

Weight loss advice and prospective weight change among overweight firefighters

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Background: Obesity compromises firefighter safety, yet more than 70% of firefighters are overweight. Though healthcare professionals are encouraged to counsel overweight patients, the effectiveness of weight counseling is not consistent across studies.

Objective: Examine longitudinal changes in cardiovascular risk factors and determine the role of healthcare professional weight loss advice on six-month weight changes among a national sample of male, overweight and obese firefighters.

Methods: This study included baseline and six-month assessments of 757 firefighters. Medical and demographic data were collected using questionnaires. Investigators collected height, weight, percent body fat, waist circumference, blood pressure, and fasting serum samples (total cholesterol, high-density lipoprotein, low-density lipoprotein, glucose). Multilevel linear regression assessed the association between weight advice and outcomes.

Results: Participants lost an average of 0.55 kg (95%CI: 0.17–0.93), and experienced significant improvements in systolic blood pressure (mean: 3.75 mm Hg; 95% CI: 2.35–5.14) and non-significant improvements in other clinical outcomes. Healthcare professional weight advice was not significantly associated with weight loss or other outcomes.

Conclusion: Similar to other studies, results show little benefit of low intensity weight loss counseling. Additional research is needed to identify effective and feasible weight management strategies to address firefighter obesity.

Keywords: Firefighters, Obesity, Body weight, Counseling, Health personnel, Weight loss

Introduction

Firefighter obesity is associated with adverse cardio-metabolic profiles, diminished physical fitness and job performance, line-of-duty injuries, and likely contributes to cardiovascular events, which are the leading cause of line-of-duty fatalities among firefighters.^{1–4} Despite the risks related to overweight and obesity, more than 70% of firefighters are overweight or obese, surpassing the age-adjusted prevalence of the U.S. adult population.⁵ The long-term health burden of obesity can be significantly reduced with intentional weight loss, and national guidelines for the clinical management of obesity encourage healthcare providers to monitor the body mass index (BMI) of all patients and deliver weight loss counseling for overweight and obese patients.^{6–8} Healthcare professional

weight loss counseling significantly increases patient weight loss intentions and attempts to lose weight, but the value of weight loss counseling in successful weight management remains unclear.^{9–11}

Several randomized controlled trials have evaluated the effectiveness of healthcare professional weight loss counseling on patient weight change and have found mixed results.^{12,13} Individuals randomized to the control arms of trials typically receive standard care, often consisting of weight loss counseling during repeated office visits. Additionally, many trials have stringent eligibility requirements and enroll relatively narrow segments of the general population, comprised of individuals highly motivated to lose weight. As a result, findings from randomized controlled trials may not accurately reflect the effectiveness of weight loss counseling in the general population. A limited number of observational studies have considered

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the impact of healthcare professional weight counseling on actual weight loss and the findings have not been consistent across studies.^{10,14,15} The inconsistent results may be attributed to varying degrees of counseling frequency, intensity, or differences in the patient populations. To date, no study has evaluated the association between healthcare professional weight loss advice and weight changes in occupational groups at high risk for obesity and obesity-related comorbidities, including the fire service. The goal of this study was to examine longitudinal changes in cardiovascular risk factors and determine the role of healthcare professional weight loss advice on six-month weight changes among a national sample of male, overweight and obese firefighters.

Methods

Fuel 2 Fight was a prospective cohort study designed to track predictors of health and safety in the fire service. The study, conducted between December 2011 and December 2012, consisted of assessments at baseline and six-month follow-up visits. Institutional review boards at the University of Texas Health Science Center at Houston and National Development and Research Institutes reviewed and approved the study procedures. Informed consent was obtained from all participants prior to data collection and participants were allowed to withdraw from the study at any time. Firefighters were assured that none of their individual results would be disclosed to their employers or union officials.

The Fuel 2 Fight study design, variables, and methods have been published in detail elsewhere.¹⁶ Study investigators recruited fire departments implementing aspects of the Fire Service Joint Labor Management Wellness-Fitness Initiative (Wellness Approach (WA) departments), the predominant health promotion program in the fire service.¹⁷ Ten WA departments were individually matched to ten fire departments not implementing the health promotion program (standard).

