [(4.95/BD - 4.5) \times 100]$ to calculate BF% for both men and women [22].

2.4. Demographic information

Geographical test sites across the northeast state were collapsed into urban, suburban, and rural. Officers were categorized by self-reported race/ethnicity as white, African American, Hispanic, Asian, and Native American. Due to the small number of Asian and Native Americans, these two ethnic groups were collapsed into one (Asian/Native American) for descriptive purposes. In the multiple regression analysis, Hispanic and Asian/Native American groups were combined with African American. Police rank was categorized as Captain, Lieutenant, Sergeant, and patrol officer, and was further collapsed as high (Captain/Lieutenant/Sergeant) and low (patrol officer) for adjustment. Years of police service were categorized as 1–3, 4–6, 7–9, and 10+ for descriptive purposes.

2.5. Statistical analysis

To estimate the prevalence of fitness in police officers, we dichotomized each test result using the 70th percentile of the New Cooper Age and Gender Base Standards for Law Enforcement [19] as a cut point. An officer was considered as being fit if their test result reached or exceeded the 70th percentile from the Cooper standard for each specific test. Appendix I, which was derived from these standards, provides the age- and sex-specific cut points of the 70th percentile for each test. There were four age groups for male and female police officers in the appendix: 20–29 years, 30–39 years, 40–49 years, and 50–59 years. For a male officer, the cut points were 10 minutes (′) and 49 seconds (″) for a 2.4-km run, 41 per minute for push-ups, 45 per minute for sit-ups, and 49.5 cm for sit-and-reach for the first age group (20–30 years), 11′09″, 34, 41, and 47.0 cm, respectively, for the second group; 11′52″, 26, 36, and 44.5 cm, respectively, for the third group; and 12′53″, 21, 31, and 41.9 cm, respectively, for the fourth age group. For a female officer, the cut points were 12′51″, 24, 41, and 54.6 cm for the first age group; 13′41″, 18, 32, and 52.1 cm for the second group; 14′33″, 14, 27, and 50.3 cm for the third age group; and 16′26″ for a 2.4-km-run, 22 for sit-ups, and 19.3 for sit-and-reach for the fourth age group. The cut point for push-ups was not available at the time of the fitness test. The 70% cut point for a police officer was above the recommended 50% level for the general population due to extra physical demands of their profession [23]. The prevalence of fitness in each individual test as well as the prevalence of overall fitness (i.e., a participant reached the 70th percentile in all the four tests) was calculated. For female officers at age 50 years and older, we used the cut point of the 70th percentile for the 40–49 age group in the push-ups test because at the time of this test the Cooper Institute had not developed a standard for the female officers at age 50 years and above.

Sex-specific descriptive statistics were used to describe the characteristics of male and female participants. Age, race/ethnicity, rank, and test site were selected as potential confounders for the association between BF% and physical fitness. The Chi-square and Student t tests were performed to assess the differences in demographic characteristics between male and female officers. The Cochran–Armitage trend test was used to test the trend of fitness prevalence across BF% tertiles in men and women. Simple and multiple linear regression models were used to examine the unadjusted and adjusted associations of BF% with fitness levels separately in men and women. All analyses were conducted using the SAS 9.3 (SAS Institute, Cary, NC, USA).

Table 1
Demographic characteristics of police officers from a northeastern state police agency in the USA ($N = 1{,}941$)

	Total participants ($N = 1{,}941$)		Men ($n = 1{,}826$)	Women ($n = 115$)	p
	n	Mean (SD) or %	Mean (SD) or %	Mean (SD) or %	
Age (y)	1,941	35.3 (6.7)	35.5 (6.8)	33.0 (4.8)	< 0.001
Body fat	1,941	16.5 (5.1)	16.2 (4.9)	22.0 (4.8)	< 0.001
Years in service	1,932	11.0 (6.5)	11.1 (6.6)	9.2 (5.0)	< 0.001
Age (y)					
20–29	371	19.1	18.8	24.4	0.004
30–39	1,130	58.2	57.7	66.1	
40–49	348	17.9	18.5	9.6	
50–59	92	4.7	5.0	0.0	
Race/ethnicity					0.001
White	1,586	87.1	80.8	95.7	
Black	205	10.6	11.1	2.6	
Hispanic	139	7.2	7.6	0.9	
Asian/Native American	11	0.6	0.6	0.9	
Rank					0.592
Patrol officer	1,516	78.1	78.0	80.0	
Captain	54	2.8	2.9	0.9	
Sergeant	306	15.8	15.7	16.5	
Lieutenant	65	3.4	3.4	2.6	
Service (y)					0.004
1–3	249	12.9	13.0	11.3	
4–6	364	18.8	18.1	31.3	
7–9	267	13.8	13.8	14.8	
10+	1,052	54.5	55.2	42.6	
Geographical location					0.039
Urban	432	22.3	22.1	24.4	
Suburban	1,192	61.4	61.0	67.8	
Rural	317	16.3	16.9	7.8	

