Sternfeld et al. Respond to: “Body Composition in Studies of Aging”

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Dr. Harris articulates several important issues regarding the study of health effects of body composition in the elderly population (1). First is the hypothesis that the separate elements of body composition (i.e., bone, lean mass, and fat) may have differential relations with specific health outcomes. For instance, low bone density may be a risk factor for fracture, but not for osteoarthritis or atherosclerosis, while a high level of fat may have the opposite relations. The purpose of our study, reported in this issue of the Journal (2), was to test this hypothesis, specifically that a lower level of lean mass, but not a higher level of fat, is a risk factor for impaired physical function.

However, our data did not support this hypothesis. More important, the data suggested that separating lean and fat, at least in terms of their relations to functioning, may not advance our understanding of the disablement process as much as consideration of lean mass relative to fat mass. The reason for this is that the more fat mass a person has, the more lean mass he or she has as well; for this reason, both fat mass and lean mass were inversely related to poorer function in unadjusted analyses. Dr. Harris refers to this problem and uses the term “sarcopenic obesity” to describe people with proportionally low lean mass relative to overall size. She hypothesizes that such a relative measure may be more related to functioning in a higher-functioning population than in a frail one. Although the implication of this hypothesis is that there is an absolute threshold of lean mass, below which values are classified as frailty, it does not address the process by which a person reaches that threshold, which may have more to do with the relative amount of lean mass than with the absolute amount.

The second issue concerns the limitations of both self-reported and performance-based measures of physical function. Although measurement approaches continue to evolve (3), this problem exists for all studies of physical function in the elderly (4, 5). Because each measure has both advantages and disadvantages, we chose several types of measures rather than only one. The performance-based walking speed and grip strength were selected because each assessed a different physiologic capacity (aerobic capacity and muscular strength, respectively, both of which are important for overall physical functioning). The self-reported measures were selected because, as Dr. Harris points out, physiologic capacity does not always reflect actual functioning. Although Dr. Harris is correct that our composite measure of self-reported functioning included both upper- and lower-body functions, as well as simpler and more complex functions, we do not think that this resulted in misleading findings. The great majority of those defined as limited by the composite measure reported problems with lower-body tasks. The fact that both slower walking speed and self-reported limitation were directly related to fat mass, inversely related to the lean-to-fat ratio, and generally not related to lean mass supports the conclusion that both measures were assessing a similar functional domain.

Finally, Dr. Harris suggests that regional measures of lean mass may be more informative in relation to function than are overall measures. In particular, the complex relation between grip strength and lean mass observed in our study might be better understood by examining appendicular lean mass or even arm mass specifically. We agree with this and regret that the method of body composition assessment that we used did not allow for this type of analysis.

Although we appreciate Dr. Harris’ comments in general, we respectfully disagree with two specific criticisms of our study. First, it is highly unlikely that our derived, population-specific regression equations for predicting body composition from the bioelectric impedance data were biased by the stratified sample selection. The equations of Roubenoff et al. (6) were derived from 455 elderly participants in the Framingham cohort. Second, while the use of variables that represent residual values from linear regression may be problematic under certain, specific circumstances, this is, in general, an analytic approach that is defensible both mathematically and intuitively. Furthermore, the interpretation of a residual variable created from multiple independent variables is no more obscure than when there is only a single independent variable; in both cases, the residual variable is

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simply the variance not accounted for by the independent variables. The appropriateness of this approach may be seen by comparing the results from models using either the original or the residual variables. For instance, when walking speed in men was modeled as a function of lean mass, fat mass, height, waist circumference, and other covariates, lean mass and waist circumference were significantly associated, but fat mass and height were not. When the model was walking speed as a function of the same variables but substituting residual values of lean mass and waist circumference, all four variables were significantly associated, with lean mass and height having a positive relation and fat mass and waist circumference having a negative relation. Similar discrepancies between models using only variables in their original form and those using residual variables were noted for all outcomes in both men and women. We think that these discrepancies arise from the collinearity of the variables. Use of the residual approach allows us to tease out the part of each variable that is not accounted for by the others and provides a more accurate estimate of the true relation between each element of body composition and the outcomes of interest. Finally, as the data presented in the paper indicate, the results from models with the ratio of lean to fat mass as an independent variable differ from those obtained when lean mass (or more precisely, the residual of lean mass) and fat mass are entered as two separate, independent variables. Although use of a ratio as an independent variable does not allow one to determine whether the unit change in the outcome is associated with a change in the numerator, the denominator, or both, we do not see this as problematic. The point of using the lean-to-fat ratio is to consider their joint effects relative to each other.

Along with Dr. Harris, we look forward to future studies of body composition and physical function in the elderly, particularly longitudinal analyses. Ongoing analyses of follow-up data in our own cohort suggest that these investigations will provide important new insights and understandings of the health effects of body composition and its role in the disablement process.

References