Journal of Clinical Densitometry: Assessment & Management of Musculoskeletal Health, vol. 20, no. 1, 128–129, 2017

1094-6950/20:128–129/$36.00
http://dx.doi.org/10.1016/j.jocd.2016.08.068

Letter to the Editor

Total Body Less Head Measurement Is Most Appropriate for Lean Mass Assessment in Adults

To the Editor:

Exclusion of the head from total-body dual-energy X-ray absorptiometry (DXA) scans is recommended when measuring pediatric bone mass *(1,2)*. We write to suggest that a similar approach, that is, total body less head (TBLH) measurement, should be considered when measuring total-body lean mass in adults.

DXA-measured total-body lean mass is often used as a surrogate for muscle mass in athletic performance settings and sometimes in clinical research studies. However, it is essential to appreciate that DXA lean mass is not simply a measurement of muscle; indeed, DXA fat-free mass is largely water *(3)*. Consequently, up to ~10% of DXA-measured whole-body lean mass is located in the head, presumably primarily a measurement of water within the brain. As such, the head constitutes a region that contributes little to skeletal muscle function/physical performance and could not be expected to be altered by exercise regimens or pharmacological approaches designed to improve muscle mass and physical performance. To explore the potential importance of this phenomenon, we assessed the proportion of total-body lean mass contained within the head region on DXA total-body scans in adults across the life span.

Initially, we evaluated DXA total-body scans in 112 men and women aged ≥70 yr (mean age 80.6 ± 6.0). In this group, the proportion of lean mass located in the head (mean [standard deviation]) was 7.3% (1.0), ranging from 4.7% to 9.2%. The percentage of lean mass in the head was negatively correlated with total-body lean mass using linear regression analysis (i.e., as lean mass declines, the proportion located in the head increases; Fig. 1; $r^2 = 0.71$, $p < 0.0001$). To further explore potential age relationships, the percent head lean mass was calculated in a younger cohort (n = 610) composed of a convenience sample from a midlife US aging study, MIDUS *(4)*, and a group of university athletes. This cohort was arbitrarily divided as young (ages 19 to <40 yr) and middle age (≥40 to 65 yr). Mean head lean mass was 5.6% and 6.3% in the young and middle-aged groups, respectively. The percentage of lean mass within the head differed between these 3 age groups by analysis of variance ($p < 0.0001$). Similar to the initial observation made in older adults, linear regression demonstrated a negative correlation of percent head lean mass with whole-body lean mass in the entire cohort ($r^2 = 0.75$, $p < 0.0001$). The 2 clinical studies were approved by the University of Wisconsin Health Sciences internal review board and student athlete data were classified as exempt.

We believe it is important that athletic trainers, clinicians, and researchers using DXA to monitor exercise interventions appreciate this phenomenon and consider the use of TBLH lean mass as such interventions will have little to no effect on head lean mass. A similar approach may be even more important in studies of older adults with sarcopenia. Indeed it is plausible that the higher percentage of lean mass located in the head region among older adults who have lower total lean mass potentially indicates that head lean mass (likely primarily water within the brain) is largely retained with advancing age, whereas lean mass elsewhere (presumably largely muscle) declines. Since the proportion of head lean mass is greatest in those with lowest muscle mass (the group targeted for therapeutic sarcopenia interventions), including a larger amount of “lean mass” that cannot be altered by muscle building therapies seems destined to impair the ability of such therapies to have a beneficial effect.

In conclusion, the head can account for up to 10% of whole-body lean mass in individuals’ aged ≥70 yr. Exclusion of head lean mass is appropriate when total-body DXA is used as a surrogate for muscle mass in settings where interventions are being undertaken to enhance muscle mass. The option to select TBLH in total-body DXA scans should not be limited to the pediatric age range.

Acknowledgments

The MIDUS research is supported by a grant from the National Institute on Aging (P01-AG020166). The project described was supported by the Clinical and Translational Science Award (CTSA) program, through the National Institutes of Health’s (NIH) National Center for Advancing Translational Sciences (NCATS) (grant UL1TR000427). The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

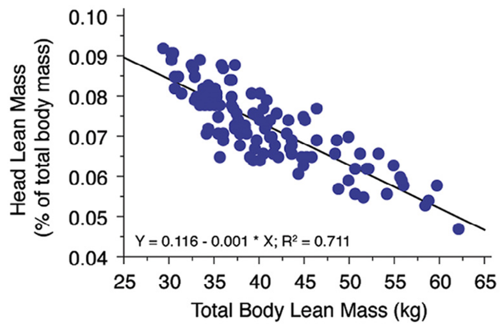

Fig. 1. The proportion of lean mass contained in the head is negatively correlated with total-body lean mass ($p < 0.0001$, $r^2 = 0.711$), demonstrating the greatest head lean mass in those with the lowest whole-body lean mass.

Diane Krueger
Osteoporosis Clinical Research Program
University of Wisconsin, Madison
WI, USA

Ellen Siglinsky
Osteoporosis Clinical Research Program
University of Wisconsin, Madison
WI, USA

Bjoern Buehring
Osteoporosis Clinical Research Program
University of Wisconsin
Madison, WI, USA

Neil Binkley
Osteoporosis Clinical Research Program
University of Wisconsin
Madison, WI, USA

References

1. Lewiecki EM, Gordon CM, Baim S, et al. 2008 Special report on the 2007 adult and pediatric Position Development Conferences of the International Society for Clinical Densitometry. Osteoporos Int 19(10):1369–1378.
2. Adams JE. 2013 Dual-energy X-ray absorptiometry. In: Osteoporosis and Bone Densitometry Measurements. Guglielmi G, ed. Heidelberg: Springer, 101–122.
3. Lustgarten MS, Fielding RA. 2011 Assessment of analytical methods used to measure changes in body composition in the elderly and recommendations for their use in phase II clinical trials. J Nutr Health Aging 15(5):368–375.
4. Radler BT. 2014 The Midlife in the United States (MIDUS) series: a national longitudinal study of health and well-being. Open Health Data 2(1):e3.