

Changes in Firefighter Weight and Cardiovascular Disease Risk Factors over Five Years

KEVIN C. MATHIAS¹, EMILIE D. BODE¹, DONALD F. STEWART², and DENISE L. SMITH^{1,3}

¹Health and Human Physiological Sciences, Skidmore College, Saratoga Springs, NY; ²Public Safety Occupational Health Center, Fairfax, VA; and ³Illinois Fire Service Institute, University of Illinois at Urbana–Champaign, Champaign, IL

ABSTRACT

MATHIAS, K. C., E. D. BODE, D. F. STEWART, and D. L. SMITH. Changes in Firefighter Weight and Cardiovascular Disease Risk Factors over Five Years. *Med. Sci. Sports Exerc.*, Vol. 52, No. 11, pp. 2476–2482, 2020. **Purpose:** This study aimed to assess changes in cardiovascular disease (CVD) risk factors in firefighters who lost, maintained, or gained weight over 5 yr. **Methods:** Anthropometrics and biomarkers of CVD were measured during two occupational medical exams 4.8 yr apart in 656 career firefighters. Weight change subgroups were loss (decrease of >3% body weight), stable (within ±3% body weight), and gain (increase of >3% body weight). Changes in CVD risk factors in the total sample and within weight change subgroups were tested for statistical significance using paired *t*-tests. **Results:** After 5 yr, 12% of the sample lost weight, 38% maintained weight, and 50% gained weight. Firefighters on average had significant increases ($P < 0.001$) in body weight (2.5 ± 0.2 kg), body mass index (0.8 ± 0.1 kg·m⁻²), total cholesterol (5.5 ± 1.4 mg·dL⁻¹), LDL cholesterol (5.2 ± 1.2 mg·dL⁻¹), and blood glucose (2.1 ± 0.5 mg·dL⁻¹). Firefighters who gained weight (6.6 ± 0.2 kg) had significant increases ($P < 0.001$) in total cholesterol (12.9 ± 1.8 mg·dL⁻¹), LDL cholesterol (11.1 ± 1.6 mg·dL⁻¹), and blood glucose (2.9 ± 0.7 mg·dL⁻¹) with a significant decrease ($P \leq 0.01$) in HDL cholesterol (-1.3 ± 0.4 mg·dL⁻¹). Firefighters who lost weight (-7.2 ± 0.5 kg) had significant decreases ($P < 0.05$) in total cholesterol (-8.5 ± 3.9 mg·dL⁻¹), LDL cholesterol (-6.7 ± 3.3 mg·dL⁻¹), and blood pressure (systolic: -5.3 ± 1.3 mm Hg; diastolic -4.2 ± 1.0 mm Hg) with a significant increase ($P < 0.05$) in HDL cholesterol (2.3 ± 1.0 mg·dL⁻¹). **Conclusions:** Although improvements in cardiovascular health among firefighters who lost weight were found, 50% of the sample gained weight with adverse changes in measures of cardiovascular health. Given that sudden cardiac death is the most common cause of duty-related death among firefighters, with increased risk among obese firefighters, the amount of weight gain and the adverse changes in cardiovascular health suggest the need for improvements in health promotion programs for firefighters in the United States. **Key Words:** FIREFIGHTING, BMI, OBESITY, CARDIOVASCULAR HEALTH

Many researchers and authors have lamented the “obesity epidemic” among Americans and other Westernized countries and have detailed the substantial health risks and economic cost associated with obesity and increasing body weight. Health consequences of obesity include increased risk of cardiovascular disease (CVD), type

2 diabetes mellitus, cancer, osteoarthritis, work disability, and sleep apnea (1,2). More specifically, obesity is associated with multiple detrimental cardiovascular conditions, including dyslipidemia, insulin resistance, high blood pressure, atherosclerosis advancement, and increased risk of sudden cardiac death, and has been implicated with increased risk of atrial fibrillation (3,4). Firefighters may represent an occupational group that is particularly affected by obesity-related concerns because of the physically and emotionally strenuous nature of emergency operations that may trigger a sudden cardiac event (5). Sudden cardiac events are a leading cause of death in the fire service, accounting for nearly half of all duty-related fatalities reported by the National Fire Protection Association each year (6).

