Published in final edited form as:

J Occup Environ Med. 2012 May ; 54(5): 579–582. doi:10.1097/JOM.0b013e318249202d.

Body Mass Index is a Predictor of Fire Fighter Injury and Worker Compensation Claims

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Abstract

Objective—To determine the relationship between lifestyle variables including body mass index (BMI) and filing a worker's compensation claim due to firefighter injury.

Methods—A cross-sectional evaluation of firefighter injury related worker compensation claims occurring 5 years after the original PHLAME study intervention.

Results—Logistic regression analysis for variables predicting filing a worker's compensation claim due to an injury were performed. with a total of 433 participants. The odds of filing a compensation claim were almost three times higher for firefighters with a BMI >30 compared to firefighters with normal BMI (odds ratio=2.89, p<.05).

Conclusions—This study addresses a high priority area of reducing firefighter injuries and worker's compensation claims. Maintaining a healthy body weight is important to reduce injury and worker's compensation claims among firefighters.

Fire Service personnel are at increased risk for musculoskeletal injuries and cardiorespiratory illness compared to other occupations.¹⁻³ Each year, tens of thousands of firefighters are injured while fighting fires, rescuing people, responding to hazardous materials incidents, and training for their job. Occupational injuries are the leading cause of disability and/or early retirement, and cardiovascular disease is the most common cause of work related death.⁴⁻⁷ As firefighters age, there is an increased prevalence of inactivity, hypertension, lower fitness level, and obesity which may lead to injury and early disability.⁸⁻⁹ These injuries contribute to a significant human and financial toll, i.e. lost work hours, higher insurance premiums, overtime, disability and early retirement payments.¹⁰

Despite countermeasures to prevent injury ranging from improved protective clothing and equipment to more effective health and safety regulations, relatively little about individual

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factors influencing fire fighter injuries are known. Although the literature has noted categories of potential predictors of injuries including equipment failure or protective equipment not worn, lack of training, civilian error, lack of teamwork, lack of fitness and fatigue, weather, decision making and communication systems, there is a paucity of information regarding how lifestyle variables and obesity contribute to the risk of injury among firefighters.¹¹

Obesity among adults has doubled in the past 15 years, and the rate of severe obesity (body mass index or BMI >40) has more than quadrupled.^{12,13} Today, roughly 2/3 of adults are overweight (BMI >25<) and 1/3 are obese (BMI>30).¹³ It is well established that as BMI increases, certain diseases increase including cardiovascular disease, hypertension, NIDDM, and several types of cancer.¹⁴⁻¹⁵ Previous studies have also estimated the health care costs associated with obesity, the costs of increased BMI in the workplace and the costs of obesity to the society as a whole.¹⁶⁻¹⁷

Recent studies have shown a relationship between obesity and increasing risk of occupational injuries.¹⁷⁻¹⁸ In a large cross sectional analysis of 42,304 US workers, there was a clear association between increasing BMI and probability of sustaining an injury.¹⁷ Among hourly manufacturing employees, increased body mass index was associated with increased risk of traumatic workplace injury in comparison with having a normal BMI.¹⁸ The odds of sustaining an injury in this study were 15% greater in the overweight category (BMI >25 and <30) and 48% greater in the obese category (BMI>30) as compared to normal body weight workers.

Little is known about the association between obesity and risk of occupational injuries among firefighters. In a prospective cohort study among 358 Massachusetts firefighters enrolled in a statewide medical surveillance program, researchers found a relationship linking obesity to increasing risk of disability among firefighters.¹⁹ Most recently, Posten and colleagues demonstrated an association between obesity and injury related absenteeism and increasing costs among 478 firefighters.¹⁰ Therefore, to evaluate the impact of lifestyle variables and BMI on injury and worker compensation claims, we prospectively examined a cohort of firefighters in Oregon and Washington with > 7 years of follow-up.

