

# BMI demonstrates poor validity against reference measures of proportional and central adiposity for classifying UK firefighter adiposity status

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BMI is intrinsically unable to differentiate between fat-free mass and fat mass, often resulting in misclassification of individuals<sup>(1)</sup>. This problem is exacerbated in populations possessing above average skeletal muscle such as firefighters, resulting in high rates of false positives<sup>(1,2)</sup>. Research has revealed concerning disparities between BMI and alternative measures of adiposity for quantifying prevalence of firefighter overweight and obesity<sup>(1–3)</sup>. There remains a paucity of evidence characterising the classification of firefighter adiposity within UK metropolitan fire brigades. We assessed levels of misclassification generated by BMI relative to alternative measures of adiposity and related health risk within a large sample of firefighters serving a major UK metropolitan city.

497 full-time London Fire Brigade white male and 78 white female firefighters were recruited from an even geographical distribution of urban and suburban fire stations within Greater London. Height was measured using a stadiometer, waist circumference (WC) was measured using anthropometric tape. Weight and percentage body-fat (BF%) were measured utilising the Tanita MC-780MA bioimpedance body composition analyser. BMI and waist-to-height ratio (WHtR) were calculated. Participants were categorised by BMI, BF%, WC and WHtR using analogous weight/adiposity/health risk cut-offs to quantify prevalence of overweight and obesity, and to determine levels of agreement between BMI and the other measures.

Combined prevalence of male firefighter overweight and obesity characterised by BMI was 80%, which contrasted widely with the other measures, BF% (63%), WC (43%) and WHtR (59%). Within the obese BMI category, agreement with the other measures was 65% BF%; 60% WC; 35% WHtR. Within the overweight BMI category agreement was 57% BF%; 34% WC; 61% WHtR. Female firefighters exhibited lower combined prevalence of overweight and obesity compared to the male firefighters: BMI (43%), BF% (18%), WC (36%) and WHtR (27%). Within the obese BMI category, agreement with the other measures was 22% BF%; 78% WC; 22% WHtR. Within the overweight BMI category agreement was 28% BF%; 44% WC; 48% WHtR. In comparison to a high rate of false positives, BMI generated far fewer false negatives, thus showing better sensitivity than specificity.

Poor agreement between BMI and other measures suggests poor validity of BMI for the adiposity and health risk classification of firefighters. When using BF% as the reference, BMI generated around twice the rate of false positives for females compared with males, which was reversed when using WC as the reference. When using WHtR as the reference, BMI misclassified males and females similarly. Phenotypic heterogeneity between male and female adipose tissue storage sites may explain this sex-based differential misclassification. BF% and WHtR are adiposity indices, therefore offering more valid assessments of firefighter adiposity status and related health risks than BMI. This represents the first study to assess adiposity/health risks of UK female firefighters.

## References

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