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

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

- Muscle, Vascular, 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:

**Energy Expenditure and Substrate Utilization with Hands-Free Crutches Compared to Conventional Lower-Extremity Injury Mobility Devices**

KJ Hackney, AP Bradley, AS Roehl, R McGrath, J Smith
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
Research Area 1) Muscle 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) examined 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 or enhance recovery from injury?” 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, surgery, 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- VO₂ 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: 1) alterations in total energy intake, macronutrient percentages, and the amount of water consumed; 2) moderate increases in specific foods or dietary supplements (examples vitamins, carbohydrate, caffeine, and phosphocreatine); or 3) complex changes in dietary habits (removal casein, gluten, or dairy).
Primary Student Advisor:

Current Doctoral Students

Sean Mahoney, MS is a doctoral candidate in the Health, Nutrition, and Exercise Sciences 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 for astronauts during long-duration spaceflight to identifying physical activity patterns and strategies in elementary-aged students.

Logan Pitts, BS is a doctoral student working towards his degree in Exercise Science and Nutrition. He completed his undergraduate degree in Kinesiology - Health and Human Performance at Saint Mary’s College of California in 2015. Logan is a Certified Strength and Conditioning Specialist (CSCS) through the National Strength and Conditioning Association (NSCA) and worked as a personal trainer and strength and conditioning coach prior to his move to Fargo. Despite continued curiosity in athletic performance improvement, Logan’s research interests are centered around exercise programming for individuals with type 2 diabetes.

Adam Bradley, MS is now a doctoral candidate after joining NDSU in 2019. His research interests include disuse-induced atrophy mitigation, resistance training across the lifespan, and athletic performance. Bradley previously served in strength and conditioning roles at the University of Louisiana, the University of Texas, and Iowa State University. He earned a bachelor’s degree in Kinesiology from Iowa State University in 2017. Bradley competed in football for the Cyclones, playing on the defensive line. He completed his master’s degree in Kinesiology from the University of Louisiana in 2018. He holds his CSCS through the National Strength and Conditioning Association and his SCCC through the Collegiate Strength & Conditioning Coaches association.
Current Masters Students

**Kelly Csernica, BS** is master’s student in Exercise and Nutrition Science. She completed her undergraduate degree at Ithaca College in Health Sciences with concentrations in Nutrition and Exercise Science. Her research interests include maximizing cardiovascular performance through nutrition interventions and stemmed from undergraduate experience rowing varsity crew. Her career goals include continuing academic research or working with competitive athletes to apply findings.

**Andrew Garner, BS** is a master’s student in the Exercise and Nutrition Science Program here at NDSU. Andrew completed his undergraduate degree at NDSU in the Exercise Science Program in the Spring of 2021. He currently works for Sanford Health as a clinical exercise physiologist in the department of cardiac rehabilitation. Andrew also works as a graduate assistant in the HNES department assisting with research and instructing classes. His research interests include autonomic modulation specifically working with heart rate variability after acute bouts of exercise or physical activity. His future goals are to continue to build his research skills here at NDSU and apply findings to his work as a clinical exercise physiologist in cardiac rehabilitation.
**Joseph Koenecke B.S.** is a transfer student in his second year pursuing his Master's Degree in Health, Nutrition and Exercise Science. He completed his Bachelor's Degree from the University of Wisconsin - La Crosse in 2021 and attended Appalachian State University until Summer of 2022 before transferring to North Dakota State University to complete his Masters Degree. Joseph's research history includes neural rehabilitation techniques after ligamentous injury, as well as ergogenic supplementation research. Joseph works full time in a career he finds highly motivating and fulfilling.

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**Deegan Gearding, BS**, is in the Exercise Science and Nutrition Master’s Program here at NDSU. Deegan completed his ungraduated degree at Northern Kentucky University in Athletic Training with a background in Men’s basketball and Women’s soccer. He is also a Certified Athletic Trainer, working with the NDSU Football Team as the Graduate Assistant Athletic Trainer. His research interests include blood flow restriction therapy, as well as soft tissue healing and rehabilitation. His goals include furthering his education and continuing to build his skills here at NDSU.
Former graduate students at NDSU

Miranda Ripplinger, MS 2021, Cardiac Rehabilitation, Essentia Health, Fargo, North Dakota

Kara Trautman, PhD-2020; Assistant Professor, University of Central Oklahoma

Chris Kotarsky, PhD-2020; Assistant Professor, Skidmore College, Saratoga Springs, New York.
Nathan Dicks, PhD- 2019-Assistant Professor, North Dakota State University.

Thomas Lillquist, MS-2020, Lab Technician, University of Minnesota

Whitney Poser, MS, Occupational Therapist at Matanuska-Susitna Borough School District

Dan Streeter, MS, Certified Exercise Physiologist