Obesity is a substantial risk factor for CVD in all populations (1) and has been shown to increase the risk of duty-related cardiac events in firefighters (7–9). Several studies have reported that 24%–35% of U.S. firefighters are obese by body mass index (BMI) categorization (5,10–12). Furthermore, similar to the general population, firefighters on average have been shown to gain weight over time (12–16). Previous research has examined weight status and associated CVD risk

Address for correspondence: Denise L. Smith, Ph.D., Tisch Family Distinguished Professor, Department of Health and Human Physiological Sciences, Skidmore College, 815 North Broadway, Saratoga Springs, NY 12866; E-mail: dsmith@skidmore.edu.

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factors (17–21). Limited research has assessed weight loss and weight gain in firefighters, as well as changes in CVD risk factors over time (17,22). Currently, no research has described changes (loss, maintained, and gain) in body weight among subgroups of firefighters who are not receiving a research intervention, and documented changes in CVD risk factors in these groups.

Obesity is associated with several health risks in the fire service. Obesity has been shown to increase firefighters' risk of injury during firefighting activity (5). Obesity is also associated with a procoagulatory state in the general population (23,24), and firefighting has been found to increase coagulatory potential in firefighters postfirefighting activity (25). Further, obesity is associated with cardiomegaly, which is a common arrhythmogenic substrate in sudden cardiac events both in the general population (26) and in firefighters (8,27). Previous studies among firefighters have found that higher BMI is related to unfavorable CVD risk factors, including hypertension, high total cholesterol, elevated LDL cholesterol, and low levels of HDL cholesterol (10,17,18,20). In part because of the physical nature of the job, and in part because of health concerns, fitness professionals and fire service leadership have promoted physical fitness programs for firefighters (28,29), which may influence body weight. However, weight maintenance or weight loss has not been a primary focus of attention in the fire service, despite the reported high prevalence of obesity (11,17) and an established link between obesity and CVD (9,18,30).

Researchers have investigated physical fitness, obesity, and cardiovascular risk in this important occupational group. Many studies have found that on average, firefighters gain weight over time (12,14–16), but limited research has separately examined weight loss (22) and weight gain (17) in firefighters and changes in measures of cardiovascular health. Examining both weight loss and weight gain potentially allows for the detection and quantification of both positive and negative changes in CVD risk factors among firefighters. The purpose of this observational study was to assess changes in body weight among an occupationally active cohort of firefighters over 5 yr, and to investigate changes in CVD risk factors in firefighters who lost body weight, maintained body weight, or gained body weight. It was hypothesized that over time body weight among the total sample would increase and cardiovascular health would decrease, firefighters who gained body weight would have detrimental changes in CVD risk factors, and firefighters who lost body weight would show improved cardiovascular risk profiles.

METHODS

Study population. A cohort of career firefighters from Northern Virginia was examined based on records from occupational medical exams that were performed between 2009 and 2016. A total of 1498 firefighters were in the database, indicating they had received at least one medical evaluation. The final sample consisted of 656 firefighters (589 males and 67

females) who had two medical exam records (with body weight measured) separated by 5 yr (range of 4–6 yr). Data from the questionnaire, medical exam, and blood laboratory report were entered into a database by the clinic staff, and a deidentified data set was transferred by the occupational clinic to researchers in the First Responder Health and Safety Laboratory at Skidmore College. The study protocol was reviewed and approved by the Skidmore College Institutional Review Board.

Data collection. Data from medical evaluations were collected by an occupational health clinic that performs annual medical evaluations on a contract basis to a large countywide fire department. The medical evaluations are consistent with the National Fire Protection Association's 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments and includes assessment of modifiable CVD risk factors (31). During the occupational exam, height and weight were recorded using a digital physician's scale and stadiometer. Medication use was recorded by questionnaire. Current smoking status was not reported because of a smoking ban policy initiated before baseline in this cohort. Blood pressure was measured in the seated position by a nurse via auscultation. A fasting venous blood draw was obtained and sent to a commercial laboratory for the determination of blood lipids and blood glucose levels.

