TACSM Abstract

Body Fat Percentage Estimation from Smartphone Three-Dimensional Optical Imaging

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ABSTRACT

Body composition is an important component of overall health. The development of digital assessment methods has led to increased interest in devices that allow users to monitor their own body composition. Smartphone applications with three-dimensional optical imaging (3DO) capabilities are a user-friendly technology capable of predicting percent body fat (BF%) from relevant body measurements. **PURPOSE**: To determine the validity of two BF% equations using smartphone 3DO data, as compared to a 4-compartment (4C) model criterion, and to produce a new BF% estimation equation. **METHODS**: At a single laboratory visit, 60 participants (28 F, 32 M; [mean ± SD] age: 24.4 ± 6.5 y; body mass index: 24.7 ± 4.3 kg/m^2) were assessed using smartphone 3DO and a 4C model. For 3DO, participants performed a full rotation in view of the front-facing smartphone camera. BF% values were then produced using the manufacturer's proprietary BF% equation (3DO-P) and the U.S. Army one-site BF% equation (3DO-A). Each set of values was compared to criterion 4C estimates through regression procedures and Bland-Altman analysis. The Pearson's R^2 and mean absolute error (MAE) were also estimated. A new BF% equation was produced using Least Absolute Shrinkage and Selection Operator (LASSO) regression with 10-fold cross-validation. **RESULTS**: For 3DO-P, R^2 and MAE values were 0.67 and 4.3%, respectively, with corresponding values of 0.74 and 4.4% for 3DO-A. Moreover, proportional bias was observed for both equations (3DO-P: slope = -0.36, 3DO-A: slope = -0.41). The new BF% equation produced from LASSO regression included five predictor variables: neck-to-height ratio, stomach-to-height ratio, hips-to-height ratio, thigh-to-height ratio, and total body volume. This model produced R^2 and MAE values of 0.81 and 3.8% using 10-fold cross-validation. **CONCLUSION**: The performance of existing BF% prediction equations using smartphone 3DO data demonstrate opportunities for refinement. The newly developed equation incorporating circumference-to-height ratios and total body volume provides a proof of concept for improved prediction equations using LASSO regression, which may additionally help avoid the common problem of overfitting in traditional multiple linear regression equations. However, continued evaluation of these methods is warranted.