A total of 1,024 firefighters were recruited from 20 departments located across 14 different U.S. states or territories. This study included overweight (BMI: 25.0–29.9 kg/m²) and obese (BMI: \geq 30.0 kg/m²) male firefighters who visited a healthcare professional (e.g. doctor, nurse, other unspecified health professional) in the past year. Females were excluded from the analysis due to low numbers in the cohort ($n = 22$). Normal weight firefighters ($n = 172$), those who did not visit a healthcare professional ($n = 32$), and those missing BMI or healthcare visit information ($n = 41$) also were excluded, yielding an eligible sample of 757 firefighters.

A trained data collection team traveled to selected stations to conduct assessments. Visits occurred over successive days to coincide with crew shift schedules. All firefighters on duty at the time of the visit were invited to participate in the study. Participation was high (94.4%) among firefighters attending recruitment sessions. Data

collection often was interrupted by emergency calls because crews were on duty. If possible, data collection was completed when crews returned from calls, but emergency calls did result in some missing data.

Questions regarding healthcare visits included on the Fuel 2 Fight questionnaire were adapted from the Centers for Disease Control Behavioral Risk Factor Surveillance System and included as part of a questionnaire administered at baseline.¹⁸ The question was: “In the past 12 months, has a doctor, nurse or other health professional given you advice about your weight?” Response options included “no” weight-related advice, “yes, maintain current weight”, “yes, gain weight”, and “yes, lose weight”. For this analysis, advice was coded as “Yes, lose weight” and all remaining categories were collapsed to represent other advice.

Data collectors measured body weight and height using portable scales and stadiometers.¹⁶ BMI was calculated from measured heights and weights and overweight (BMI: 25.0–29.9 kg/m²) and obese (BMI: \geq 30.0 kg/m²) categories were defined using standard cut points.⁷ Change in weight (kg), the primary outcome, was calculated as the difference in weight between the baseline and six-month assessments. Secondary endpoints of interest included changes in percent body fat, waist circumference, blood pressure, and clinical lab values. Serum glucose, cholesterol, HDL-cholesterol, LDL-cholesterol, and triglyceride concentrations were determined from available blood samples. Study investigators followed standard procedures to measure percent body fat, waist circumference, and blood pressure.^{5,7} A second study was funded to expand the data collected on the initial cohort and included funds for blood sample collection. Willing firefighters consented to fasting blood draws performed by certified phlebotomists, typically occurring the morning after the initial data collection session.

Additional covariates were assessed using self-administered questionnaires. Demographic and occupational questions included participant age, ethnicity, education, marital status, and rank in the fire department. Medical information included self-reported history of physician diagnosed chronic conditions (e.g. heart disease, hypertension, cancer, depression, etc.), physician-diagnosed anxiety disorders, and injuries in the previous six months. Firefighters completed the Center for Epidemiological Studies Short Depression Scale (CES-D 10) and those with a score of four or more were classified as having depressive symptoms, a categorization shown to have high reliability in the general population.¹⁹ Use of tobacco products and alcohol was assessed through a series of questions previously used in the fire service and similar occupations.²⁰

Descriptive statistics were calculated for the study population and compared across the primary exposure variable (healthcare professional weight loss advice). The distributions of continuous variables are presented as means and standard deviations, while statistics for categorical

variables are presented as raw counts and percentages. Statistical inference was conducted using two-sided tests with $\alpha = 0.05$. Multilevel linear regression models were generated to account for correlation among individuals clustered within the same fire department. The impact healthcare professional weight loss advice had on weight change was adjusted for statistically significant covariates (P -value < 0.05) and covariates which resulted in a 10% change in the estimated regression coefficient for the primary exposure variable. Additional regression models were generated for the secondary outcomes of changes in anthropometric (waist circumference, percent body fat), hemodynamic (systolic and diastolic blood pressure), serum lipid (total cholesterol, low-density lipoprotein, high-density lipoprotein, and total triglycerides), and serum glucose values. A sensitivity analysis excluded firefighters with both low percent body fat (e.g. $< 18\%$) and waist circumferences (e.g. < 94 cm) to avoid misclassifying firefighters with high lean mass as overweight.^{7,21} All statistical analyses were conducted using Stata version 13 (StataCorp, College Station, TX).

