

Differential Obesity Measures for the Firefighter Wellness and Fitness (WEFIT) Program: BMI, Waist Circumference, or Skin-fold based Percent Body Fat?

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Background – FORWARD study

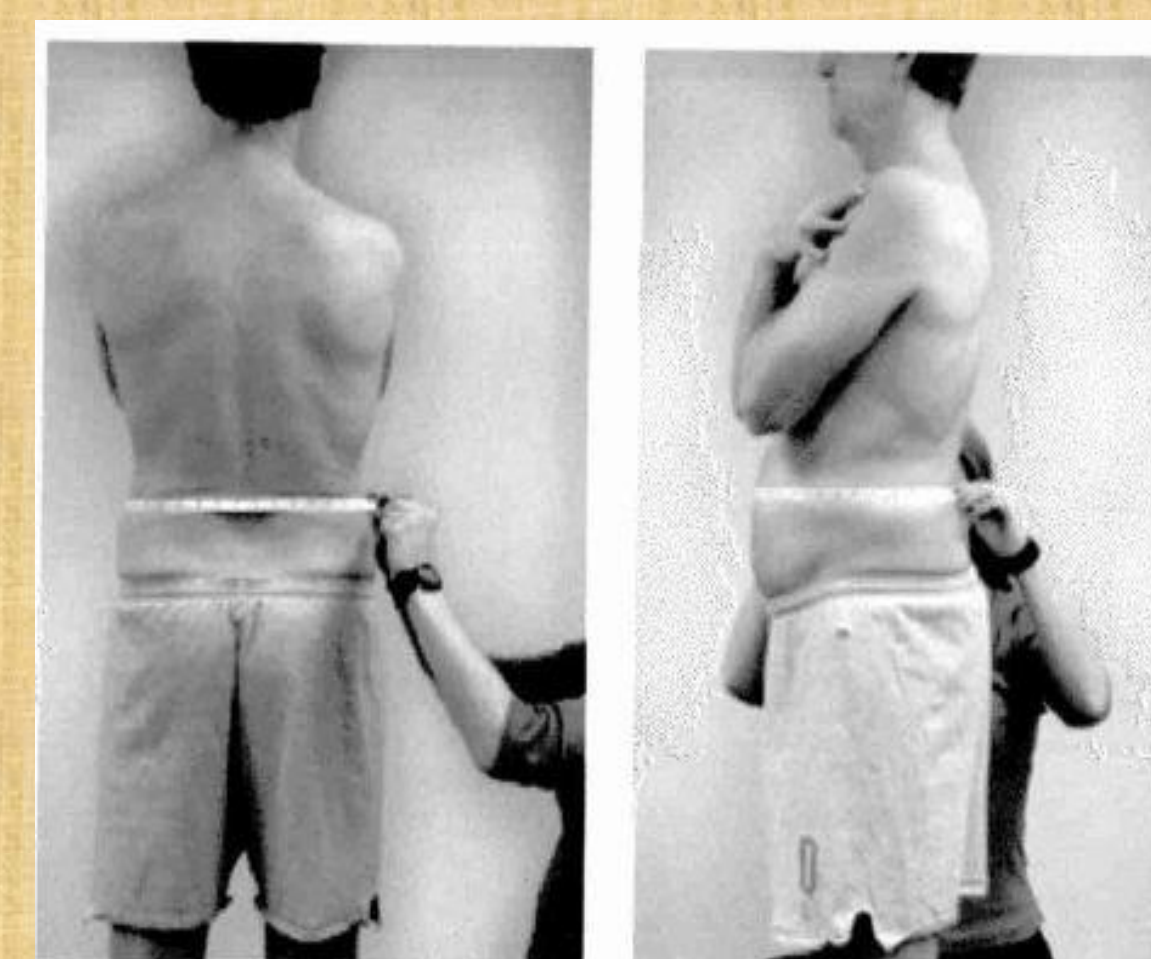
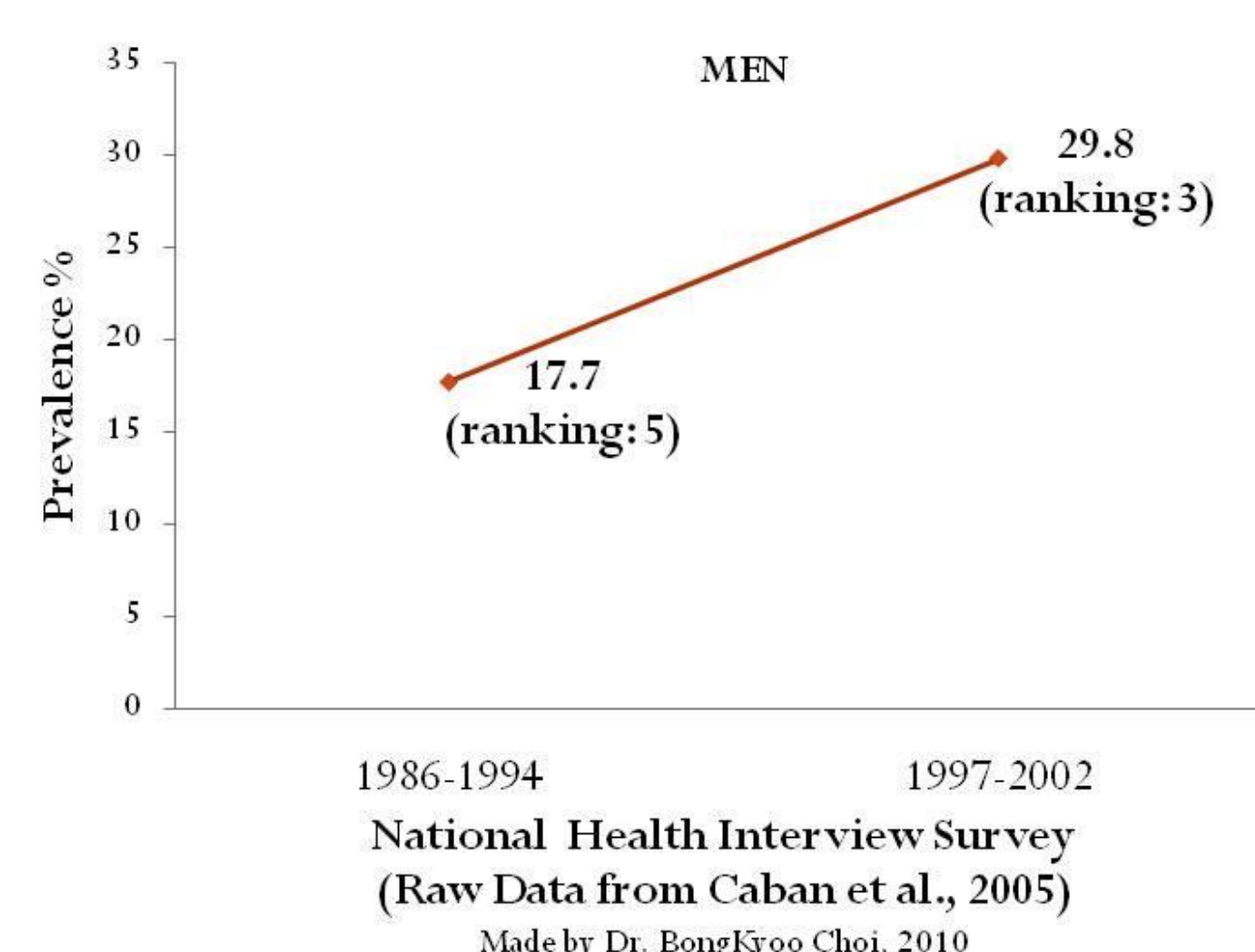
FORWARD (Firefighter Obesity Research: Workplace Assessment to Reduce Disease) study:

