Impact of standardised vs non-standardised athlete presentation on technical and biological error in physique assessment methods

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Introduction

- Two compartment (2C) models of physique assessment contain assumptions that can be overcome by a three compartment (3C) model, where total body water (TBW) is measured rather than assumed, or a four compartment (4C) model, where both TBW and bone mineral content (BMC) are measured. TBW is the most variable component of fat free mass (FFM) but the impact of athlete presentation on measurement error in 2C models has not been established. Additionally, the reliability of surface anthropometry (SA) on athletes presenting after ad libitum food and fluid intake plus physical activity is unknown.

- The aim of this study was to evaluate the impact of standardised versus non-standardised athlete presentation on technical and biological error on surface anthropometry, 2C, 3C and 4C models of physique assessment.

Method

- Thirty two athletic males underwent five tests including estimates of composition calculated by Evans et al1 (SA), dual energy x-ray absorptiometry (DXA), bioelectrical impedance spectroscopy (BIS) and air displacement plethysmography (BOD POD) to measure body composition, with combinations of these used to establish 3C and 4C models.

- Tests were conducted after an overnight fast, and ~7 hrs later after ad libitum food/fluid and physical activity, then repeated at 24 hrs replicating the initial standardised presentation, and finally ~15 min after ingestion of a specified meal (500g with/without 1000mL water) (Figure 1).

- Magnitudes of changes in the mean and typical errors of measurement were assessed by standardisation.

Results

- Mean change score for body mass were trivial for standardised presentation but were small and moderate for non-standardised presentation and post meal tests being 1% (890g) and 1.6% (1480g) respectively.

- Mean change scores for TBW assessment were trivial for standardised presentation tests (0.2%, -0.3%) and large for non-standardised test (~7 hrs post ad libitum) (3.4%).

- Standardised presentation mean change scores for FM were trivial for all models but substantially large for non-standardised presentation tests (~7 hrs post ad libitum) in BIS, SA, 3C, and 4C models (-15.1%, 10.4%, -6.9% and -6.7% respectively) and in BIS, 3C and 4C post meal (9.8%, 5.7% and 5.2% respectively).

- For FFM, mean change scores for standardised presentation tests were trivial for all models but non-standardised presentation tests (~7 hrs post ad libitum) produced large changes for BIS, 3C and 4C models (3.4%, 2.3% and 2.2%), small for DXA (1%) and trivial for BOD POD (0.9%) (Figure 2).

- SA raw values (mm) were very reliable throughout all conditions and likewise for SA values with standard presentation testing (FFM) with trivial mean changes. There were moderate errors in post meal conditions (FFM) and non-standardised conditions (FM) for this method due to the inclusion of body mass in the calculation.

Discussion

- Models that included a measured TBW value from BIS (3C and 4C) were more sensitive to TBW changes in non-standardised conditions than 2C models in FM and FFM measurements.

- Biological error via acute TBW change in FFM is minimised in physique assessment models if subjects present in an overnight fasted and rested state. Therefore, standardised presentation of subjects should be mandatory for all physique assessments if reliable measures of FM and FFM are required.

- When circumstances prevent standardised presentation of subjects then DXA and BOD POD are acceptable if acute food and fluid intake remains below 500g.

- If overnight fasted body mass is measured, surface anthropometry is a reliable method for physique assessment in athletes despite time of day or presentation.