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## Overweight and obesity in UK firefighters

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## OVERWEIGHT AND OBESITY IN UK FIREFIGHTERS

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## **ABSTRACT**

**Background:** Obesity among firefighters can present a hindrance to operational effectiveness. In North American studies 80% of US firefighters are overweight or obese. No studies have explored obesity among firefighters in the UK and it is unclear whether obesity is a problem among UK firefighters.

**Aims:** To establish the prevalence of obesity among a large sample of firefighters in the UK and to explore changes in body mass index (BMI) over a three year period.

**Methods:** The BMI and body composition of 735 male firefighters from a UK county Fire and rescue service was assessed in 2008 and 2011.

**Results:** In 2008, 65% of the firefighters were either overweight (54%) or obese (11%). In 2011, slightly fewer firefighters were overweight (53%) however the proportion classified as obese increased significantly to 13%. Those classified as normal-weight in 2008 were more likely to have gained weight by 2011 in comparison to those categorised as obese at baseline. A lower proportion of firefighters were classified as high-risk for obesity based on their waist circumference in 2008.

**Conclusion:** The proportion of firefighters who are either overweight or obese is lower in this UK sample than found in US studies. Nevertheless, the proportion of UK firefighters classed as overweight was higher than that found in the general population samples from England. Given the negative implications of obesity for performance, there is a need for further investment in theory-based sector-specific health promotion research and practice.

**Word count: 238**

**Keywords:** BMI, firefighters, emergency responders, obesity

## **INTRODUCTION**

Firefighters are expected to maintain high levels of physical fitness [1]. However, US evidence suggests that firefighters struggle to maintain fitness levels [2,3]: 73-88% of US firefighters are overweight or obese [2-4]. Obesity can negatively impact on firefighters' safety at work, their overall well-being and work productivity [2, 4-8].

The prevalence of obesity among UK firefighters is unknown. Although there is no statutory requirement for fitness tests, guidance, recommends that firefighters should have their weight, body mass index (BMI) and waist circumference (WC) assessed periodically [1]. Those with BMI  $>27 \text{ kg/m}^2$  should be advised to lose weight. This longitudinal study examines body weight and composition in a cohort of UK firefighters.

## **METHOD**

Data were collected from a UK county fire and rescue service comprising 40 stations. Assessments were carried out by occupational health personnel. Ethics committee approval was gained from the Institute of Work, Health and Organisations, University of Nottingham.

1232 employees took part in the 2008 annual health assessment (90% participation rate). Operationally active firefighters ( $n = 877$ ) assessed in 2008 and 2011 were included in this study (71% of the 2008 cohort). 119 firefighters were excluded for missing data. Female firefighters ( $n=21$ ) were also excluded, producing a sample of 735 male firefighters.

Body weight (kg) and height (cm) were measured using electronic weighing scales (Seca, UK) and a stadiometer. BMI was calculated as  $\text{kg/m}^2$ . Waist circumference was measured around the umbilicus to the nearest 0.5cm using anthropometry tape. Body fat percentage (BF%) was measured using the Omron<sup>®</sup>BF 306 body fat monitor (Omron Matsusaka Co., Ltd). Age and employment type were recorded for each firefighter.

BMI data was used as a continuous variable and recoded into categories: normal-weight (18.5-24.9 kg/m<sup>2</sup>), overweight (25.0-29.9 kg/m<sup>2</sup>) and obese ( $\geq 30.0$  kg/m<sup>2</sup>) [9]. We dichotomised BMI using a cut-off of  $\geq 27$  kg/m<sup>2</sup> defined by the guidelines [1] as the threshold for intervention.

Chi-square tests were performed to examine change over time in the proportion of firefighters in each BMI category. A 2 (time) x 3 (2008 BMI category) mixed ANCOVA examined the effects of BMI on body composition over time (BF% and WC). The analyses were repeated with the dichotomous measures of BMI (2x2 mixed ANCOVA). In each analyses, we controlled for mean age and employment type.

## RESULTS

Participants' mean baseline age was 37.6 years (SD 8.5), 439 worked whole time and 296 were retained. In 2008, 35% firefighters were classified as normal-weight, 54% were overweight and 11% were obese (Table 1). In 2011, the numbers categorised as normal-weight and overweight fell to 34% and 53% respectively. The proportion classified as obese ( $n = 95$ , 13%) increased significantly ( $\chi^2 = 708.8$ ,  $df = 4$   $p < 0.001$ ). Of those classified as normal-weight in 2008, 47 became overweight and 2 became obese in 2011. From the 2008 overweight category, 30 became obese whilst 39 moved into the normal-weight category. Sixteen firefighters classified as obese in 2008 became overweight, and 1 moved into the normal-weight category in 2011.

There were no significant overall changes in BF% [ $F(1, 730) = 354$ ,  $p = \text{NS}$ ] and WC [ $F(1, 730) = .03$ ,  $p = \text{NS}$ ] for the whole sample between 2008 and 2011. Significant between-participants effects for the BMI group for BF% [ $F(2, 730) = 359.9$ ,  $p < 0.001$ ] and WC [ $F(2,$

730) = 349.4  $p < 0.001$ ] were found. There were significant interaction effects between time and BMI (2008) for BF% [ $F(2, 730) = 9.5, p < 0.001$ ]; and between time and BMI (2008) for WC [ $F(2, 730) = 7.4, p < 0.01$ ]. Therefore, while overall averages for BF% and WC remained stable, 2008 BMI category predicted the amount of change over time. Firefighters within the 2008 normal-weight category had a mean increase in BF% and WC in 2011. In contrast, these measures decreased on average in those categorised as obese. There were no significant changes in the overweight group. Using dichotomised measures of BMI, the ANCOVA showed significant interaction effects for BF% [ $F(1, 731) = 10.6, p < 0.01$ ]; and WC [ $F(1, 731) = 8.3, p < 0.01$ ] (Table 2).

