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Professor

The Aims of the Muscle, Metabolism, and Ergogenics Lab are to:

- 1) Understand how exercise, nutrition, and environmental stimuli interact to produce phenotype changes (examples- skeletal muscle hypertrophy, strength gain, fatigue resistance).
- 2) Develop exercise-nutrition interventions for a variety of populations (recreational exercisers, athletes, aging adults, or other specialized populations) that may benefit. In this capacity, faculty, undergraduate, and graduate students generally work within the scope of three research areas:

- Muscle and Metabolic Health with Aging
- Countermeasures to Inactivity or Musculoskeletal Disuse
- Human Performance and Ergogenic Aids



[Click here to see where we are publishing our work!](#)

Below are some recent selected publications:

[The Effect of Direct and Remote Postexercise Ischemic Conditioning on Muscle Soreness and Strength 24 Hours After Eccentric Drop Jumps](#)

Lillquist, T., Mahoney, S. J., Kotarsky, C., McGrath, R., Jarajapu, Y., Scholten, S. D., & Hackney, K. J. (2023). *The Journal of Strength & Conditioning Research*, 37(9), 1870-1876.

[Reliability of a novel automated ultrasound technology for body composition assessment and comparisons with dual energy X-ray absorptiometry](#)

Bradley, Adam P., Lukus Klawitter, Emma Carver, Zach Johnson, Ryan McGrath, Sherri Stastny, Bryan Christensen, and Kyle J. Hackney (2023). *International Journal of Exercise Science*, 16(4), 393.

[Energy Expenditure and Substrate Utilization with Hands-Free Crutches Compared to Conventional Lower-Extremity Injury Mobility Devices](#)

Hackney, K. J., Bradley, A. P., Roehl, A. S., McGrath, R., & Smith, J. (2022). *Foot & Ankle Orthopaedics*, 7(4), 24730114221139800.

[Intermittent Blood flow restriction exercise rapidly improves muscular and cardiovascular health in adults with beyond adequate protein intakes](#)

KA Stone, SJ Mahoney, RA Paryzek, L Pitts, SN Stastny, SL Mitchell, ...

Acta Astronautica 199, 224-231

Blood flow restriction exercise stimulates mobilization of hematopoietic stem/progenitor cells and increases the circulating ACE2 levels in healthy adults

S Joshi, S Mahoney, J Jahan, L Pitts, KJ Hackney, YPR Jarajapu
Journal of Applied Physiology 128 (5), 1423-1431

Contribution of Protein Intake and Concurrent Exercise to Skeletal Muscle Quality with Aging

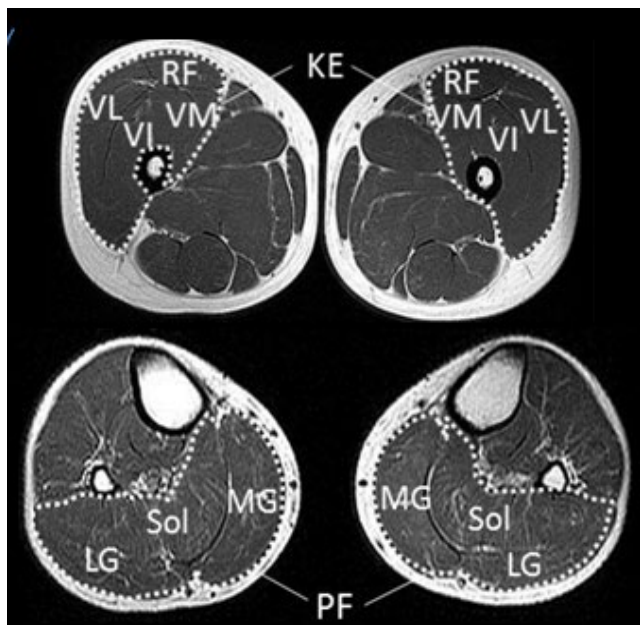
ND Dicks, CJ Kotarsky, KA Trautman, AM Barry, JF Keith, S Mitchell, ...
The Journal of Frailty & Aging, 1-6

Endothelial, Cardiovascular, and Performance Responses to L-Arginine Intake and Resistance Exercise

