Relationships Between Fat Mass and Lean Mass

Richard F. Burton

Affiliation

School of Life Sciences, College of Medical, Veterinary and Life Sciences, University of Glasgow, Glasgow, G12 8QQ, UK.

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Corresponding Author: Dr. Richard F. Burton

15 Lansdowne Crescent, Glasgow G20 6NQ, UK.

Telephone: +44(0) 141 334 9738

Email: richard.burton@glasgow.ac.uk.

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TO THE EDITOR: The recent 'Perspective' of Abe et al. (1) is a valuable contribution to the topic of quantitative relationships between the fat and the fat-free components of the body. They utilized published data relating to six different programs of dietary restriction, mostly combined with exercise. My aim here is to link their approach to those of related studies on adults in which exercise programs are not involved (2,3). These concern the influence of fat mass (FM) on lean (i.e. fat-free) mass (LM), quantified by the ratio ΔLM/ΔFM, where Δ denotes difference or change.

From mean changes in LM and FM, in kg, Abe et al. calculated changes in mean LM that excluded the masses of the fat-free components of adipose tissue, denoted FFAT (1). On the assumption that 85% of adipose tissue is fat, FFAT was calculated as (1 – 0.85) × FM/0.85, i.e. 0.176.FM. Finally Δ{LM – FFAT} was calculated as the difference between that and the LM, i.e. Δ{LM – 0.176.FM}. The results for the six programs constitute the last column of their Table 1.

With the programs designated as in their Table 1, the corresponding values of ΔLM/ΔFM, not tabulated, are: 'Diet+Life' 0.23; 'Diet+Aerobic' 0.07; 'Control' no value; 'Aerobic' 0.43; 'Combined' 0.24 and 'Resistance' 0.14.

Facilitating comparisons of the two approaches when individual data are unavailable is the fact that Δ{LM – FFAT} and ΔLM/ΔFM are closely related. Indeed, over a realistic range of values,

$$\Delta\{\mathrm{LM} - \mathrm{FFAT}\} \approx 1.20 - 6.60 \times \Delta\mathrm{LM}/\Delta\mathrm{FM}.$$

Table 1 of Burton (2) records mean values of ΔLM/ΔFM calculated for obese individuals on restricted diets with no exercise program. For 12 groups of women the values—of varied reliability—range from 0.14 to 0.61, averaging 0.28. For six groups of men they range from 0.25 to 0.56, averaging 0.37. According to the above formula, Δ{LM –

FFAT} ranged from 0.28 to –2.83. Values of ΔLM/ΔFM obtained for three groups of overfeeding men were 0.50, 0.54 and 0.65, with Δ{LM – FFAT} being calculated respectively as –2.1, –2.4 and –3.1.

If the fat content of adipose tissue is again taken as a constant 85%, with FFAT equal to 0.176.FM, then ΔFFAT/ΔFM is 0.176. In theory this should be less than ΔLM/ΔFM—because of adjustments in other components of LM—and this is true of most of the values in the previous paragraph. Nevertheless, it is clear that changes in the fat-free component of adipose tissue (FFAT) are responsible for significant parts of the changes in whole-body LM, as emphasized by Abe et al. (1).

The papers of Burton (2,3) are mainly concerned with relating LM and FM for 'ordinary', non-experimental, population samples. The later paper (3), involving a novel regression method, produced estimates of ΔLM/ΔFM of 0.40-0.53 (for women and men of three U.S. ethnic groups). As four of the five values calculated for the data tabulated by Abe et al. (1) are substantially lower (see above), one may speculate that FM and LM might eventually have adjusted over time to conform to the above more typical non-experimental relationships.

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References

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