Int J Obes Relat Metab Disord 1994 Jul; 18(7): 503-12

Comparative evaluation of body composition methods and predictions, and calculation of density and hydration fraction of fat-free mass, in obese women.

Fuller NJ, Sawyer MB, Elia M.

MRC Dunn Clinical Nutrition Centre, Cambridge, UK.

The objective of this study was to apply a three-component model of body composition to a group of obese women in order to (a) establish the relative value of a number of readily available prediction equations by comparison of the extent of agreement between these predictions and body composition estimated by the model and other reference methods and (b) evaluate density and hydration of fat-free mass.

Estimation of body composition was carried out by reference methods and prediction equations and the usefulness of these prediction equations for application specifically to obese women was evaluated.

The subjects were 15 obese, otherwise healthy, Caucasian women (body mass index > 30kg/m2 and body fat > 40% of body weight, as originally determined using densitometry).

Body composition was estimated using three established reference methods (deuterium dilution which primarily measures total body water, densitometry for body fat and fat-free mass and total body potassium) and the three component model constructed from deuterium dilution and densitometry. Density and hydration fraction of the fat-free mass were calculated from appropriate values obtained as integral parts of the three-component model. In addition, body composition was predicted from various prediction equations incorporating weight and height (some of which include a factor for age), from a number of prediction equations utilizing different terms involving the same whole-body bio-electrical impedance measurement and from measurements of skinfold thickness and near infrared interactance.

The extent of agreement between methods was assessed using bias and 95% limits of agreement. Mean density of fat-free mass was found to be 1.104 kg/l (s.d. 0.006kg/l) with a range of 1.093 to 1.117 kg/l, and mean hydration fraction was 0.712 (s.d. 0.016) with a range of hydration from 68.2% to 75.1% (all values were calculated from the three-component model).

In general, the reference methods (densitometry, deuterium dilution, the three-component model and total body potassium) demonstrated better agreement with each other than with the prediction methods or equations. In these obese women, skinfold thickness measurements are apparently less reliable (large bias and 95%

limits of agreement) than in the lean subjects of a variety of other studies. A majority of interpretations of weight and height measurements and predictions incorporating impedance/resistance measurements are apparently not applicable to this group of obese women, due to large values for both bias and 95% limits of agreement. For body fat estimation (% body weight), for example, the bias between reference methods and weight/height prediction equations ranged from –12.5% to 8.4%, with 95% limits of agreement up to 15.8%; and the bias between reference methods and predictions incorporating whole-body bio-electrical impedance ranged from –7.6% to 8.1%, with 95% limits of agreement up to 24.7%.

The results of this study suggest that there is no compelling reason, on the basis of the three-component model, to change the traditional value of 1.1 kg/l for use in densitometry with obese female individuals. It is also suggested that, there is apparently a large and unacceptable variability in estimates of body composition obtained by the various prediction equations applied here, and that there is a particular risk involved in applying prediction equations, originally derived in lean individuals, to obese women. Interpretation of bio-electrical impedance measurements in terms of body composition has been advocated for both lean and obese subjects. Previous studies from our laboratory have show that use of only certain of the many available bio-electrical impedance predictions are valid in non-obese subjects, but obese subjects were not always included in these particular evaluations. In this study, which does compare predictions of body composition in obese females, the **Bodystat-500** package appears to agree better with various reference methods, including the three-component model, than other commercial bio-electrical impedance packages, some of which may result in major inaccuracies. The bio-electrical impedance equations derived from studies in the obese (and, therefore, advocated for use in the obese) appear to be the most promising.