

Highlights of our Master's and PH.D. Programs

The School of Health and Rehabilitation Sciences (SHRS) is one of the six health science schools of the University of Pittsburgh. SHRS stands on its solid reputation as an international leader in rehabilitation and disabilities education, research, and community service, improving the lives and independence of all people with a focus on people at risk for or having chronic conditions or disabilities and those who have traditionally been underserved and underrepresented.

Students in several academic programs within the School of Health and Rehabilitation Sciences' Department of Sports Medicine and Nutrition may work in the NMRL as part of their curriculum or research experience.

These programs include: Sports Medicine (MS), Sports Science (MS) and Rehabilitation Science (PhD).

Collaborations and Partnerships

We have ongoing collaborations across the Department of Defense (Army Navy Marines). Additionally, we have active collaborations with human performance optimization researchers from the United Kingdom, Finland, and Australia. We regularly interface with strength coaches, dietitians, athletic trainers, and support staff to apply sports science/medicine practices for Pitt student-athletes.



FEE FOR SERVICE

We provide fee-for-service exercise performance assessments such as **aerobic capacity, lactate threshold, and body composition testing.** Tests available to the public include:

- BodPod
- Maximum Oxygen Uptake (VO2Max)
- Wingate Anaerobic Cycle
- Lactate Threshold
- Resting Metabolic Rate (RMR)

“The innovative and translational military physical performance research conducted by the University of Pittsburgh’s NMRL/WHPRC provides important scientific knowledge to enhance readiness and resilience for our military service members.”

–Dr. Karl Friedl, (COL, ret.) S&T, Senior Physiologist, US Army

“The NMRL/WHPRC’s research portfolio provides a holistic and integrated assessment of human performance optimization. Their cutting-edge research capabilities and ability to publish and translate their research findings provide important information to bolster health and performance across the lifespan.”

–Anthony Delitto, Ph.D., Dean, School of Health and Rehabilitation Sciences, University of Pittsburgh



REPRESENTATIVE GRANTS

In the 8 years since 2015, the NMRL/WHPRC has received over \$24M in grants, published over 150 peer-reviewed manuscripts, and graduated numerous PhD students. Our external grants have included:

- Characterization of Psychological Resilience and Readiness: Cross-Validation of Cognitive and Behavioural Metrics during Acute Military Operational Stress (W81XWH-17-2-0070)
- Physiological Biomarkers of Resilience and Musculoskeletal Readiness (W81XWH-18-1-0452)
- Women in Ground Close Combat (WGCC 5.5.6): Task 0107-Optimizing the Physical Performance of Women in Ground Close Combat Roles (Task 0107)
- Developing a Warfighter Mobility Signature and Predictive Algorithm for Musculoskeletal Injury Risk During Marine Corps Candidate School (# N00014-20-C-2020)
- NSCOR for Evaluating Risk Factors and Biomarkers for Adaptation and Resilience to Spaceflight: Emotional Valence and Social Processes in ICC/ICE Environments (PI - Dinges) Award #: T804051
- Optimizing Muscle and Bone Mechanoadaptation to Physical Training: Mechanistic Control Pathways via Muscle Bone Crosstalk to Altered Mechanical Loading (W81XWH-18S-BAA1)
- Development of a Physical Readiness Decision Tool to Leverage Wearable Technologies for Monitoring Warfighter’s Mobility and Load Exposure
- Physiological Monitoring and Assessment of Marine Physical Readiness During Arduous Military Training and Operations
- USMC Gender-Integrated Recruit Training Study (#: M95494-20-C-0021)

REPRESENTATIVE PUBLICATIONS

Beckner, M. et al. (2022). Neuroendocrine, inflammatory, and extracellular vesicle responses during the Navy Special Warfare Screener Selection Course. *Physiological genomics*, 54(8), 283–295. <https://doi.org/10.1152/physiolgenomics.00184.2021>

Bird, M. et al. (2022). Unsupervised Clustering Techniques Identify Movement Strategies in the Countermovement Jump Associated With Musculoskeletal Injury Risk During US Marine Corps Officer Candidates School. *Frontiers in physiology*, 13, 868002. <https://doi.org/10.3389/fphys.2022.868002>

Conkright, W. et al. (2022). Men and women display distinct extracellular vesicle biomarker signatures in response to military operational stress. *Journal of applied physiology* (Bethesda, Md. : 1985), 132(5), 1125–1136. <https://doi.org/10.1152/jappphysiol.00664.2021>

Koltun, K. et al. (2022). Tibial Bone Geometry Is Associated With Bone Stress Injury During Military Training in Men and Women. *Frontiers in physiology*, 13, 803219. <https://doi.org/10.3389/fphys.2022.803219>