Definitions. Weight change categories were generated based on a previously published definition of weight maintenance (32). The three categories of weight change were defined as weight loss—decrease >3% in body weight, weight stable—change within $\pm 3\%$ in body weight, and weight gain—increase >3% in body weight. Subjects were classified as obese if their BMI was $\geq 30 \text{ kg}\cdot\text{m}^{-2}$ (33); elevated cholesterol levels were defined as primary hypercholesterolemia (LDL cholesterol $\geq 160 \text{ mg}\cdot\text{dL}^{-1}$ or non-HDL cholesterol $\geq 190 \text{ mg}\cdot\text{dL}^{-1}$) (34); low HDL cholesterol was defined as $< 40 \text{ mg}\cdot\text{dL}^{-1}$ for males and $< 50 \text{ mg}\cdot\text{dL}^{-1}$ for females (34); high blood pressure was defined as systolic blood pressure $\geq 130 \text{ mm Hg}$ or diastolic blood pressure $\geq 80 \text{ mm Hg}$ (35); and high fasting blood glucose was defined as $\geq 126 \text{ mg}\cdot\text{dL}^{-1}$ (35). The 10-yr risk of a first CVD event among ≥ 30 yr olds was estimated from risk functions using data from the Framingham Heart Study and the Framingham Offspring Study (36).

Statistical analyses. Descriptive statistics were expressed as mean \pm SD in Table 1. For changes over time within the total sample or weight change categories, paired *t*-tests were used for continuous measurements, and McNemar's test of differences were conducted for proportions. The level of significance for all analyses was considered at $P < 0.05$ and was two sided for all tests. All analyses were conducted using Stata 15.1 (StataCorp, College Station, TX).

RESULTS

The baseline characteristics of the cohort are presented in Table 1. After 5 yr, 12% of the sample lost weight, 38% were stable, and 50% gained weight. The total sample gained an

TABLE 1. Descriptive statistics of a U.S. firefighter cohort at baseline by prospective weight change.

| | Total Sample | Weight Loss ^a | Weight Stable ^b | Weight Gain ^c |
|--|--------------|--------------------------|----------------------------|--------------------------|
| <i>n</i> (%) | 656 (100) | 81 (12) | 248 (38) | 327 (50) |
| Age (yr) | 38.1 ± 7.8 | 39.3 ± 9.1 | 39.2 ± 7.3 | 37.0 ± 7.7 |
| Male, <i>n</i> (%) | 589 (90) | 71 (88) | 224 (90) | 294 (90) |
| White/other, <i>n</i> (%) | 525 (80) | 61 (75) | 202 (81) | 262 (80) |
| African-American, <i>n</i> (%) | 131 (20) | 20 (25) | 46 (19) | 65 (20) |
| Duration between exams (yr) | 4.8 ± 0.6 | 4.7 ± 0.6 | 4.8 ± 0.5 | 4.8 ± 0.6 |
| Height (m) | 1.8 ± 0.1 | 1.8 ± 0.1 | 1.8 ± 0.1 | 1.8 ± 0.1 |
| Body weight (kg) | 88.8 ± 14.9 | 95.0 ± 14.8 | 87.7 ± 14.0 | 88.1 ± 15.2 |
| BMI (kg·m ⁻²) | 28.1 ± 3.8 | 29.7 ± 3.9 | 27.9 ± 3.6 | 27.8 ± 4.0 |
| Total cholesterol (mg·dL ⁻¹) | 186.1 ± 35.3 | 185.0 ± 35.3 | 190.0 ± 35.6 | 183.3 ± 35.0 |
| LDL cholesterol (mg·dL ⁻¹) | 116.5 ± 30.8 | 116.9 ± 29.9 | 119.9 ± 35.6 | 113.7 ± 29.4 |
| HDL cholesterol (mg·dL ⁻¹) | 47.5 ± 11.2 | 46.7 ± 11.9 | 47.1 ± 11.6 | 48.2 ± 10.7 |
| Systolic blood pressure (mm Hg) | 121.0 ± 10.9 | 122.5 ± 12.1 | 122.0 ± 10.5 | 119.8 ± 10.8 |
| Diastolic blood pressure (mm Hg) | 79.3 ± 8.8 | 79.8 ± 9.3 | 80.3 ± 8.5 | 78.5 ± 8.8 |
| Blood glucose (mg·dL ⁻¹) | 94.1 ± 11.7 | 98.3 ± 19.0 | 93.7 ± 10.4 | 93.2 ± 9.6 |
| 10-yr risk of CVD event (%) ^d | 5.0 ± 3.8 | 6.4 ± 5.3 | 5.4 ± 3.9 | 4.1 ± 2.9 |

Data are presented as *n* (%) or mean ± SD.