## **DISCUSSION**

Firefighters in 2008 were overweight (54%) or obese (11%). In 2011, the proportion of overweight fell slightly (53%), whilst the proportion classified as obese increased significantly (13%). Study strengths include longitudinal design. Study limitations include using firefighters within one UK region, limiting its generalisability. In addition differences in the way anthropometric measures are taken by different occupational health personnel may have impacted on the results.

The prevalence of overweight/obesity in 2008 and 2011 (65% and 66%), is lower than the prevalence of overweight/obesity in US firefighters (73-88%) [2-5]. UK firefighters may not have the same health and fitness issues as US firefighters and which may be due to general population differences.

The proportion of firefighters classified as normal-weight in 2008 (35%) was similar to that (34%) reported in a general population sample of adult males in England [10]. A greater proportion of firefighters were classified as overweight (54%) compared to this population (42%), however fewer were classified as obese (11% versus 24%) [10]. Approximately 34%

of men in England had a WC >102cm in 2008 [10], compared with 11% of the firefighters. This suggests that despite a higher prevalence of firefighters classified as overweight, a lower proportion are classified as high-risk based on their WC. This highlights the importance of measuring both BMI and WC in populations with higher levels of lean tissue.

Male firefighters classified as normal-weight in 2008 were likely to gain weight over time. In contrast, firefighters classified as obese in 2008 were likely to lose weight over time.

Although the findings are significant, the average change in weight is small and suggests that body composition is fairly stable in firefighters. This suggests those with obesity could be benefitting from advice on losing weight from occupational health personnel. For those classified as normal-weight, it is unclear whether weight gain is due to body fat or muscle gain. Further research is required.

This study provides an indication of the prevalence of obesity among UK firefighters and provides a benchmark for occupational health staff across UK Fire and Rescue Services.

Total word count: 998

Discussion word count: 342

## **KEY POINTS**

- This is the first study to present data on the prevalence of overweight and obesity among UK firefighters.
- A greater proportion of UK firefighters are overweight when compared to nationally representative data, although the proportion of firefighters classed as obese was lower.
- The findings could contribute to the development of an evidence-base to support the prioritisation of firefighters' health and fitness initiatives.

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**Table 1: BMI, BF% and WC measured in the 3 BMI groups in 2008 and 2011**

	Baseline 2008				Follow-up 2011			
	Normal BMI 18.5-24.9 (n = 257)	Overweight BMI 25.0 to 29.9 (n = 398)	Obese BMI ≥30 (n = 80)	P	Normal BMI 18.5-24.9	Overweight BMI 25.0 to 29.9	Obese BMI ≥30	P
Mean BMI (kg/m <sup>2</sup> ) (s.d.)	23.3 (1.3)	27.2 (1.4)	32.5 (2.3)		23.7 (1.8)	27.2 (1.8)	31.8 (3.0)	
*Mean BF% (s.d.)	17.2 (4.3)	23.7 (3.9)	30.4 (3.8)	<0.001	17.9 (4.2)	23.5 (4.2)	29.6 (4.1)	<0.001
*Mean WC (cm) (s.d.)	84.9 (5.9)	93.4 (6.3)	104.4 (6.3)	<0.001	86.0 (6.0)	93.7 (6.4)	105.4 (7.6)	<0.001
+Mean age (years) (s.d.)	35.5 (9.2)	38.5 (8.0)	40.3 (7.8)	<0.001	37.7 (9.1)	40.6 (8.0)	42.0 (7.9)	<0.001
Whole time employment n (%)	168 (38)	238 (54)	33 (8)	<0.01	154 (35)	240 (55)	45 (10)	<0.05
Retained employment n (%)	88 (30)	160 (54)	48 (16)	<0.01	94 (32)	152 (51)	50 (17)	<0.01

BMI= Body mass index; BF% = Body fat percentage; WC= Waist circumference; s.d = standard deviation

\* Controlling for age and employment type at baseline

+Controlling for employment type at baseline

Categorical data analysed with chi-square test

**Table 2: BMI, BF% and WC measured in those with a BMI $\leq$ 26.9 (n=442) and those with BMI $\geq$ 27 (n =293)**

	Baseline 2008		Follow-up 2011		<i>P</i>
	BMI $\leq$ 26.9	BMI $\geq$ 27.0	BMI $\leq$ 26.9	BMI $\geq$ 27.0	
Mean BMI (kg/m <sup>2</sup> ) (s.d.)	24.4 (1.7)	29.5 (2.3)	24.7 (1.9)	29.2 (2.6)	
*Mean BF% (s.d.)	19.3 (4.8)	26.5 (4.2)	19.6 (4.7)	26.0 (4.6)	<0.001
*Mean WC (cm) (s.d)	87.3 (6.3)	98.7 (8.0)	88.2 (6.3)	98.5 (7.8)	<0.05

BMI= Body mass index; BF% = Body fat percentage; WC= Waist circumference; s.d = standard deviation

\*2x2 Mixed ANCOVA, controlling for age and employment type at baseline