METHODS

Participants

Sample consisted of 433 firefighters who participated in the Promoting Healthy Lifestyles: Alternative Models' Effects (PHLAME) worksite wellness program implemented in fire departments in Oregon and Washington. We analyzed injuries, worker's compensation claims and related health behavior variables occurring five years after the original PHLAME intervention. The majority of the participants were male (95%), white (90%), and attended some college or technical school (67%). The mean age of the firefighters was 39.2.

Measures

Firefighters completed a medical history, physical measures and a survey assessing demographics, diet and physical activity, team support, and a general health instrument. They reported the type of *injury* that occurred, the required type of health care, and if they filed a *worker's compensation claim* due to injury or not in the last 12 months. Participants reported how many days per week they exercise in addition participating in hard *physical activity* in the past month. *Team support* was assessed with one item "Members of my shift or work group really help and support one another" using a 7-point Likert-type agreement scale (1=strongly disagree, 7=strongly agree). *General health* was the mean of five items that asked the extent to which participants agreed that their health was in good condition

using a 5-point scale. The Cronbach's alpha for the scale was .70. Lower scores indicated better overall health.

BMI—Height and weight were assessed, and body mass index (BMI) was calculated as weight in kg/[height in meters]². Six BMI categories are created following the National Heart, Lung, and Blood Institute guidelines: underweight (BMI < 18.5), normal weight (18.5 BMI 24.9), overweight (25 BMI 29.9), obese I (30 BMI 34.9), obese II (35 BMI 39.9), and obese III (BMI 40). There was no participant who was underweight. There was only 1 participant under the obese III category. Based on the distribution of BMIs of firefighters in this cohort, obese I, obese II and obese III categories were combined into the obese category to form a total of 3 categories of BMI: normal (18.5 BMI 24.9), overweight (25 BMI 29.9), and obese (BMI >30).

Statistical Analysis

We conducted logistic regression analysis for the binary outcome variable of whether the respondent filed a worker's compensation claim or not in the last 12 months. The reference BMI category was the normal weight category. We had complete data for 392 (90%) firefighters. To account for the missing data, we used full information maximum likelihood estimation in MPlus 5.2 which uses all of the available data. Full Information Maximum Likelihood estimation (FIML) yields unbiased parameter estimates under the missing at random (MAR) mechanism by borrowing information from the observed data. The interpretation of the missing data maximum likelihood estimates are the same as it is in a complete data regression analysis.

RESULTS

Of the 433 firefighters, there were 184 injuries overall and 160 injured firefighters had at least one injury. Of the 184 injuries, 68 were injuries for which a worker's compensation claim was filed (37%). About 35% of injuries involved the back which was twice as many as the next largest category which was knee/lower leg at 17%.

Table 1 shows the mean BMI by socio-demographic variables. Mean BMI was significantly higher for male, married and older firefighters. Firefighters who were college graduates had lower BMI compared to firefighters who attended high school or some college/technical school. And firefighters with Hispanic origin had higher BMI.

Injury prevalence as percentage scores within each weight category are reported in Table 2. Twenty-five percent of firefighters were in the normal weight category (BMI 18.5–24.9). Fifty-six percent of the firefighters were in the overweight category (BMI 25–29.9). Nineteen percent of the firefighters were in the obese weight category (BMI > 30). The occurrence of injuries were categorized as body part, nature of injury, and the required visit type. Firefighters in the overweight or obese weight categories had a higher percentage of injury prevalence for all types of required visit, all body parts except for foot/ankle, and all injury types except for contusions. The body part most injured among the obese participants was the back; 17.6% of the firefighters in the obese category reported back injuries compared to the 11.5% of firefighters who had normal weight. Elbow/hand injuries were significantly more prevalent among firefighters in the overweight and obese categories. There were a significantly higher percentage of firefighters in the obese category requiring a visit to a specialist (33.8%) compared to the 12.5% of firefighters who had normal weight. Furthermore, injuries that required a PCP visit were significantly more prevalent among firefighters in the overweight and obese categories as compared to the normal weight group.

