

# Muscular Function and Strength Predictions Using DXA in Collegiate Athletes

Devon Cataldi, Jonathan P. Bennett, Yong En Liu, Nisa N. Kelly, Brandon K. Quon, Lambert Leong, John A Shepherd

## Introduction

- Introduction Lean body mass (LBM) and function are well-known predictors of overall health and quality of life and have played an integral part in athletic and medical research.
- Isokinetic dynamometry is widely regarded as the gold standard for assessing muscle strength.
- Methods of determining LBM, appendicular lean mass (ALM) or skeletal muscle mass (SMM) include DXA, bioelectrical impedance, 3D optical anthropometry and recently, a novel method of isotopic-labeled D3-Cr (1).
- Few studies reported the association of D3-Cr derived SMM and its relationship with muscle function and strength and no study has investigated the associations within an athletic population.

## Objective

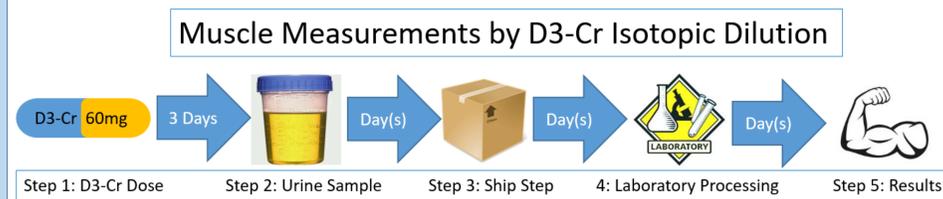
- To compare different methods of determining body composition measures and their predictive ability to muscle strength in an athletic population. We **hypothesize** that DXA's body composition measures will provide better predictive capability in determining strength output for all measures of strength over D3-Cr and demographics.

## Methods

- This analysis was part of the *Da Kine* study, a healthy cohort (Male N=40, female N=40) or multi-ethnic/ multi-racial collegiate and intramural athletes.
- The determination of SMM by D3-Cr involved each subject ingesting a single 60 mg dose of D3-Cr three days before testing; all issues will consume an ad libitum diet during this period. The processing time of D3-Cr and DXA are outlined in **Figure 1**.
- LBM and ALM were measured on a DXA Hologic Discovery/A system, Apex version 4.5 (Hologic Inc., Marlborough, MA).
- As shown in **Figure 2**, knee and trunk extension and flexion were measured using an isokinetic dynamometer (Humac NORM, Computer Sports Medicine, Stoughton, MA, USA).

## Statistic

- Stepwise linear regression determined which demographic and DXA variables to operate within the model.
- A p-value <0.10 was included in the testing model and had a p-value of 0.05 to stay in the model.
- Results are reported as adjusted R<sup>2</sup> and root mean square error (RMSE) in Nm.
- All statistical calculations were performed using SAS 9.4



## Whole Body Composition Analysis by DXA Scanning

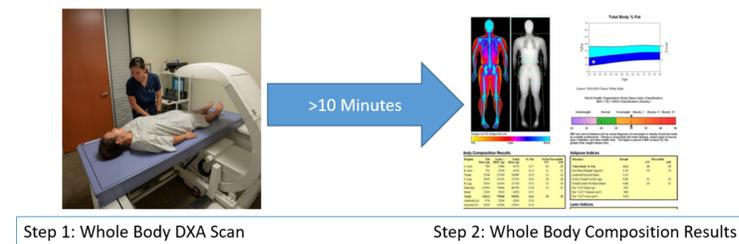


Figure 1 – D3-Cr Processing time verse DXA Scanning

**“Does muscle mass determine muscle strength?”**



Figure 2 – HUMAC Dynamometer Testing of Thigh and Trunk

## Results

- Results of the participants demographics and mean distributions are shown in **Table 1**, with significant differences found in all measures by sex

Table 1– Descriptive Characteristics of 67 athletes

Variables	Units	Male (n=33)		Female (n=34)		p value
		Mean	SD	Mean	SD	
Weight	kg	80.99	10.12	63.92	12.11	<.0001
Height	cm	179.32	10.13	167.78	9.18	<.0001
Age	years	24.24	5.00	21.91	4.25	0.0435
BMI	kg/m <sup>2</sup>	25.27	3.22	22.62	3.24	<.0001
D <sub>3</sub> -Cr	kg	40.99	7.05	24.84	3.65	<.0001
Lean Body Mass	kg	70.12	7.84	49.70	7.90	<.0001
ALM	kg	33.23	3.97	22.34	3.87	<.0001
Leg Extension	Nm	134.85	33.51	95.00	26.96	<.0001
Leg Flexion	Nm	70.82	18.42	48.21	14.29	<.0001
Trunk Extension	Nm	185.70	60.74	94.18	38.14	<.0001
Trunk Flexion	Nm	272.94	89.40	172.88	53.94	<.0001

- **Leg Extension:** For males, LBM was the most highly predictive (R<sup>2</sup>=0.28, RMSE=28.37), and ALM in females (R<sup>2</sup>=0.38, RMSE=21.22).
- **Leg Flexion:** For males, LBM was the most highly predictive (R<sup>2</sup>=0.25, RMSE=15.96), and ALM in females (R<sup>2</sup>=0.42, RMSE=10.87)
- **Trunk Extension:** For males, LBM was the most highly predictive (R<sup>2</sup>=0.46, RMSE=44.62), and ALM in females (R<sup>2</sup>=0.69, RMSE=21.21)
- **Trunk Flexion:** For males, LBM was the most highly predictive (R<sup>2</sup>=0.17, RMSE=85.6), and ALM in females (R<sup>2</sup>=0.56, RMSE=35.7)
- All measures of LMB performed the best when predicting muscular strength in males, and measures of ALM was best in females.
- All measures of D3-Cr to strength performed better than demographic variables alone, but did not our perform DXA variables

## Conclusion

- Conclusion DXA's standard body composition output variables produce a more reliable measure of muscular strength and function over the use of D3-Cr or demographic variables in an athletic population.

**Acknowledgments:** We gratefully acknowledge En Liu and Nisa Kelly for subject recruitment and implementation of the study protocol

**Funding:** Hologic, Inc. Marlborough, MA, USA

## Reference(s)

1. Evans, W. J., Hellerstein, M., Orwoll, E., Cummings, S., & Cawthon, P. M. (2019). D3-Creatine dilution and the importance of accuracy in the assessment of skeletal muscle mass. *Journal of cachexia, sarcopenia and muscle*, 10(1), 14-21.

