

The Authors reply:

“Dual energy X-ray absorptiometry: gold standard for muscle mass?” by Scafoglieri et al.

We appreciate your interest in our recent publication¹ and your valuable comments. We completely agree that there is still ambiguity in the literature on the definition and use of parameters characterizing body composition.² From this perspective, DXA actually is a progress as the definition of lean and fat (according to DXA terminology) and based on differences of X-ray mass absorption coefficients. With a two energy X-ray system, two materials that differ in atomic number can be uniquely identified using a so-called base material composition.³ Specific calibration equations of identification of dedicated anatomical entities consisting of either one of the materials is not required. As shown by Pietrobelli *et al.*⁴ in terms of the so-called *R*-value that quantifies differences in the mass absorption coefficient for a given material at different X-ray energies fatty acids and triglycerides the ingredients of can well be separated from non-lipid body composition materials.

From this perspective, lean and fat mass as measured by DXA are clearly defined, but do not necessarily agree with anatomical entities such as the amount of adipose tissue. As fat is a term used in many different contexts, perhaps a different name should have been given to what is now known as DXA fat mass. We agree that DXA lean body mass is smaller than FFM.⁵ FFM is the mass of the body excluding the chemical fat. So essential lipids are also excluded. Lean body mass, interpreted the ‘DXA way’, is the soft lean tissue of the body, excluding the bone minerals and the chemical fat. However, lean body mass from a historical point of view, does include the bone, and very closely resembles FFM (but is not perfectly the same). What we would like to stress is that the concept of lean body mass (of FFM for that matter) is not very useful for muscle research. You would like to focus on the bone-free and fat-free mass of the arms and legs, as this measure most closely resembles the actual skeletal muscle tissue. Apparently, a standardization of terminology in the field of body composition is required.

We agree with comments that lean mass and muscle mass are two different measurements but this was clearly outlined as a weakness of DXA in Table 1. However, as the commentators showed themselves, the correlation was high ($r = 0.94$),⁶ and lean was almost the sum of muscle, skin, and viscera. In the appendicular skeleton, there is no viscera, thus

only the difference in the lean composition, i.e. the variation of relative amounts of water, protein, and glycogen remains.

With regard to estimations of fat-free mass and (appendicular) lean mass using bioelectrical impedance (BIA), we appreciate the confirmation that large prediction errors at the individual level may occur which hampers the use of BIA in clinical practice. We also showed that on a group level, discrepancies might occur between lean mass predicted by BIA and lean mass measured by DXA. We agree these discrepancies should not be interpreted as BIA not being valid to assess lean mass. We merely provided these examples to highlight the fact that estimates of lean mass from BIA clearly differ from those from DXA, thereby influencing the interpretation of findings (e.g. the prevalence of sarcopenia and the comparison of data obtained with different methods).

Given the high degree of DXA standardization, excellent precision, the high correlation of DXA lean mass with muscle mass and muscle volume, currently DXA seems to be the best reference technique, in particular for appendicular muscle measurements. This does not imply that DXA will be the gold standard for the diagnosis of sarcopenia, which requires a functional component in addition to appendicular muscle mass assessments. It also calls for further efforts to develop anthropometric standards representing the wide range of body compositions encountered in the clinical routine in order to validate the accuracy of methods, such as DXA and BIA. At this stage, the scientific evidence derived from the published literature seems to support the conclusions of the original article.

Conflict of interest

The authors declare no conflict of interest. The authors certify that they comply with the ethical guidelines for publishing in the Journal of Cachexia, Sarcopenia and Muscle: update 2017.⁷

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