The p values were obtained from Chi-square for categorical variables or the t test for continuous variables.

3. Results

The average age of the 1,941 officers was 35.3 years (Table 1). About 87% of the participants were white and 78% were patrol officers. More than half of them had more than 10 years of police service, and about 60% worked in suburban areas. Male officers accounted for 94% of the total participants, were older, had more years of service, and had less body fat than their female counterparts (BF%: 16.2% vs. 22% respectively). Male participants were significantly different from the female officers in ethnic background and the geographical locations; the proportion of African Americans or Hispanics was higher in men, and male officers were less likely to serve rural areas than women.

BF% was associated with prevalence of overall fitness in both male ($p < 0.001$) and female officers ($p = 0.001$; Table 2). The

Table 2
Unadjusted prevalence of fitness by body fat percentage (%BF) tertiles stratified by sex in police officers from a northeastern state police agency in the USA ($N = 1{,}941$)

%BF tertiles	2.4-km run		Push-ups		Sit-ups		Sit-and-reach		All tests combined	
	n	Fitness* (%)	*n*	Fitness (%)	*n*	Fitness (%)	*n*	Fitness (%)	*n*	Overall fitness (%)
Men ($n = 1{,}826$)										
2.7–13.6	597	56.8	601	96.0	601	76.2	580	55.9	601	30.3
13.8–18.3	609	36.0	621	91.3	619	64.1	582	53.8	621	17.6
18.4–34.1	570	20.0	602	77.7	602	50.8	549	46.1	604	7.1
p		< 0.001		< 0.001		< 0.001		0.001		< 0.001
Women ($n = 115$)										
7.0–20.0	37	70.3	37	91.9	37	89.2	37	56.8	37	46.0
20.2–23.4	39	53.9	39	84.6	38	84.6	38	60.5	39	28.2
23.7–35.3	39	38.5	39	87.2	39	69.2	39	38.5	39	12.8
p		0.005		0.538		0.026		0.106		0.001

The *p* values were obtained from Cochran–Armitage trend test.
* The cutpoint for being fit in a test was $\geq 70^{th}$ percentile of the Cooper's standard for the test.

prevalence of overall fitness was 4.3 (30.3/7.1 = 4.3) times greater in male officers and 3.6 (46/12.8 = 3.6) times greater in female officers having the lowest BF% tertile compared with the highest tertile (30.3% vs 7.1% and 46.0% vs 12.8%, respectively). BF% was inversely associated with the prevalence of fitness in each individual test among male officers ($p < 0.001$) and with the 2.4-km run ($p = 0.005$) and sit-ups ($p = 0.026$) in female officers. In male police officers who had the highest tertile of BF%, the prevalence of fitness for the 2.4-km run test was about one third of that in the lowest BF% tertile (20% vs. 56.8%). Similarly, among female officers, fitness prevalence was 38.5% in the highest and 70.3% in the lowest BF% tertile.

BF% was associated with mean values of each fitness test in male officers and with all except the sit-and-reach in female officers (Table 3). In male officers, every 1% increase in BF% was associated with 10 seconds of increased time to complete the 2.4-km run ($\beta = 10.29$, $p < 0.001$), and was associated with reduction of one push-up ($\beta = -1.00$, $p < 0.001$) and nearly one sit-up per minute ($\beta = -0.55$, $p < 0.001$), and about 0.25 cm in the sit-and-reach test ($\beta = -0.08$, $p < 0.001$). In female officers, BF% was similarly associated with the time for the 2.4-km run ($\beta = 9.18$, $p < 0.001$), number of push-ups ($\beta = -0.91$, $p < 0.001$), and the number of sit-ups ($\beta = -0.62$, $p < 0.001$), but not for the sit-and-reach test ($\beta = -0.08$, $p = 0.072$). These associations were independent of age, race/ethnicity, rank, and geographical location.

