COMPARISON OF 2, 3 AND 4 COMPARTMENT BODY COMPOSITION MODELS IN TRAINED MALES

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The two-compartment hydrodensitometry model for determining body composition divides the body into the fat free mass (FFM) and fat mass (FM) which are assumed to have invariant densities of 1.1000 and 0.9007 $g.cm^{-3}$, respectively. Body fat (%BF) is then calculated from body density (BD) which is determined via underwater weighing (Withers et al. in press). The three compartment model (fat; total body water or TBW; fat free dry solid) estimation of %BF is based on measurements of BD and TBW (Withers et al. in press). The latter variable has the lowest density (0.9937 $g.cm^{-3}$) but comprises the largest percentage (~74%) of the four (TBW; protein; bone mineral or BM; non-bone mineral) FFM components. The four compartment model (fat; TBW; BM; residual) incorporates the additional variable of BM which constitutes ~6% of the FFM at a relatively high density of 2.982 $g.cm^{-3}$.

The aim of this study was to compare the %BF estimates via two, three, and four compartment body composition models in highly trained males. Nine middle-distance runners (X ± SD: 22.6 ± 5.7 yr; 174.9 ± 5.3 cm; 66.60 ± 4.59 kg; VO_2 max = 69.5 ± 3.9 $ml.kg^{-1}.min^{-1}$) were accordingly measured for BD, TBW and BM via UWW, deuterium dilution and dual-energy x-ray absorptiometry, respectively. The results (X±SD) are summarised below:

Models	2 compartment	3 compartment	4 compartment
%BF	9.3 ± 1.6	12.1 ± 2.1	12.2 ± 2.0
FFM (kg)	60.38 ± 4.49	58.60 ± 4.73	58.52 ± 4.63

While greater validity should be associated with the measurement of more compartments, individual differences between the two and three compartment models (X±SD: 2.8 ± 1.5%BF; range = 0.6 to 5.3% BF) were significantly ($P < 0.001$) greater than those between the three and four compartment models (X ± SD: 0.1 ± 0.3%; range = -0.4 to 0.5% BF). The higher %BF for the three compartment model compared with the two compartment one is because the FFM hydrations (X ± SD: 72.2 ± 0.8%) were all less than the two compartment hydrodensitometry assumption of 73.7% which is based on analyses of just three male cadavers. Hence, the lower FFM hydrations would increase BD and result in a lower estimation of %BF via hydrodensitometry. The additional incorporation of bone mineral via the four compartment model impacted little on the %BF estimates because the overall mean (X ± SD: 5.75 ± 0.34% FFM) differed little from that of 5.63% FFM for the three cadavers and our data were very homogeneous for this variable which comprises a much smaller percentage of the FFM than water.

Our preliminary data on highly trained males therefore suggest that:

1) The three compartment model is more accurate than the two compartment hydrodensitometry one because it controls for biological variability in TBW.
2) The four compartment model, which controls for inter-individual variability in bone mineral, achieves negligible extra accuracy compared with the three compartment model.

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