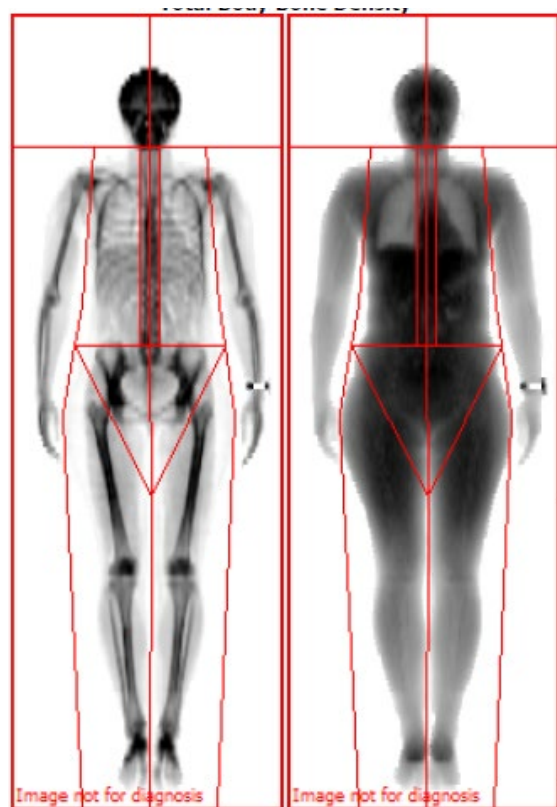
DM Streeter, KA Trautman, TW Bennett, LE McIntosh, JW Grier, ...
International journal of exercise science 12 (2), 701

Research Area 1) Muscle and Metabolic Health with Aging.

In the United States individuals over the age of 65 years is the fast growing segment of the population. In North Dakota the population is expected to increase by 50% by 2025 (from 98,595 to 148,060). Unfortunately, the fifth decade of life is associated with an age related reduction in muscle mass (sarcopenia) and strength (dynapenia). The fundamental question being asked in this research area is “*What exercise and nutrition interventions may be the most effective in prolonging the negative effects of sarcopenia, dynapenia, and the loss of functional independence as we age?*” We seek to 1) observe changes in muscle morphology using gold-standard analysis techniques such magnetic resonance imaging (MRI) and dual energy x-ray absorptiometry (DEXA); and diagnostic ultrasound including an innovate new technique called MuscleSound®. 2) explore strength/endurance and steadiness using Biodex; 3) examine neural drive or task activity using the interpolated twitch technique or surface electromyography; and 4) evaluate real world changes in task performance and function.

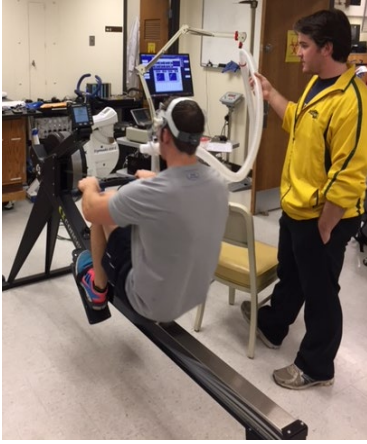
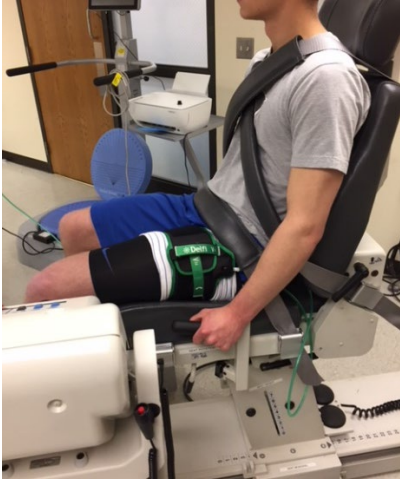


Example MRI scan of upper (KE= knee extensors) and lower (PF=plantar flexors) limbs.



Research Focus Area: 2) Countermeasures to Muscle and Strength Loss During Inactivity/Disuse or Injury.

