Obesity prevalence and accuracy of BMI-defined obesity in Russian firefighters

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Background

No data exist on obesity or the accuracy of body mass index (BMI) in Russian Federation firefighters.

Aims

To determine the prevalence of obesity and rates of misclassification of BMI-based obesity status.

Methods

Career firefighters in the Moscow region completed anthropometric assessments including height, weight, BMI, body fat per cent (BF%) and waist circumference (WC). Using these three methods, we defined obesity as BMI ≥30, BF% >25 and WC >102, respectively.

Results

The study group consisted of 167 male firefighters. Obesity prevalence was 22% for BMI [95% confidence interval (CI) 16.9–28.5], 60% for BF% (95% CI 52.5–67.3) and 28% for WC (95% CI 21.3–34.9). False positive rates for BMI-based obesity status were low, with 3% (95% CI −1.1 to 7.1) and 6% (95% CI 1.6–9.9) of non-obese participants defined by BF% and WC standards misidentified as obese using BMI. However, 65% (95% CI 55.7–77.4) of BF%-defined obese participants and 36% (95% CI 22.5–49.9) of WC-defined obese participants were misclassified as non-obese using BMI (i.e. false negatives).

Conclusions

Rates of BMI-based obesity in Russian male firefighters were similar to that of males in the general Russian adult male population. Compared with BF% or WC standards, BMI-based obesity classification produced low rates of false positives but demonstrated high rates of false negatives.

Key words

BMI; body fat; firefighters; obesity; Russia; waist circumference.

Introduction

Fire service activities demand and require high levels of fitness and readiness to perform safely [1]. Despite these demands, firefighters in some Western nations are experiencing an obesity epidemic that parallels that found in the general population [2]. This is troubling given that obesity is associated with a number of problematic health issues among firefighters (e.g. cardiovascular-related events, risk for injury) [3].

There are no published data available on obesity in Russian Federation firefighters, but adult obesity rates in the Russian Federation are steadily increasing, with current estimates of 18.6% for men and 32.9% for women [4,5]. Body mass index (BMI) is used to classify obesity [2,3], but there are concerns about its accuracy for firefighters. Because of the nature of their duties, firefighters may have greater muscle mass at any given BMI. This preliminary investigation is the first to document rates of obesity and compare gender-specific (males) age-standardized rates to the adult Russian male population. Also, we determined the accuracy of BMI-based obesity compared to body fat per cent (BF%) and waist circumference (WC).

Methods

This study received ethical approval from the Moscow State University of Medicine and Dentistry Ethics Committee and the National Development and Research...
Institutes, Inc. approved a data use/sharing agreement. Participants were Moscow region, male career firefighters undergoing mandatory annual medicals in March to April 2015. Participants completed additional anthropometric assessments including height, weight, BMI, BF% and WC, using current standards [6].

We computed crude prevalence of overweight and obesity combined (BMI ≥ 25), obesity (BMI ≥ 30) using BMI and obesity based on BF% (BF% > 25) and WC (WC > 102 cm). We computed age-standardized estimates to facilitate comparison with national rates [4,7] using a StatsDirect Statistical Software (StatsDirect Ltd., England; www.statsdirect.com). We used OpenEpi (www.openepi.com) to compute rates of false positives and negatives.

Results

Of the 298 firefighters present and solicited during annual medicals, 167 (56%) consented to participate. Reasons for not participating (44%) including being on-call, that body composition measures would take too long and/or they did not consider it important. All consenting participants were male career firefighters (mean age 39.9 ± 11.2). Mean BMI, BF% and WC values were 27.2 ± 3.9 kg/m², 25.8 ± 6.2% and 95.3 ± 11.6 cm, respectively.

Correlations between BMI, BF% and WC were moderate–high \( r_{\text{BMI-WC}} = 0.83 \), 95% confidence interval (CI) 0.78–0.81; \( r_{\text{BMI-BF%}} = 0.67 \), 95% CI 0.58–0.74; \( r_{\text{BF%-WC}} = 0.57 \), 95% CI 0.46–0.66; \( P < 0.001 \) for all. Prevalence of overweight and obese combined was 69% (95% CI 61.9–75.9). Prevalence of BMI- (22%; 95% CI 15.9–28.5) and WC-based obesity (28%; 95% CI 21.3–34.9) were much lower than BF% (60%; 95% CI 52.5–67.3). Figure 1 provides crude and age-standardized estimates for BMI-defined overweight (BMI ≥ 25) and obesity (BMI ≥ 30) among Russian male firefighters and the most recent overweight and obesity prevalence for adult Russian males.