^aWeight loss subgroup defined as >3% of body weight lost.

^bWeight stable subgroup defined as within ±3% body weight change (gain or loss).

^cWeight gain subgroup defined as >3% of body weight gained.

^dThe 10-yr risk of a first CVD event among ≥30 yr olds estimated from risk functions published in 2008 using data from the Framingham Heart Study and the Framingham Offspring Study.

average of 2.5 ± 0.2 kg (Table 2). Overall, significant increases in body weight ($P < 0.001$), BMI ($P < 0.001$), total cholesterol ($P < 0.001$), LDL cholesterol ($P < 0.001$), blood glucose ($P < 0.001$), and 10-yr risk of a CVD event ($P < 0.001$) were found in the total sample with significant decreases in systolic blood pressure ($P < 0.01$) and diastolic blood pressure ($P < 0.001$). Changes in body weight among the weight change categories of weight loss, weight stable, and weight gain were -7.2 ± 0.5 kg ($P < 0.001$), 0.3 ± 0.1 kg ($P < 0.01$), and 6.6 ± 0.2 kg ($P < 0.001$), respectively. Within the weight loss subgroup, significant decreases in BMI ($P < 0.001$), total cholesterol ($P < 0.05$), LDL cholesterol ($P < 0.05$), and blood pressure ($P < 0.001$) were found with significant increases in HDL cholesterol ($P < 0.05$). Within the weight stable subgroup, blood pressure significantly decreased ($P < 0.001$) and blood glucose ($P < 0.01$) and 10-yr risk of a CVD event ($P < 0.001$) significantly increased. Within the weight gain subgroup, significant increases in BMI ($P < 0.001$), total cholesterol ($P < 0.001$), LDL cholesterol ($P < 0.001$), blood glucose ($P < 0.001$), and 10-yr risk of a CVD event ($P < 0.001$)

were found with a significant decrease in HDL cholesterol ($P < 0.01$).

At baseline, 27% of the sample was obese, 9% had high cholesterol, 27% had low HDL cholesterol, 1% had high blood glucose, 56% had high blood pressure, and 11% were taking hypertensive medication (Table 3). Over the 5 yr, significant increases were observed in the percentage of firefighters who were obese ($P < 0.001$), had high cholesterol ($P < 0.01$), had high blood glucose ($P < 0.05$), had high blood pressure ($P < 0.001$), and who were taking antihypertensive medications ($P < 0.001$).

Among the weight loss subgroup over the 5 yr, obesity prevalence decreased significantly ($P < 0.001$) and prevalence of high blood pressure decreased significantly ($P < 0.01$). Among the weight stable subgroup, a significant decrease in the prevalence of high blood pressure was found ($P < 0.001$), and changes in all other CVD risk factors were nonsignificant. Among weight gain subgroup, significant increases in the prevalence of obesity ($P < 0.001$), high cholesterol ($P < 0.01$), low HDL cholesterol ($P < 0.05$), high blood

TABLE 2. Changes in CVD risk factors in a cohort of U.S. firefighters over 5 yr by weight change category.