Vaara, J. P. et al. (2022). Physical training considerations for optimizing performance in essential military tasks. *European journal of sport science*, 22(1), 43–57. <https://doi.org/10.1080/17461391.2021.1930193>

Sterczala, A. et al. (2022). Insulin-like growth factor-I biocompartmentalization across blood, interstitial fluid and muscle, before and after 3 months of chronic resistance exercise. *Journal of applied physiology* (Bethesda, Md. : 1985), 133(1), 170–182. <https://doi.org/10.1152/jappphysiol.00592.2021>

Neuromuscular Research Laboratory/ Warrior Human Performance Research Center

Specialized in Human Performance Optimization/Injury Prevention



CONTACT US

412-246-0460

3860 South Water Street
Pittsburgh, PA 15203

www.nmrl.pitt.edu



@nmrlpitt/



@company/neuromuscular-research-laboratory



@NMRLPitt



@NMRLPitt



Scan QR Code





BACKGROUND

> The Neuromuscular Research Laboratory/Warrior Human Performance Research Center is a multi-disciplinary, comprehensive human performance optimization research facility in the Department of Sports Medicine and Nutrition in the School of Health and Rehabilitation Sciences at the University of Pittsburgh. The lab has a rich research legacy of studying musculoskeletal injury prevention and human performance optimization.

Our 4 Strategic Themes and Priorities:

GRANTSMANSHIP

Plan, develop, implement, and execute proactive and aggressive funding/grant-seeking strategies by two major approaches:

- Continued pursuit of legacy DoD funding; and
- Diversification of our research funding portfolio by pursuit from non-DoD funding (NIH, VA, industry, etc.).

SCHOLARSHIP

Maximize our scientific impact, influence, and acumen through prevention, athletic training, biomechanics, and exercise physiology. Develop thought leaders in the field who are highly sought after for invited talks, research collaborations, consultation, and expertise. Full and visible participation

with professional organizations/societies, editorial boards, and national/international scientific meetings.

PARTNERSHIP

Establish regionally, nationally, and internationally collaborative mutual partnerships that synchronize efforts, and enhance, complement, and optimize our grantsmanship and scholarly results.

MENTORSHIP

Instill, cultivate, and foster an altruistic, mentor-based culture to benefit and develop students and faculty to be future global thought leaders. A supportive environment manifested by visible and transparent lines of communication that nurtures scholarship, teaching, and service bands of excellence.

VISION

> To be internationally recognized as a premier academic research center and become thought leaders in musculoskeletal injury prevention and human performance optimization.

MISSION

> To mitigate musculoskeletal injuries and optimize human performance by conducting innovative, multi-disciplinary, basic, and applied research providing evidence and translating scientific knowledge; enhancing clinical decisions and education. This research will lead to improved quality of life and resiliency in athletic, military, and active populations.

Core Values Supporting Our 4 Strategic Themes:

- Integrity
- Innovation
- Professionalism
- Diversity, Equity, and Inclusion (DEI)
- Diligence
- Perseverance
- Adaptability
- Collaboration
- Mentorship
- Impact

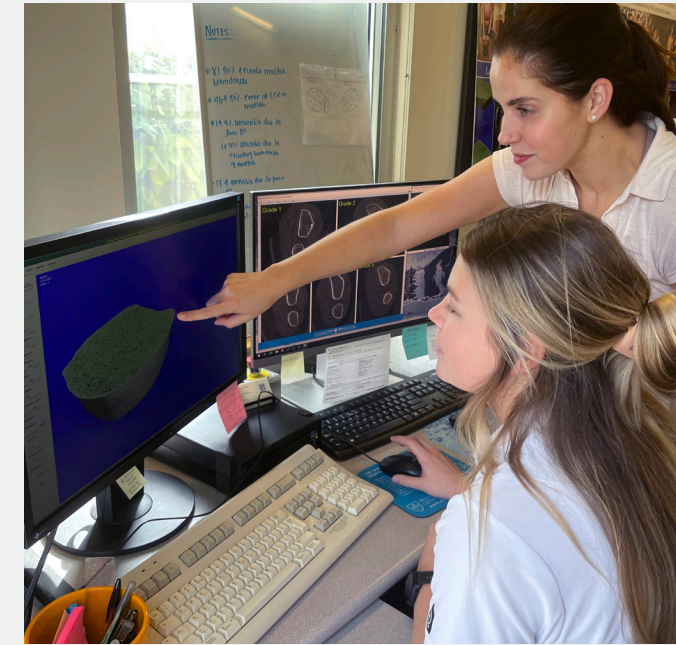
Lab Capabilities

NEUROMUSCULAR PERFORMANCE

The NMRL has a traditional gold standard and novel technology to conduct assessments of the aerobic and anaerobic physiology systems. Additional performance measures of biomechanics (kinetics and kinematics), strength, and power can also be assessed.