Results

Firefighters who recalled receiving weight loss advice were slightly older, reported more comorbidities, and had higher estimates of adiposity than firefighters who did not recall receiving advice to lose weight (Table 1). On average, individuals who reported advice to lose weight also had more unfavorable blood pressure and lipid profiles at baseline compared to those who did not receive weight loss advice (Table 1). The average systolic blood pressure for both advice groups was in the pre-hypertensive range, while the mean diastolic blood pressure and triglyceride values for individuals recalling weight loss advice were in the pre-hypertensive and borderline high categories, respectively. Approximately 60% of eligible firefighters completed both baseline and follow-up assessments ($N = 458$). Participants who completed both assessments were similar to firefighters who were lost to follow-up with respect to most characteristics, except those lost to follow-up were significantly (P -value < 0.05) less likely to report comorbidities and more likely to be never smokers at baseline (results not shown).

Among the participant with complete assessments, firefighters lost an average of 0.55 kg (95% CI: -0.93 , -0.17) over the six-month follow-up period (Table 2). This corresponded to a mean reduction in waist circumference of 0.81 cm and percent body fat of 0.49%. The changes in weight, waist circumference, and percent body fat did not differ significantly between weight advice groups after adjusting for other covariates. Sensitivity analyses with exclusion of 27 BMI-defined overweight and obese firefighters with waist circumference (< 94 cm) and percent body fat ($< 18\%$) measurements in the healthy range did not meaningfully change the results (Table 2 – model 2). The six-month changes in clinical outcomes were similar

to changes in body composition and suggestive of overall improvements in firefighter cardiovascular profiles, with the exception of serum glucose values (Table 3). On average, firefighters experienced a slight increase in HDL cholesterol and decreases in mean blood pressure (systolic and diastolic), total cholesterol, LDL cholesterol, and triglycerides. However, the estimated mean changes in lipid and glucose values lack precision because these outcomes were only measured on a small subset of the population. Like changes in body composition, weight loss advice was not significantly associated with the six-month changes in any of the blood pressure, lipid, or glucose variables.

Discussion

The current high prevalence of overweight and obesity threatens the future cardiovascular health of fire service personnel. While previous studies have reported average annual increases in firefighter weights, overweight and obese firefighters in this study lost an average of 0.55 kg over a period of six months.²² In general, obese firefighters lost significantly ($p = 0.038$) more weight (mean: 0.99 kg) than overweight firefighters (mean: 0.29 kg, results not shown). The blood pressure and lipid profiles of firefighters included in this study also showed modest improvement over time; however, statistically significant improvements were only observed for systolic blood pressure (mean change: -3.75 mm Hg; 95% CI: -5.14 , -2.35). This discrepancy between weight trajectories reported in this study and previous firefighter cohorts could reflect changes in the culture of the fire service, increased awareness of the dangers of being overweight, or improved efforts to promote health among firefighters. While a decreasing trend in firefighter weight is promising, only 15% of firefighters managed to reduce their weight by the 3–5% typically considered clinically meaningful (results not shown).²³

The results of observational studies looking at the degree of weight loss following healthcare professional weight loss counseling have been inconsistent. Recent observational studies suggest that healthcare provider weight loss advice may lead to weight loss in overweight and obese individuals in the general population.^{10,14} Conversely, Noel and colleagues concluded that weight management counseling did not positively affect weight loss among military veterans.¹⁵ Consistent with the results of Noel et al., we failed to identify a significant impact of participant-reported healthcare profession weight loss advice on weight change over a period of six months in overweight and obese male firefighters.