4. Discussion

To summarize, the prevalence of overall fitness, as measured by Cooper Institute standards, decreased linearly with the increase in BF% both for male and female officers. BF% was significantly and inversely associated with the mean values of fitness tests in both men and women. These associations were independent of age, race/ethnicity, rank, and geographic location where the participants served.

The results suggested that increased BF% was significantly associated with decreased prevalence of overall fitness in police officers [24]. Given the occupational characteristics of policing, officers are expected to be more physically fit than those working in many other occupations. However, the US National Health Interview Survey data collected annually from 2004 to 2011 showed a higher prevalence of obesity (BMI ≥ 30 kg/m^2) both in non-Hispanic white men and women working in the protective service occupations than the general working population [25]. Wright et al [34] compared male police officers' traditional cardiovascular risk factors with nonpolice male workers and found that police officers have a significantly higher BMI. Future studies are needed to investigate whether losing weight through physical activity or fitness training is a regimen to improve the fitness in police officers.

The present study indicated that officers with higher BF% had lower cardiorespiratory capacity, lower dynamic strength, and lower flexibility. Our results were consistent with previous studies that have reported inverse associations of BF% with aerobic power in 16–18-year-old soccer players [13] and in adults. Previous studies have reported that a higher level of BF% significantly impacts the physical abilities of police officers in areas that are important for their occupation. Push-ups are test of dynamic strength that may be required for the same type of police work activities [26]. The 1.5-mile run, for example, may come into play while chasing on foot or subduing a suspect. As evident in our results, a 1% increase in body fat was associated with 11 more seconds for men and 9 more seconds for women to complete the 2.4-km run. Similarly, a 1% of increase in body fat was associated with a decrease of about one push-up or one sit-up per minute both for men and women. In our police sample, the average age was 35.3 years. Age differences between police officers and younger criminals together with poor physical conditioning may not only make their job more difficult but also more dangerous. In 2011, over one million individuals under the age of 18 years and over eight million over the age of 18 years were arrested for serious crimes in the USA [27]. Most of those over the age of 18 years were in the 25–39-year category. The National Health Interview Survey data also demonstrate that overweight and obese workers were 23–43% more likely to experience injuries than normal weight workers [28]. Future longitudinal studies are warranted to investigate the potential pathways between body fat and fitness such as behavioral, psychosocial, and environmental factors.

4.1. Sex differences

Although, based on Cooper standards, there was a slightly lower percentage of women achieving the fitness criteria for push-ups among women in the high BF% category than the lower BF% categories, it was not significant ($p < 0.538$). Good performance on push-ups among women regardless of BF% was an interesting result, as previous work has shown that women have approximately 60% of the upper body strength of men [29]. BF% levels also did not appear to affect women's ability to perform the sit-and-reach test. The sit-and-reach test is a common measure of flexibility, and specifically measures the flexibility of the lower back and

Table 3
Unadjusted and adjusted mean fitness testing results by tertiles of body fat percentage (%BF) stratified by sex in police officers from a northeastern police agency in the USA ($N = 1{,}941$)

%BF tertiles	2.4-km run (′ ″)		Number of push-ups (per min)		Number of sit-ups (per min)		Sit-and-reach (cm)	
	Unadjusted	Adjusted*	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
	Mean (SD)	Mean (SE)	Mean (SD)	Mean (SE)	Mean (SD)	Mean (SE)	Mean (SD)	Mean (SE)
Men ($n = 1{,}826$)								
2.7–13.6	11′06″ (1′27″)	11′22″ (0′05″)	54.7 (15.1)	54.6 (0.7)	46.0 (7.9)	46.1 (0.4)	48.0 (7.6)	27.2 (0.5)
13.8–18.3	12′00″ (1′37″)	12′10″ (0′05″)	48.1 (13.7)	49.2 (0.7)	42.5 (7.8)	43.3 (0.4)	47.0 (7.6)	46.0 (0.5)
18.4–34.1	13′10″ (2′13″)	13′13″ (0′05″)	40.6 (13.3)	43.0 (0.7)	38.6 (9.8)	40.2 (0.4)	45.7 (7.1)	45.5 (0.5)
β (SE)†	11.42″ (0.51″)	10.29″ (16.65″)	−1.22 (0.07)	−1.0 (0.06)	−0.68 (0.04)	−0.55 (0.04)	−0.23 (0.20)	−0.08 (0.20)
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Women ($n = 115$)								
7.0–20.0	12′38″ (1′32″)	12′14″ (0′35″)	39.2 (16.3)	39.7 (4.3)	44.2 (9.2)	44.9 (2.7)	53.3 (7.4)	54.12 (2.0)
20.2–23.4	13′26″ (1′55″)	12′53″ (0′34″)	32.4 (14.0)	33.7 (4.2)	42.4 (8.8)	43.9 (2.6)	52.6 (6.6)	52.4 (2.0)
23.7–35.3	14′21″ (2′12″)	13′53″ (0′33″)	27.6 (12.0)	30.2 (4.0)	36.5 (9.4)	38.2 (2.6)	50.8 (5.6)	52.1 (1.8)
β (SE)	9.14″ (2.20″)	9.18″ (2.21″)	−1.03 (0.27)	−0.98 (0.27)	−0.67 (0.18)	−0.62 (0.17)	−0.23 (0.13)	−0.08 (0.13)
p	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	0.072	0.122