Features:

- > **Parvomedics Metabolic Carts**
 - Aerobic assessment via oxygen consumption during maximal exercise
- > **LactatePro**
 - Lactate threshold testing
- > **Velotron Wingate Cycle Ergometer**
 - Anaerobic assessment of maximal strength and power
- > **Kinematic assessments**
 - Vicon motion capture, can be integrated with force plates
 - DARI markerless motion capture
 - HumanTrak
- > **Force Plate systems**
 - Kistler
 - VALD
 - Hawkin



> Unilateral Isometric Strength Testing

- Biodex
- ForceFrame

> Heart Rate Variability

- Equivital Lifemonitor
- Capable of collecting heart rate, heart rate variability, breathing rate, skin conductance, and accelerometry data

BONE AND BODY COMPOSITION

The NMRL utilizes gold standard equipment in assessing total and regional body fat mass, lean mass and bone tissue.

Features:

- > **Air Displacement Plethysmography: BODPOD (Cosmed)**
 - Body composition assessment based on air displacement plethysmography that provides fat and fat-free measurements in adults and children
 - Fast, safe, and non-invasive testing process
 - Free of ionizing radiation
- > **DXA: Lunar iDXA (GE, Prodigy)**
 - Assessment of bone health and body composition via dual-beam x-ray
 - Two-dimensional bone mineral density (BMD), fracture risk, body composition (fat mass, lean mass, fat-free mass)
 - Scan capabilities: AP Spine, Lateral Spine, Femur/Dual Femur, Forearm, Total Body
- > **Bioelectrical Impedance Analysis-BIA (InBody 970)**
 - Advanced bioelectrical impedance analysis with direct segmental measurements and multi-frequencies to measure body composition
 - Free of ionizing radiation
- > **3D Body Scanner (SizeStream)**
 - Utilizes three-dimensional optical imaging technology via high-frequency infra-red-light emission to capture multi-dimensional circumference, surface area and volume measures
 - Captures > 240 body circumference, surface area and volumetric measurements in less than 10 seconds.
- > **HR-pQCT: Xtreme CT II (Scanco)**
 - High resolution in-vivo bone imaging of the radius and tibia
 - Assesses three-dimensional cortical and trabecular bone
 - Only ~60 units worldwide, <30 in US/Canada



Capabilities Cont.

WEARABLES ACTIVITY/TRACKERS

Modern technologies continue to evolve in a changing world including those enabling increased granular monitoring of physiological responses to stress in military and athletic populations. The NMRL employs continuous monitoring techniques to remotely capture noninvasive physiological responses to environmental and biogenic stressors. Our technology of continuous monitoring trackers include the Garmin Instinct Solar wristwatch and Inertial Measurement Unit accelerometers to effectively capture positional, activity, and physiological stress responses in a high-resolution time series data output to determine how acute or chronic responses may result in prospective outcomes, including musculoskeletal injuries.

Features:

> Actigraph (wrist/hip sensor)

Measures: Steps, activity intensity, sleep, caloric expenditure, METs

> IMU (iMeasureU tibia)

Measures: Steps, step intensity, impact load, step & intensity asymmetry (left vs. right), bone stimulus

> Garmin Instinct Solar (Garmin watch)

Measures: Steps, distance travelled, elevation, activity intensity, energy expenditure, METs, sleep, stress, HR, activity specific metrics (ie. run cadence, pace)

METABOLISM AND NUTRITION

Our metabolism and nutrition lab houses state-of-the-science metabolic equipment to conduct research on human health, performance, and disease. These include the measurement of energy expenditure during rest and in response to eating a meal, blood flow measures, as well as biomarker, cognitive and behavioral assessments. The application of these techniques allows us to better understand how lifestyle strategies may enhance overall health and optimize physical performance.



MOBILE RESEARCH LABORATORY

The NMRL is outfitting a fully customized mobile research vehicle offering world class assessments of physical performance, bone imaging, musculoskeletal health, and biospecimen collection/analysis.



BIOCHEMISTRY

The presence of the biochemistry lab enables to collection, processing, storing, and analyzing biological samples in-house.

Features:

- > **Thermo Fisher** – Legend refrigerated Centrifuge Portable lab centrifuges (3)
- > **Savant SpeedVac** – vacuum concentrator
- > **Tuttnauer Autoclave**
- > **Luminex 200**
- > **Biotek Synergy HT plate reader**
- > **Biotek ELX50 and EX405 plate washers**
- > **Leica Cryostat**
- > **Purair fumehood**
- > **Thermo and PHC** –80 freezers (4) GE –20 chest freezer (2)
- > **Thermo refrigerators (2)**
- > **Biorad Chemidoc MP Imager**
- > **Thermo Spart2Pure ultra-pure water system**
- > **Western blotting, cellular and microvesicle preparation**
- > **Fisher Isotemp water and air incubators**