These seemingly inconsistent results may be explained by variability in healthcare professional weight recommendations. The most recent guidelines for the treatment of obesity encourage healthcare professionals to provide overweight and obese patients with comprehensive weight management programs, including dietary and exercise components.²³ However, many healthcare professionals

Table 1 Baseline characteristics of overweight and obese male firefighters (N = 757)^a, Fuel 2 Fight, 2011–2012

	Weight advice in past year ^b	
	Lose weight (N = 187)	Other advice (N = 569)
Mean age, years (SD)	42.5 (7.9)	39.3 (8.7)
Mean BMI, kg/m ² (SD)	32.3 (4.2)	28.8 (3.2)
Mean waist, cm (SD)	107.5 (11.2)	97.2 (8.9)
Mean body fat, % (SD)	29.0 (6.8)	23.5 (5.8)
Mean systolic BP, mm Hg (SD)	133.3 (13.5)	128.7 (11.7)
Mean diastolic BP, mm Hg (SD)	81.8 (9.4)	76.8 (9.5)
Mean cholesterol, mg/dL (SD)	193.6 (38.8)	192.5 (35.3)
Mean LDL cholesterol, mg/dL (SD)	117.4 (35.4)	116.0 (31.6)
Mean HDL cholesterol, mg/dL (SD)	44.0 (10.8)	48.1 (12.6)
Mean triglycerides, mg/dL (SD)	158.5 (72.8)	141.5 (91.2)
Mean glucose, mg/dL (SD)	100.5 (28.0)	92.6 (23.6)
Chronic conditions ^c , N (%)		
Comorbidities	123 (66)	243 (43)
Anxiety	18 (10)	40 (7)
Depression	34 (19)	86 (16)
Smoking status, N (%)		
Never	84 (46)	224 (40)
Experimental	54 (29)	179 (32)
Former	34 (19)	98 (18)
Current	11 (6)	53 (10)
Alcohol Intake ^d , N (%)		
Abstinent	35 (19)	80 (14)
1–2 drinks/day	77 (42)	211 (38)
3–4 drinks/day	43 (23)	159 (28)
≥5 drinks/day	29 (16)	111 (20)
Rank in department, N (%)		
Firefighter	119 (64)	392 (70)
Officer	44 (24)	121 (22)
Chief	10 (6)	19 (3)
Other	12 (6)	27 (5)
Ethnic minority ^e , N (%)	74 (41)	204 (36)
Relationship status, N (%)		
Long-term/married	158 (85)	422 (75)
Single/divorced/separated	27 (15)	138 (25)
Department type, N (%)		
Standard	87 (46)	270 (47)
WA	100 (54)	300 (53)

Abbreviations: SD, standard deviation; BMI, body mass index; LDL, low-density lipoprotein; HDL, high-density lipoprotein; WA, departments currently implementing a wellness approach health promotion program.

^aMissing: Age ($n = 1$); Waist ($n = 1$); Body fat ($n = 13$); Comorbidities ($n = 9$); Anxiety ($n = 8$); Depression ($n = 24$); Smoking ($n = 21$); Alcohol ($n = 12$); Rank ($n = 13$); Minority ($n = 14$); Relationship ($n = 12$).

^bParticipants reported receiving advice to lose weight (Lose Weight) or no advice, advice to maintain weight, or advice to gain weight (Other Advice).

^cPercentages may not sum to 100% because groups are not mutually exclusive. Comorbidities include self-reported physician-diagnosed diabetes, hypertension, hypercholesterolemia, arthritis, asthma, cancer, cardiovascular disease; Anxiety is self-reported physician diagnosis; Depression defined as CESD-10 ≥ 4 .

^dAlcohol intake defined by self-reported number of drinks per day in past 30 days.