BMI-defined obesity was similar to that found for adult Russian males after age standardization. Rates of false positives and false negatives for comparing BF% and WC standards to the BMI-based obesity are shown in Table 1.

We found that 65% (95% CI 55.7–74.4) and 36% (95% CI 22.5–49.9) of BF%- and WC-defined obese participants were misclassified as non-obese using BMI (i.e. false negatives). In contrast, only 3% (95% CI 1.1 to 7.1) and 6% (95% CI 1.6–9.9) of non-obese participants defined by BF% and WC standards were misidentified as obese using BMI (i.e. false positives). BMI was more accurate for correctly identifying participants’ obesity status when using WC as the standard (86%) than BF% (59%).

Discussion

We found that 22, 60 and 28% of participants were classified as obese when using BMI, BF% and WC standards, respectively. Also, 65 and 36% of BF%- and WC-defined obese participants were misclassified as non-obese using BMI, while 3 and 6% of non-obese participants defined by BF% and WC standards were misidentified as obese using BMI.

Strengths of this study include the use of multiple body composition measures (note that our BF% method is validated against other standard measures [8]) and their administration by trained professionals in a previously unstudied group. Limitations are that data were collected only from male firefighters in a convenience sample undergoing annual evaluations in March to April 2015. Therefore, the results cannot necessarily be generalized to all Russian Federation firefighters, including women (who represent <5%). However, obesity prevalence in this sample parallels that reported for Russian adult males, thus increasing confidence in the results, as firefighter obesity rates also parallel the general population in the USA [2,3,9].

Russian Federation firefighters’ BMI-based obesity rates were lower than those among US firefighters [2,9], but comparable to males in the general adult Russian population [4]. This is similar to US findings [2]. Comparing BMI to analogous BF% and WC categories resulted in low rates of false positives (3 and 6%) but relatively high rates of false negatives (65 and 36%), which has also been so in US firefighters [2,10]. False positive misclassification (i.e. categorizing those with high degrees of muscle mass and low BF% as obese when they are not), the most concerning issue to firefighters, is rare both for Russian Federation and US firefighters. Therefore, the use of BMI for determining obesity is reasonable for the fire service and related occupational groups [2,3,8,10] but could be augmented easily with WC if there are concerns about missing firefighters with elevated abdominal adiposity even though they are not obese based on BMI.

BMI-based classification was most accurate when compared with WC. However, to minimize false negative
misclassification, BF% or WC standards should be used with BMI to classify obesity status. There are currently no policies regarding obesity in the Russian Federation fire service. Our results represent a first step by providing data for parliamentary-level discussions on the accuracy of BMI-based screening.

### Key points

- Obesity among male Russian career firefighters was 22% for body mass index, 60% for body fat per cent and 28% for waist circumference.
- False positive rates for body mass index-based obesity status, compared with body fat per cent and waist circumference, were low, with 3 and 6% of non-obese participants defined by body fat per cent and waist circumference standards misidentified as obese using body mass index.
- Body mass index-determined prevalence of obesity for male Russian Federation firefighters was similar to males in the general Russian adult population.

**References**


**Table 1.** Rates of false positives and negatives using BMI-based obesity classification and comparable BF% and WC categories

<table>
<thead>
<tr>
<th>Obesity status</th>
<th>BF% standard*</th>
<th>Types and rates of misclassification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obese (BMI ≥ 30.0)</td>
<td>Obese (≥25%)</td>
<td>Non-obese (&lt;25%)</td>
</tr>
<tr>
<td>Non-obese (BMI &lt; 30.0)</td>
<td>65</td>
<td>2</td>
</tr>
<tr>
<td>WC standard*</td>
<td>Overall diagnostic accuracy = 60%</td>
<td></td>
</tr>
<tr>
<td>Obese (BMI ≥ 30.0)</td>
<td>Obese (&gt;102 cm)</td>
<td>Non-obese (≤102 cm)</td>
</tr>
<tr>
<td>Non-obese (BMI &lt; 30.0)</td>
<td>17</td>
<td>113</td>
</tr>
<tr>
<td>Overall diagnostic accuracy = 86%</td>
<td></td>
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</tbody>
</table>

*For each analysis, either BF% or WC categories serve as the standards and BMI-based categories as the ‘screening test’; cut-points for BF% and WC from current standards [6].

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**Conflicts of interest**

None declared.