The fundamental question being asked in this research area is “*can exercise prescription, nutritional intake, or a combination of exercise and nutrition overcome the negative effects of inactivity/disuse?*” Changes in muscle morphology, metabolism, and function are a well-known consequence of inactivity or disuse. This may occur from: 1) an accumulation of small events such as sitting 8 hours each day; 5 days per week at a sedentary job, 2) extended immobilization following injury or hospitalization; or 3) a very complex endeavor such as prolonged exposure to microgravity via spaceflight. In this focus, we strive to explore acute responses and chronic adaptations using multiple analogs and novel intervention strategies.



Research Focus Area: 3) Human Performance and Ergogenic Aids.

The fundamental question being asked in this research area is “*can athletic or occupational performance be optimized through exercise training and nutrition?*” Exercise training is highly variable and specific to the sport or occupational tasks required; therefore; in this research area we strive to make meaningful contributions to a science that is rapidly evolving and adapting. Many outcome variables in this research area are considered classic (example- VO_2 max, lactate threshold, one repetition max, vertical jump, agility timing); while others are highly innovative (example- blood flow and muscle cross-sectional area assessment via ultrasound). Nutritional modulation can occur in a variety of ways and may include: alterations in total energy intake, macronutrient percentages, time restricted feeding, or dietary supplementation.



Example-Brachial artery blood flow assessment in collaboration with dietary supplement and exercise intake.

Primary Student Advisor:

Current Doctoral Students



Sean Mahoney, MS is a doctoral candidate then Exercise Sciences and Nutrition PhD program at NDSU. He completed his master's degree at NDSU as well, focusing on blood flow restriction during rowing exercise as a supplemental exercise intervention for microgravity-induced deconditioning. His research interests are broad and range from focusing on developing methods of assessment and intervention during disuse, muscle activation patterns, and balance with aging.



Jacob Fanno, MS is a second-year doctoral student in the Exercise Science and Nutrition PhD program. He completed his bachelor's degree in Kinesiology from Texas A&M University-Corpus Christi in 2021 and his master's degree in Exercise Science from Kennesaw State University in 2023. His research interests broadly include nutrition, supplementation, and skeletal muscle hypertrophy. Jacob's career goal is to remain in academia and continue conducting exercise science research.

Current Masters Students



Alexis Roehl, BS, is a master's student in the Exercise Science/Nutrition Science program at NDSU. She completed her undergraduate degree in Exercise Science with minors in psychology and statistics at NDSU while also competing on the track and field and cross-country teams. Her research interests include sports performance and sports testing, stemming from a wide exposure to a variety of sports from a young age. Her goals include furthering her knowledge and skills of the field and getting more experience in research and different testing methods.



Josh Liggett, BS, is in the Exercise/Nutrition Science Master's Program at NDSU. Josh completed his undergraduate degree in Exercise Science at Bemidji State University in Bemidji, Minnesota. He holds a Certified Strength and Conditioning Certification (CSCS) through the National Strength and Conditioning Association (NSCA). Josh has a broad range of research interests including human rehabilitation, fitness technology, human performance, and exercise physiology. His goals are to develop quality research skills and foster innovation in the field of exercise science.

Previous graduate students mentored at NDSU

Deegan Gearding, MS- Exercise/Nutrition Science, 2024

Andrew Garner, MS- Exercise/Nutrition Science, 2024

Joseph Koenecke, MS- Exercise/Nutrition Science, 2023

Amy Herrington, MS- Exercise/Nutrition Science, 2023

Adam Bradley, PhD- Exercise Science and Nutrition, 2023

Kelly Csernica, MS- Exercise/Nutrition Science, 2022

Miranda Ripplinger, MS- Exercise/Nutrition Science, 2021

Kara Trautman, PhD- Exercise Science and Nutrition, 2020

Chris Kotarsky, PhD- Exercise Science and Nutrition, 2020

Nathan Dicks, PhD- Exercise Science and Nutrition, 2019

Thomas Lillquist, MS- Exercise/Nutrition Science, 2020

Whitney Poser, MS- Exercise/Nutrition Science, 2017

Dan Streeter, MS- Exercise/Nutrition Science, 2017