After controlling for age, gender, race, marital status, education, general health, physical activity, and team support, there were significantly increased odds of filing a compensation claim due to injury for firefighters in the obese category when compared with the reference group (i.e., normal weight category) (see Table 3). The odds of filing a worker's compensation claim are almost three times higher for firefighters under the obese category compared to firefighters with normal weight (odds ratio=2.89, CI=1.17, 7.13). There was a trend showing an inverse relationship between vigorous physical activity and increased odds of filing a compensation claim due to injury ($p<.10$), indicating a firefighter who participates in a higher intensity exercise training program has reduced odds of filing a worker's compensation claim due to an injury. In addition, team support had an inverse relationship to injuries showing as team cohesion and support increases among firefighters, there are reduced worker's compensation claim injuries. Figure 1 is a plot graph showing the probability of filing a worker's compensation claim as a function of BMI.

DISCUSSION

In this cohort of 433 firefighters there was a nearly three-fold increase in workers compensation injury claims among those with a BMI > 30 as compared to those with normal BMI (<25). This result is consistent with other studies among the general U.S. workforce showing obesity increases on the job illness/injury and worker's compensation claims, absenteeism rates and lower work performance, higher work limitations, early disability retirement, and increased mortality.¹⁰⁻¹⁷

This study addresses a high priority area of understanding firefighter injuries and worker's compensation claims. Nearly one third of firefighters get injured each year with a total of 78,150 injuries occurring in 2009 and substantial resources have been allocated to determine causes.^{3,9,20-22} A recent study identified major factors that contribute to firefighter line-of-duty (LOD) injury.¹¹ The factors were examined for frequency of occurrence and clustering with other factors. The dominant contributing factors to LOD injury were lack of situational awareness (37%), lack of wellness/fitness (29%) and human error (10%). The wellness cluster contributes to almost one-third of the explained firefighter injuries thus making obesity related injuries a substantial impact on this number.

This study reinforces the research findings by Posten¹⁰ and Soteriades¹⁹ showing firefighters with obesity had increased absenteeism and disability rates. Posten assessed 478 career male firefighters showing that BMI was an independent predictor of absenteeism due to injury. Fire fighters meeting the definition of class II and III obesity had nearly five times the number of missed work days due to injury when compared to normal weight counterparts at an attributable cost of \$1,682.90 per firefighter.¹⁰ Soteriades and colleagues assessed 340 firefighters in Massachusetts as part of a statewide medical surveillance program with 6 years of follow-up. In a regression model, a one-unit increase in BMI was associated with a 5% increase in job disability, while firefighters with a BMI >30 were two times more likely to have a disability than those in the lowest BMI tertile.¹⁹

In summary, our results demonstrate a nearly three fold increase in firefighter injury related worker compensation claims when BMI >30. These findings support the need to improve the health and wellness of firefighters. In other occupational settings, worksite health promotion has demonstrated cost effectiveness and a positive Return On Investment (ROI).²³⁻²⁵ The International Association of Fire Fighters (IAFF) and The International Association of fire Chiefs (IAFC) recommend implementing a medical wellness program to help identify early disease risk factors and reduce injury rates.²⁶ A recent study determined the effects of a physician-oriented wellness regime (POWR) on a cohort of firefighters while applying the 2007 National Fire Protection Association Standard 1582.²⁷ The POWR

wellness initiative led to a substantial cost savings from an injury-reduction alone. An injury prevention program among 433 Tucson firefighters reduced the number of injuries by 42% and the lost time due to injuries by 62% over a twelve month period.²⁸ In addition, a firefighter wellness program highlighted in the third edition of the IAFF IAFC Joint Labor Management Wellness Fitness Initiative is the PHLAME program.^{8,29-32} The PHLAME (Promoting Healthy Lifestyles: Alternative Models' Effects) program is a cost effective, firefighter health promotion program proven to improve exercise and nutrition habits, reduce body weight and injuries with an annual cost savings of \$1200.00 per firefighter. A complete description and study results and can be found on the website, www.phlameprogram.com and cancer control P.L.A.N.E.T. website (<http://rtips.cancer.gov/rtips/index.do>).