The *p* values were for the linear trend between from linear regression models.
* Age, race/ethnicity, rank, and geographical location were adjusted.
† Indicating for adjusted mean values that 1% increase in BF% was associated with 10.29 seconds of increased time to complete the 2.4-km run, and was associated with reductions of one push-up and nearly one sit-up per minute, and about 0.25 cm in the sit-and-reach test in men.
′, minutes; ″, seconds; β, unstandardized regression coefficient; SE, standard error.

hamstring muscles. Previous research has suggested that women have more flexibility in this area than do men [30,31].

4.2. Strengths and limitations

This was among one of the first studies to assess BF% based on the Cooper Institute for Research national standard for police fitness over such a large geographic expanse. Most studies focusing on this topic were limited to one specific area. The large sample size and standardized protocol training of testers across the statewide area increased the likelihood of generalizability of these results to other police agencies.

The present study was cross sectional and does not suggest causality. Due to lack of information on physical activity, we were not able to investigate how much of the differences in fitness tests was explained by physical activity. However, we believe that the majority of the differences in fitness tests might be explained by differences in physical activity intensity, especially physical fitness training in the participants as a previous study has reported [32]. Compared with officers who did not participate in the fitness incentive program, those who did were slightly younger, had fewer years of service, and were less likely be female and white (data not shown). Contrary results have been found in other studies. For example, Boyce et al [33] found in a 12.5-year longitudinal study of police fitness that both male and female officers increased in strength well into their 30s and 40s. The authors reported that female officers had approximately 44% of the upper body strength of male officers and attributed this positive finding to maintaining ongoing fitness training and testing by departments. Differences in sample size, types of testing and study design may account for some of the differences in findings between our study and those of the Boyce et al [33].

Body fat was inversely associated with fitness in police officers regardless of age, sex, race/ethnicity, rank, and the geographical area. Future studies are warranted to explore the role of physical activity and muscle strengthening program in this association. Health and fitness issues for law enforcement have been steadily coming to the forefront in police education curriculums. Future longitudinal studies should be initiated that include BF% as a factor affecting fitness level. Policies established by police departments encouraging good health among its members should be a priority goal. Officers at the academy training level should be educated about the value of maintaining good health through diet and physical conditioning beyond their training period and throughout their careers. The advantages of changes in lifestyle are numerous, and can be realized by the agency as well as by the individual officer.

Conflicts of interest

The authors declare no conflicts of interest. 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.

Appendix I.

Table A1.
Age- and sex-specific 70th percentile for each fitness test

Age (y)	2.4-km run (′ ″)	No. of push-ups/min	No. of sit-ups/min	Sit-and-reach (cm)
Men				
20–29	10′49″	41	45	49.5
30–39	11′09″	34	41	47.0
40–49	11′52″	26	36	44.5
50–59	12′53″	21	31	41.8
Women				
20–29	12′51″	24	41	41.7
30–39	13′41″	18	32	52.1
40–49	14′33″	14	27	50.3
50–59	16′26″	na	22	49.0

Values were generated from the New Cooper Age and Gender Base Standards for Law Enforcement [20].
′, minutes; ″, seconds; na, not available (a cut-off point of 14 was used for the 50- to 59-year age group in the present analyses).

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