^eEthnic minority includes any self-identified race other than non-Hispanic White.

do not provide any weight loss counseling.²⁴ We previously reported that fewer than half (47.8%) of obese and less than 12% of overweight firefighters report receiving weight loss counseling from a healthcare professional in the past year.²⁵ Even when weight is discussed with patients it often is a low quality message, rarely including advice on diet and physical activity,²⁶ and the duration of the discussions, generally only lasting a few minutes,

is usually insufficient to effectively counsel patients.²⁷ Evidence from randomized controlled trials suggests brief weight loss counseling is not effective for the treatment of obesity and frequent, intensive physician counseling is necessary to help patients achieve clinically meaningful weight loss.²⁸ Unfortunately, follow-up visits are only scheduled as a part of weight loss counseling with 5% of overweight and obese patients.²⁹ Short, low intensity

Table 2 Association between weight loss advice and six month changes^a in body composition, Fuel 2 Fight, 2011–2012

	N	Weight advice in past year ^b					Mean difference ^f (95% CI)
		Total	Advice to lose weight		Other advice		
		Mean change ^c (95% CI)	N	Mean change (SE)	N	Mean change (SE)	
Weight, kg	458	-0.55 (-0.93, -0.17)	112	-0.35 (0.33)	326	-0.62 (0.21)	0.27 (-0.45, 0.99)
Model 1 ^d	438						
Model 2 ^e	411		108	-0.42 (0.33)	303	-0.67 (0.20)	0.26 (-0.49, 1.00)
Waist, cm	457	-0.81 (-1.48, -0.13)	112	-0.70 (0.44)	324	-0.81 (0.35)	0.11 (-0.68, 0.90)
Model 1	436						
Model 2	410		108	-0.82 (0.43)	302	-0.91 (0.33)	0.09 (-0.70, 0.89)
Body fat, %	457	-0.49 (-0.79, -0.18)	111	-0.47 (0.27)	324	-0.51 (0.18)	0.04 (-0.53, 0.60)
Model 1	436						
Model 2	411		108	-0.48 (0.26)	303	-0.54 (0.17)	0.06 (-0.52, 0.64)

Abbreviations: CI, confidence interval; SE, standard error.

^aChange calculated as follow-up values minus baseline values.

^bParticipants reported receiving advice to lose weight (Lose Weight) or no advice, advice to maintain weight, or advice to gain weight (Other Advice).

^cAdjusted for age, minority status, and baseline BMI category.

^dAdjusted for age, smoking status, minority status, departmental health promotion program, and baseline BMI category.

^eAdjusted for covariates in Model 1, excludes participants with waist circumference < 94 cm and percent body fat < 18% at baseline (n = 27).

^fDifference calculated as value for advice to lose weight minus other advice.

Table 3 Association between weight loss advice and six-month changes in clinical outcomes, Fuel 2 Fight, 2011–2012

	N	Weight advice in past year ^a					Mean difference ^c (95% CI)
		Total	Advice to lose Weight		Other advice		
		Mean change ^b (95% CI)	N	Mean change (SE)	N	Mean change (SE)	
Sys. BP, mm Hg model ^b	435	-3.75 (-5.14, -2.35)	111	-2.15 (1.04)	324	-4.02 (0.69)	1.86 (-0.35, 4.08)
Dia. BP, mm Hg model	435	-0.57 (-1.33, 0.20)	111	-0.12 (0.71)	324	-0.72 (0.40)	0.60 (-1.06, 2.26)
TC, mg/dL model	122	-0.58 (-7.88, 6.72)	35	3.26 (5.18)	87	-2.15 (4.00)	5.41 (-4.38, 15.20)
LDL, mg/dL model	119	-1.34 (-8.33, 5.66)	35	2.16 (4.87)	84	-2.79 (3.83)	4.95 (-4.15, 14.05)
HDL, mg/dL model	122	0.88 (-0.65, 2.42)	35	-0.12 (1.37)	87	1.25 (0.93)	-1.37 (-4.39, 1.65)
TG, mg/dL model	122	-2.30 (-13.98, 9.38)	35	3.55 (12.26)	87	-4.66 (7.35)	8.20 (-21.25, 37.65)
Glucose, mg/dL model	121	2.38 (-1.05, 5.81)	35	3.92 (3.05)	36	1.75 (1.99)	2.17 (-4.89, 9.23)

Abbreviations: Sys. BP, systolic blood pressure; Dia. BP, diastolic blood pressure; TC, total cholesterol; LDL, low-density lipoprotein; HDL, high-density lipoprotein; TG, triglycerides; CI, confidence interval; SE, standard error.