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Firefighters are one of the heaviest occupational groups among 41 male US occupational groups. However, little is known about the strengths and weaknesses of practical obesity measures would be best for the firefighter wellness and fitness (WEFIT) program, a worksite health promotion program for preventing cardiovascular disease among firefighters. Although BMI has been the mostly used obesity measure at firefighter WEFIT programs across the nation, **there has been a strong skepticism as to whether BMI is a valid measure for obesity among firefighters.**

A recent study (Poston et al., 2011) on 677 professional and volunteer firefighters from Missouri Valley region compared three obesity measures (BMI, waist circumference, and body fat percent based on bioelectrical impedance) and concluded that “obesity was even more prevalent when assessed by body fat percentage than by BMI, and misclassifying muscular firefighters as obese by using BMI occurred infrequently.”

Self-reported obesity (BMI ≥ 30 kg/m²) prevalence in police and firefighters: among 41 occupational groups



Objectives

- Compare **three obesity measures** (BMI, waist circumference (WC), and skin-fold thickness based body fat %) in definition of obesity cases
- Examine **their differential relationships with the Framingham coronary heart disease risk score** (based on age, HDL, LDL, blood pressure, diabetes medication, and smoking) in a sample of Southern California firefighters.

Methods (N=282 male firefighters)

This study presents preliminary findings from the on-going cross-sectional FORWARD study (Choi et al., 2011) based on 282 male firefighters (study participation rate = 85%) in a Southern California county.

The adiposity of each of 282 firefighters was assessed at their Wellness and Fitness (WEFIT) exams in three ways with standard protocols by an experienced exercise physiologist: BMI; estimated body fat % based on 3-site skinfold thickness using the Jackson & Pollock equation; and waist circumference.

The components of the Framingham coronary risk score (age, HDL, LDL, blood pressure, diabetes medication, and smoking status) were measured at their WEFIT exams.

Analyses:

- **Spearman correlations among three obesity measures (as continuous variable)**
- **Sensitivity and specificity of the BMI-based (BMI ≥ 30 kg/m²) obesity cases against the WC-based (> 40 inches) and skin-fold thickness based [> 25 %, according to the American Association of Clinical Endocrinology/American College of Endocrinology (1998), and > 22.0 %-24.5 %, as alternative cut-points for obesity (Clark et al., 1993; Oreopoulos et al., 2011; Stout et al., 1994)] obesity cases**
- **Spearman correlations between three obesity measures (as continuous variables) and the Framingham coronary risk score**

Results

Table 1. Means (range) of obesity measures and their Spearman correlations

Obesity Measure	Mean (Range)	1	2
1. BMI (kg/m ²)	27.61 (21.76-40.29)	-	
2. WC (inches)	37.49 (30.00-53.00)	.86*	-
3. Skin-fold based Body Fat %	18.59 (6.21-37.41)	.73*	.82*

* P < 0.001

Table 2. Obesity prevalence by three obesity measures in the male firefighters

BMI-based (30 ≥ kg/m ²)	WC-based (> 40 inches)	Skin-fold based (> 25%)	Skin-fold based (>22.0% - 24.5%)
21.8 %	25.9 %	15.7 %	17.1% - 30.5 %

Table 3. Sensitivity and Specificity of the BMI-based obesity cases against the WC-based and skin-fold thickness based obesity cases

BMI-based (30 ≥ kg/m ²)	WC-based (> 40 inches)	Skin-fold based (> 25%)	Skin-fold based (>22.0% - 24.5%)
Sensitivity (obese firefighters)	72.6 %	65.1 %	52.9 % - 66.7 %
Specificity (non-obese firefighters)	96.6 %	87.3 %	87.1% - 91.8 %

Table 4. Spearman correlations between three obesity measures (as continuous variables) and the Framingham coronary risk scores

With BMI	With WC	With Skin-fold based body fat %
.374*	.423*	.545*

*P < 0.001.

Three obesity measures were also significantly correlated with each component of the Framingham risk scores, except for diabetes medication: Skin-fold body fat % was more highly correlated with age, LDL, and diastolic blood pressure than BMI and WC. BMI was more highly correlated with systolic blood pressure than Skin-fold body fat % and WC. WC was better in relation to HDL than the other two measures.

Conclusions and Implications

In this study, there were larger false negative rates of obesity by the BMI against the body fat % and waist circumference in the current study (34.6% and 27.4%, respectively) than in the Missouri Valley region study (2.9% and 9.8%).

This study indicates that body fat % and waist circumference measures may need to be used and tested along with the BMI as practical obesity measures for the firefighters WEFIT program. A comparative study of the practical obesity measures against the underwater weighing method in a small group of firefighters will further clarify the strengths and weaknesses of the practical obesity measures.

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