| | Total Sample | Weight Loss ^a | Weight Stable ^b | Weight Gain ^c |
|--|---------------|--------------------------|----------------------------|--------------------------|
| Body weight (kg) | 2.5 ± 0.2*** | -7.2 ± 0.5*** | 0.3 ± 0.1** | 6.6 ± 0.2*** |
| BMI (kg·m ⁻²) | 0.8 ± 0.1*** | -2.2 ± 0.2*** | 0.09 ± 0.04* | 2.1 ± 0.1*** |
| Total cholesterol (mg·dL ⁻¹) | 5.5 ± 1.4*** | -8.5 ± 3.9* | 1.4 ± 2.3 | 12.9 ± 1.8*** |
| LDL cholesterol (mg·dL ⁻¹) | 5.2 ± 1.2*** | -6.7 ± 3.3* | 2.0 ± 1.9 | 11.1 ± 1.6*** |
| HDL cholesterol (mg·dL ⁻¹) | -0.1 ± 0.3 | 2.3 ± 1.0* | 0.5 ± 0.5 | -1.3 ± 0.4** |
| Systolic blood pressure (mm Hg) | -1.3 ± 0.5** | -5.3 ± 1.3*** | -3.5 ± 0.8*** | 1.3 ± 0.7 |
| Diastolic blood pressure (mm Hg) | -2.4 ± 0.4*** | -4.2 ± 1.0*** | -3.7 ± 0.6*** | -0.9 ± 0.6 |
| Blood glucose (mg·dL ⁻¹) | 2.1 ± 0.5*** | -2.2 ± 1.2 | 2.7 ± 0.9** | 2.9 ± 0.7*** |
| 10-yr risk of CVD event (%) ^d | 2.0 ± 0.1*** | 0.6 ± 0.3 | 1.7 ± 0.2*** | 2.6 ± 0.2*** |

Data are presented as mean ± SE.

^aWeight Loss subgroup defined as >3% of body weight lost.

^bWeight Stable subgroup defined as within ±3% body weight change (gain or loss).

^cWeight Gain subgroup defined as >3% of body weight gained.

^d10-yr risk of a first CVD event among ≥30 yr olds estimated from risk functions published in 2008 using data from the Framingham Heart Study and the Framingham Offspring Study.

* $P < 0.05$.

** $P < 0.01$.

*** $P < 0.001$.

TABLE 3. Percentages with CVD risk factors over a 5-yr period in a cohort of U.S. firefighters by weight change category.

| | Total Sample | | Weight Loss ^a | | Weight Stable ^b | | Weight Gain ^c | |
|---------------------------------|--------------|------------|--------------------------|------------|----------------------------|------------|--------------------------|------------|
| | Time 1 (%) | Time 2 (%) | Time 1 (%) | Time 2 (%) | Time 1 (%) | Time 2 (%) | Time 1 (%) | Time 2 (%) |
| Obese | 27 | 36*** | 38 | 20*** | 26 | 29 | 25 | 45*** |
| High cholesterol | 9 | 14** | 6 | 12 | 12 | 12 | 8 | 16** |
| Low HDL | 27 | 27 | 29 | 22 | 31 | 26 | 24 | 30* |
| High blood glucose | 1 | 3* | 6 | 6 | 2 | 2 | 0 | 4** |
| High blood pressure | 56 | 44*** | 59 | 39** | 61 | 42*** | 53 | 48 |
| Antihypertensive medication (%) | 11 | 16*** | 20 | 25 | 11 | 15 | 9 | 16*** |

^aWeight loss subgroup defined as >3% of body weight lost.

^bWeight stable subgroup defined as within ±3% body weight change (gain or loss).

^cWeight gain subgroup defined as >3% of body weight gained.

**P* < 0.05.

***P* < 0.01.

****P* < 0.001.

glucose (*P* < 0.001), and antihypertensive medication usage were found (*P* < 0.001).

DISCUSSION

This observational study examined changes in CVD risk factors in firefighters who lost weight (>3% body weight), maintained weight (within ±3% body weight), or gained weight (>3% body weight) over a 5-yr period. On average, firefighters gained 0.5 kg·yr⁻¹ with significant increases in BMI, total cholesterol, LDL cholesterol, and blood glucose and a significant decrease in blood pressure (systolic and diastolic). Firefighters who lost weight had positive changes in BMI, total cholesterol, LDL cholesterol, HDL cholesterol, and blood pressure, with a nonsignificant change in blood glucose after 5 yr. Firefighters who maintained weight had a statistically significant, but clinically insignificant increase in weight, a significant increase in blood glucose, and a significant decrease in blood pressure. Firefighters who gained weight showed detrimental changes in most of the reported CVD risk factors, including significant increases in BMI, total cholesterol, LDL cholesterol, and blood glucose. Firefighters who gain weight also exhibited a decrease in HDL cholesterol.