^aParticipants reported receiving advice to lose weight (Lose Weight) or no advice, advice to maintain weight, or advice to gain weight (Other Advice).

^bAdjusted for age, smoking status, minority status, baseline BMI category and baseline clinical value.

^cDifference calculated as value for advice to lose weight minus other advice.

sessions typical of physician weight loss counseling are unlikely to produce meaningful weight loss and could have contributed to the lack of significant findings in this study.

This study has several strengths. First, this study recruited a diverse sample of career firefighters from across the United States. Thus, the results of this study are more generalizable than clinical weight loss trials, which often include participants who are highly motivated to lose weight. Further, this study included multiple investigator-measured estimates of body composition, which are more reliable than participant-reported weights used in some previous studies.¹⁰

This study also has several limitations. First, information on healthcare professional weight loss advice was self-reported. However, the prevalence of weight loss advice in this study is similar to the prevalence estimated from previous observational studies and video recordings of patient and provider interactions.^{9,11,27} Additionally, a sizable portion of the baseline population (39.5%) was lost to follow-up due to relocation and unavailability at

the follow-up visit. This resulted in a decrease in study power, because our analysis was limited to a subset of the original population. Still, the study had greater than 80% power to detect clinically meaningful weight loss (3–5%). Further, baseline characteristics were similar for firefighters who remained in the study and those who were lost to follow-up, suggesting the bias due to lost to follow-up was probably minimal.

Information was not collected on the intensity, timing or frequency of weight loss advice received. Thus, it is possible firefighters weight change was differentially impacted, however we assume this bias was random. There is a possibility that weight loss occurred among individuals who were advised to lose weight in years prior to our study assessment. Although a six-month follow-up period is typical of many clinical studies, it may not be sufficiently long to measure meaningful change in body composition, blood pressure, blood lipids, and glucose. Long-term improvements in clinical phenotypes, occurring over years to decades, are likely more meaningful

indicators of health, but were not assessed in the current study. Additionally, previous research suggests health surveillance alone may be associated with firefighter weight loss.³⁰ All firefighters who took part in the study were provided information about their body composition measurements. Although the study investigators did not provide any explicit weight-related advice, it is possible that informing firefighters of their weight status at baseline was sufficient to encourage weight loss and may have randomly attenuated or enhanced the impact of healthcare professional weight loss recommendations.

Annual medical evaluations are recommended for all career firefighters and present healthcare providers with an opportunity to identify and counsel overweight and obese firefighters.³¹ Although weight loss advice has previously been associated with weight loss intentions and behaviors among firefighters, weight loss advice was not significantly associated with weight loss in this study.³² Similar to the general population, healthcare professional weight loss counseling provided to firefighters likely consists of low quality, brief counseling and likely only occurs at annual medical screenings. The results of this study are consistent with observational and RCT studies showing little benefit of low intensity weight loss counseling.^{12,15} Healthcare providers should recognize the limitations of low intensity interventions and consider increasing the intensity and frequency of weight loss counseling. Current clinical guidelines for the management of overweight and obese adults recommend high-intensity weight loss interventions, which consist of bi-monthly visits with a healthcare provider.²³ However, the time and financial investment required to conduct high-intensity interventions likely limits their application on a large scale. Alternative cost- and resource-efficient approaches suggested in the guidelines such as electronic or telephone interventions are an acceptable alternative for clinicians to prescribe.²³ Future weight loss interventions in the fire service are warranted to evaluate the efficacy of frequent electronic- or telephone-administered weight loss counseling to support the healthcare professional weight loss advice addressing firefighter obesity.

Disclosure statement

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