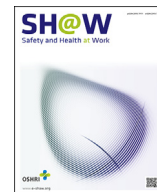




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Original Article

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

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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.

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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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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 Lagestad 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 state-wide 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

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