Improving the Diagnosis of Sarcopenia:
Dual-Energy X-ray Absorptiometry Corrected for Muscle Quality

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Abstract

Rationale: Novel estimates of fluid volume may help predict functional status and thereby, improve sarcopenia diagnosis.

Main Result: Bioimpedance-derived fluid volume, combined with DXA, improves identification of jump power over traditional measures.

Significance: DXA-measured muscle should be corrected for fluid distribution to account for muscle quality in older populations.

Background

Sarcopenia, the age-related loss of muscle and function, negatively impacts mobility, quality of life, and mortality. However, there is no consensus definition for sarcopenia.

DXA measured appendicular lean mass index (ALM/ht^2) is a quantitative measure used to define sarcopenia. However, muscle quality, which DXA is unable to measure, declines more rapidly with aging. Therefore, DXA may underestimate true muscle loss in older adults (Fig.1).

Bioimpedance spectroscopy (BIS) can measure extracellular and intracellular water ratio (E/I$_c$), which has been suggested as a surrogate of muscle quality (Fig.2). This is critical to muscle function, therefore, sarcopenia assessments should include both muscle quantity and quality to improve diagnosis.

We hypothesize that creation of a new variable combining BIS measures of quality and DXA measures of quantity—ALM/(E/I$_c$)—will better predict physical performance compared to traditional measure of DXA alone (ALM/ht^2). Accurately diagnosing sarcopenia will lead to improved care for our rapidly aging society.

Methods

Participants:

- 112 community-dwelling men and women over age 70

Body composition measures:

- Whole-body DXA
- Bioimpedance Spectroscopy

Functional Measures:

- Grip Strength
- Jump Mechanography

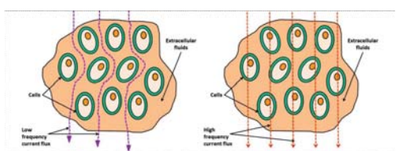


Fig.2. Bera TK. Bioelectrical Impedance and The Frequency Dependent Current Conduction Through Biological Tissues: A Short Review. IOP Conf Ser Mater Sci Eng. 2018;331:012005.

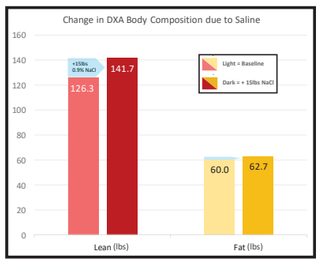
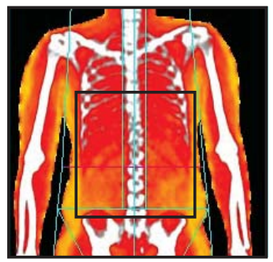
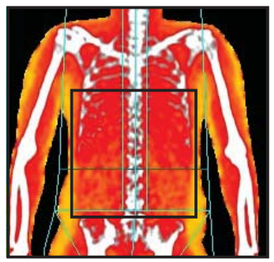


Fig. 1. Artificial extracellular fluid presents as increased muscle in DXA whole body scan.



Baseline

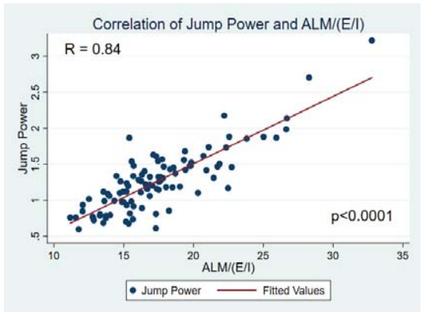


Baseline + 15lbs 0.9% NaCl

Results

- ALM/(E/I$_c$) significantly improved correlation with jump power and grip strength over DXA ALM/ht^2 (Fig.3).
- In a bivariate model, ALM/(E/I$_c$) and age predicted more of the variability in jump power (R^2=.74) compared to ALM/ht^2 and age (R^2=.44; p<.0001).
- ALM/(E/I$_c$) was the most predictive variable in both univariate and bivariate linear regression models.

Fig. 3. Correlation of Jump Power and novel variable ALM/(E/I$_c$) compared to standard measure of ALM/ht^2. Novel variable is more correlated overall and consistent at higher values of DXA-measured ALM.



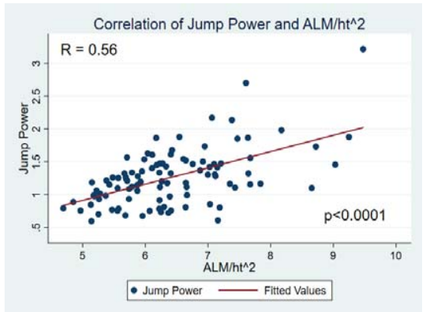


Table 1. Correlation between muscle mass and fluid volume with jump power and hand grip strength by gender and total population.

	Jump Power				Hand Grip Strength			
	Men	Women	Total		Men	Women	Total	
Variable	Correlation Coefficient			P-Value	Correlation Coefficient			P-Value
DXA LST	0.67	0.50	0.67	<0.0001	0.47	0.49	0.64	<0.0001
DXA ALM	0.70	0.54	0.70	<0.0001	0.50	0.47	0.64	<0.0001
DXA ALM/Ht^2	0.67	0.44	0.56	<0.0001	0.38	0.26	0.41	<0.0001
ALM/(E/I$_c$)	0.92	0.70	0.84	<0.0001	0.69	0.52	0.69	<0.0001
BIS FFM	0.67	0.56	0.68	<0.0001	0.53	0.54	0.66	<0.0001
ICW$_c$	0.83	0.67	0.80	<0.0001	0.69	0.59	0.73	<0.0001
E/I	-0.72	-0.44	-0.0045	0.965	-0.54	-0.15	0.21	0.037

Conclusions

- The creation of a new variable, ALM/(E/I$_c$), improved the ability of DXA to predict jump power and grip strength in an elderly population.
- ALM/(E/I$_c$) is more appropriate for predicting functional status than ALM/ht^2, since it evaluates both muscle quantity and quality.
- ALM/(E/I$_c$) advances the ability to diagnose sarcopenia and should be incorporated in the diagnostic definition.

Future Directions

- Corroborate results in a more diverse population
- Compare ALM/(E/I$_c$) to outcome measures in a longitudinal study
- Use ALM/(E/I$_c$) to appraise therapeutic intervention

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