Our findings extend previous research on average weight gain in firefighters, by reporting that over the 5-yr period, 12% of firefighters lost body weight, 38% of firefighters maintained body weight, and 50% of firefighters gained body weight. These findings characterize the pattern of weight change in career firefighters in a large, countywide fire department that has adopted the National Fire Protection Association's 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments (31) and the International Association of Fire Fighters/International Association of Fire Chiefs Joint Wellness and Fitness Initiative (29). Very few studies have observationally assessed weight change in firefighters over time. In 1996, Gerace et al. (14) conducted a study to assess predictors of weight gain in male firefighters and paramedics over a 7-yr period. Of the 438 participants, 11% lost ≥2.3 kg, 24% were within 1.8 kg of baseline weight, and 65% gained ≥2.3 kg. Although the results showed a higher percentage of firefighters gaining weight than the current study, the definition of weight maintenance in the current study (±3% body weight) equates to approximately ±2.7 kg,

as compared with the weight maintenance parameter of ±2.3 kg used by Gerace et al. (14). Differences in how weight maintenance was defined may partially explain why fewer firefighters gained weight in the current study. Differences in departments or more recent efforts in the fire service to address the high prevalence of obesity are additional potential explanations for the difference.

In a study published in 2005, Soteriades et al. (17) investigated changes in BMI among firefighters who were assigned to hazardous materials teams over a 5-yr period and reported the average BMI of the group increased from 29.0 to 29.7. The authors also reported that obese firefighters were more likely to have hypertension and low HDL cholesterol at follow-up. However, this study did not report changes in body weight, nor did it consider subcategories of firefighters who lost weight, remained weight stable, or gained weight.

Firefighters who lost weight over the 5-yr period in the current study lost an average of 7.2 kg and had significant reductions in BMI, total cholesterol, LDL cholesterol, systolic and diastolic blood pressure, and a significant increase in HDL cholesterol. The percentage of firefighters with established CVD risk factors for obesity and hypertension significantly decreased over the 5-yr period among firefighters who lost weight. The 10-yr risk of a first CVD event among firefighters who lost weight and were at least 30 yr old at baseline did not significantly change although the firefighters were 5 yr older. There is currently no known observational research on long-term weight loss in firefighters and subsequent changes in CVD risk factors. Brown et al. (22) conducted a 6-month observational study on obese and overweight firefighters to assess the longitudinal effects of weight loss advice on weight change and CVD risk factors. On average, obese and overweight firefighters had significant weight loss (0.55 kg), nonsignificant increase in HDL cholesterol, and nonsignificant decreases in blood pressure, LDL cholesterol, and triglycerides (22). Our findings extend the current literature in firefighters by providing a longer observation of firefighters and results from greater changes in weight.

Obesity is associated with increased risk of CVD in all populations (1), and both public health messaging and commercial groups have focused on weight maintenance or weight loss. Studies investigating weight loss in the general population have reported improvements in CVD risk factors and in

cardiac structure and function with weight loss (22,37–39). Norman et al. (39) found that over 10 yr, those who lost or maintained weight had significantly reduced LDL cholesterol and systolic blood pressure with an average increase in HDL cholesterol. The results from the current study with firefighters are similar to general population studies, which support the association of weight loss with improved cardiovascular risk profiles. However, this study focused on an occupational group that regularly works together for 24-h shifts, performs strenuous physical work, and has an elevated risk of duty-related cardiac death due to the performance of their duties (40). Managing CVD risk and weight gain in firefighters is of particular concern for occupational health care providers.

In this study, firefighters who were weight stable had a significant decrease in blood pressure, and an increase in blood glucose and body weight. The significant decrease in blood pressure might be attributed to the increase in antihypertensive medication use (11% to 15%) or changes in lifestyle factors. No known observational studies have been conducted to assess weight maintenance in firefighters, but weight maintenance and small weight gain in the general population have been shown to be protective against incident coronary heart disease as compared with weight gain >10% over a 30-yr period (41). However, the 10-yr risk of a first CVD event increased significantly by 1.7%, which may partially be explained by the firefighters being 5 yr older at follow-up. The small but statistically significant increase in blood glucose among the weight stable subgroup is of unknown clinical significance. This increase in blood glucose may be consistent with the small but significant weight gain, or associated with advancing age.