Limitations

A limitation of this study may be that body composition was not assessed in addition to height and weight. There has been concern that BMI is not a valid indicator of obesity among firefighters due to the fact that some firefighters with elevated BMIs could have greater muscle mass since BMI cannot distinguish between muscle and fat mass. However, a recent paper by Posten et al³³ found very low rates of false positives when comparing BMI-based obesity (obese=BMI>=30) classifications to those based on Bioelectrical Impedance Analysis (BIA) determined body fat percentage (>25%) or waist circumference (>40 inches) among male firefighters. Future studies could include DEXA as a more accurate assessment of obesity, but the recent study demonstrates that most male firefighters who had a BMI>=30 were obese also when classified using the standard definitions based on body fat percentage or waist circumference.

Acknowledgments

Conflicts of Interest and Source of Funding: There is no conflict of interest for any of the authors to declare. This research was supported by the National Cancer Institute R01 CA105774 and in part PHS M01 RR00334.

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Figure 1.
Probability of filing a worker's compensation claim as a function of BMI

Table 1
Mean body mass index (BMI) by socio-demographic covariates

Variable	% of firefighters	Mean BMI (SD)	F-value [±]
Sex			
Male	95	27.4 (3.4)	6.68 ^{**}
Female	5	25.4 (3.1)	
Age			
22-34	38	26.7 (3.2)	3.24 [*]
35-44	28	27.5 (3.7)	
45-54	31	27.9 (3.3)	
55-64	3	27.2 (3.8)	
Education			
High school graduate	5	27.5 (5.0)	.79
Some college / technical school	67	27.4 (3.5)	
College graduate	28	26.9 (3.1)	
Race			
White	90	27.2 (3.5)	.63
Black	3	27.5 (3.1)	
Hispanic	3	29.7 (2.2)	
Other	4	27.5 (3.1)	
Marital status			
Married	77	27.5 (3.5)	8.19 ^{**}
Unmarried	23	26.3 (3.1)	

[±] Univariate F-test value

^{*} p<.05

^{**} p<.01

Table 2
Injury prevalence within each BMI category

Variable Prevalence (% within BMI categories)	Normal 18.5 24.9 (N =105)	Overweight 25 29.9 (N = 219)	Obese BMI>30 (N = 69)
Body Part			
Neck	3.8	4.6	4.5
Shoulder	3.8	5.5	10.3
Back	11.5	16.4	17.6
Elbow / hand **	0.8	3.7	5.9
Hip / leg / knee	7.7	8.7	11.8
Foot / ankle	6.7	6.4	5.5
Other	2.9	6.4	5.9
Nature of Injury			
Strains / sprains	16.2	16.9	15.2
Contusions	2.9	2.7	1.5
Lacerations	1.0	2.7	0.0
Fractures	1.9	2.3	1.5
Other **	12.5	23.4	32.3
Required visit			
ER visit	6.7	10.1	10.3
PCP visit **	16.3	20.1	19.1
Specialist visit **	12.5	20.1	33.8
Physical therapy	10.6	14.2	16.1
Surgery	3.8	4.2	4.4

** Chi-square significant at $p < .05$

Table 3
Summary of Logistic Regression Analysis for Variables Predicting Filing a Compensation Claim Due to Injury (0=not filed, 1=filed) (n = 433)

	<i>B</i>	<i>SE B</i>	<i>Odds ratio (95% CI)</i>
Overweight	.42	.40	1.52 (.70 – 3.30)
Obese	1.06 **	.46	2.89 (1.17 – 3.30)
Age	.04 ***	.02	1.05 (1.01 – 1.08)
Physical activity	-.17 *	.10	.84 (.70 – 1.02)
Team support	-.20 *	.11	.82 (.67 – 1.01)
General health	.13	.26	1.14 (.68 – 1.92)
Male	.85	.65	2.34 (.65 – 8.40)
White	.36	.52	1.43 (.51 – 3.96)
Married	.37	.41	1.45 (.65 – 3.25)
College degree	.44	.33	1.55 (.81 – 2.97)

R-square = .17

Omitted reference categories: normal weight, female, Black/Hispanic/other, unmarried, high school/some technical school.

p<.01

**
p<.05

*
p<.10