

Commentary

Bioimpedance and the estimation of human skeletal muscle mass

Clinicians, epidemiologists, anthropologists and nutritional scientists interested in energy metabolism have constantly looked for simple indicators or techniques for the estimation of body composition in human subjects. Anthropometric indicators and simple and relatively inexpensive instrumentation techniques like bio-electric impedance which could either be used in large groups of individuals in the field or by the bedside, have been the ones most sought after. While the early interest in human body composition was driven by the need to estimate the fat and fat free mass of the body, increasingly as methods were developed - both the advanced, sophisticated and the simple, inexpensive techniques were harnessed to more nuanced body composition analysis for the purpose of clinical and epidemiological investigations. These included the need to estimate or quantify non fat tissues such as skeletal muscle and visceral protein mass, total body water and body fluid compartments and the estimation of bone mass.

A wide range of investigators have an interest in the estimation of human skeletal muscle mass. These include, exercise physiologists who need to relate exercise performance, VO_2 max and other physiological parameters with skeletal muscle mass and to assess the impact of training programmes on muscle mass. Clinicians have a need to assess the effects of catabolic diseases on muscle wasting in patients and the effect of therapeutic regimes to reverse the process. Increasingly clinicians dealing with the problem of sarcopaenia in the elderly have a need to quantify muscle mass and function and to assess the impact of exercise regimes in halting or reversing this process. Clearly there is a need at the sharp end of clinical practice to resort to simple and inexpensive, non invasive techniques to quantitate skeletal muscle mass.

Anthropometry has been used as a simple, non invasive and inexpensive, method to provide a measure

of muscle status for some time now¹. However, it is only in more recent times that anthropometric indices have been validated to estimate total body skeletal muscle mass in humans². The validation of the bioelectrical impedance analysis technique to estimate skeletal muscle mass has also only been carried out³. Both these simple techniques have been validated against more sophisticated and relatively more accurate methods of estimation of body composition in western subjects. The present report by Kuriyan and colleagues⁴ in this issue is a report of similar validation of simple techniques and the generation of predictive equations using bioimpedance measurements and anthropometric indicators to estimate total skeletal muscle mass in Indian subjects. While in itself the study cannot be considered as being novel, it addresses an important need given both our increasing understanding of the special risk of metabolic diseases that South Asians face, and the emerging epidemic of these chronic diseases in societies in rapid developmental transition, like India and the increase in the numbers of elderly amongst them.

A few comments however would not be out of place here. The validation of both anthropometry and bioimpedance in this study⁴ has been made with estimates of skeletal muscle mass derived from a single 24 h creatinine excretion while on a meat free diet. Diet and physical activity are important factors that influence creatinine excretion⁵; and the authors have taken care to ensure this is minimized. Menstrual cycle also contributes to the variation, but is not relevant to this study confined only to men. While it is generally accepted, based on a review of the literature, that urinary creatinine output on a constant diet composition is proportional to muscle mass⁵, it is also well known that even under these conditions the day to day variations in creatinine excretion can be of the order of 4 to 8 per cent which cannot be explained by small variations in diet or physical activity⁶. Switching to a meat free diet for 3 days does not ensure

that the readjustments in the creatinine pool have occurred and one is inclined to suggest that maintaining the same meat and protein intake over the same period may be more logical than is the practice to advise a 3 day meat free period when using 24 h creatinine excretion to assess muscle mass. Equally important is to remind oneself that creatinine excretion is better related to lean body mass (of which only 30 to 50% is muscle) than to muscle mass *per se* in several studies⁵. The relevance of these comments are not meant to undermine the approaches of the authors to provide simple inexpensive tools to assess muscle mass, but to raise an important question that validation of anthropometric or bioimpedance analysis may require that the an accurate measure of the variable that is being predicted *i.e.*, skeletal muscle mass in this case, is crucial. The authors would have enormously enhanced the usefulness of their contribution by obtaining in a sub-population of their group, a more sophisticated but accurate measure of muscle mass such as by CT or MRI scans and by dual energy X-ray absorptiometry (DEXA). In addition repeat 24 h creatinine excretions may have provided a measure of the variability that may need to be accounted for to improve their predictive equations.

A final word relates to the caution in using these simple techniques for assessing muscle mass in the individual as opposed to comparing groups of individuals; a point in fact made by the authors in their discussion⁴. In addition, while the use of bioimpedance analysis can estimate differences in muscle mass between groups, they have not demonstrated the ability to pick up differences before and after a strength-training regimen for one year to improve muscle mass although significant increase in muscle mass was demonstrated both when estimated by creatinine excretion and by *in vivo* neutron activation⁷.

Undoubtedly there is much further work that needs to be done to both improve the validity of these simple techniques to predict skeletal muscle mass and to document their use in assessing changes at the bedside following treatment regimes.

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