Firefighters in the weight gain subgroup increased their body weight by an average of 6.6 kg over 5 yr; had significant increases in BMI, total cholesterol, LDL cholesterol, blood glucose, and 10-yr risk of a first CVD event; and had a significant decrease in HDL cholesterol. Firefighters who gained weight did not have significantly higher blood pressure after 5 yr, despite the well-understood relationship between obesity and hypertension (18,20,25). Importantly, among firefighters who gained weight, the percentage of firefighters taking antihypertensive medication increased from 9% to 16%, which may partially explain the stability of blood pressure in this group. Previous studies have found that obese firefighters generally have higher blood pressure, triglycerides, total cholesterol, LDL cholesterol, and blood glucose, and lower HDL cholesterol than normal weight firefighters (11,17,18,20,30). Weight gain assessed in young adults of the general population is associated with adverse changes in LDL cholesterol, HDL cholesterol, triglycerides, fasting insulin, and blood pressure levels, regardless of age, sex, race, or initial body weight (39). The firefighters in the current study were overweight on average, and in the 50% of firefighters who gained weight, obesity prevalence rose from 20% to 45%. The increasing prevalence of CVD risk factors is of particular concern in this occupational group given that obesity, hypertension, high cholesterol, and diabetes are associated with 3.1, 12.0, 4.4, and

10.2 higher odds of duty-related cardiac events, respectively (25). Given that firefighters gain 0.5–1.6 kg·yr⁻¹ (11,13,15,17), it is necessary to further investigate the factors driving weight gain and the effectiveness of current health and fitness programs that aim to prevent excessive weight gain in the fire service. It may also be instructive to study the strategies or factors that allowed a significant portion of the firefighters to maintain or lose weight and realize the associated cardiovascular benefits.

Because of the observational design, the direct effect of weight change on changes in CVD risk factors cannot be inferred from the results of this study. The purpose of this study was to quantify the likelihood and amount of positive and negative changes made among a cohort of firefighters with respect to bodyweight and cardiovascular health. A strength of this study design is that the changes reported reflect those of firefighters in a natural setting (i.e., the changes were made by the firefighters in their normal work/life and not due to a research intervention). In addition, examining both weight loss and weight gain provides more informative insights into the changes made that were not fully captured when analyzing the total sample. This study relied on changes in body weight, measured during an occupational examination, as body weight is regularly measured and weight gain is known to be associated with detrimental cardiovascular changes. However, we did not assess whether weight changes were due to changes in body fat or lean tissue, which would likely impact the changes in cardiovascular health. Additional research is needed to identify the characteristics of firefighters who typically gain weight and the support or motivating factors that influence firefighters who make positive lifestyle changes to lose weight. Future research is also needed to investigate the most effective weight loss strategies, including increased physical activity and dietary changes.

CONCLUSIONS

The results of this study provide insights into changes in weight and CVD risk factors that occurred over time in a cohort of career firefighters without a research intervention. Similar to previous studies, on average, firefighters gained weight over time. However, this study extends previous research by further investigating weight change among firefighters and reporting that 50% of firefighters successfully lost weight or were weight stable over 5 yr. Although it is expected that the 10-yr risk of a first CVD event would increase due to firefighters being 5 yr older at follow-up, those who were weight stable had few detrimental changes in CVD-related biomarkers and those who lost weight had positive changes in CVD-related biomarkers, even with advancing age and exposure to the occupational hazards of firefighting. Despite some encouraging findings among firefighters who lost or maintained weight, the prevalence of CVD risk factors, including obesity, was high at baseline and after the 5-yr follow-up period. These findings demonstrate that while positive and meaningful changes were made, additional treatment and preventive efforts are needed. In addition, average changes for the full sample did not fully capture the extent to which

detrimental changes in CVD risk factors occurred within the subgroup of firefighters who gained weight. The amount of weight gain and adverse changes in cardiovascular health reported in the group that gained weight provides strong evidence for the need for continued efforts to improve or maintain health throughout the careers of firefighters in the United States.

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