



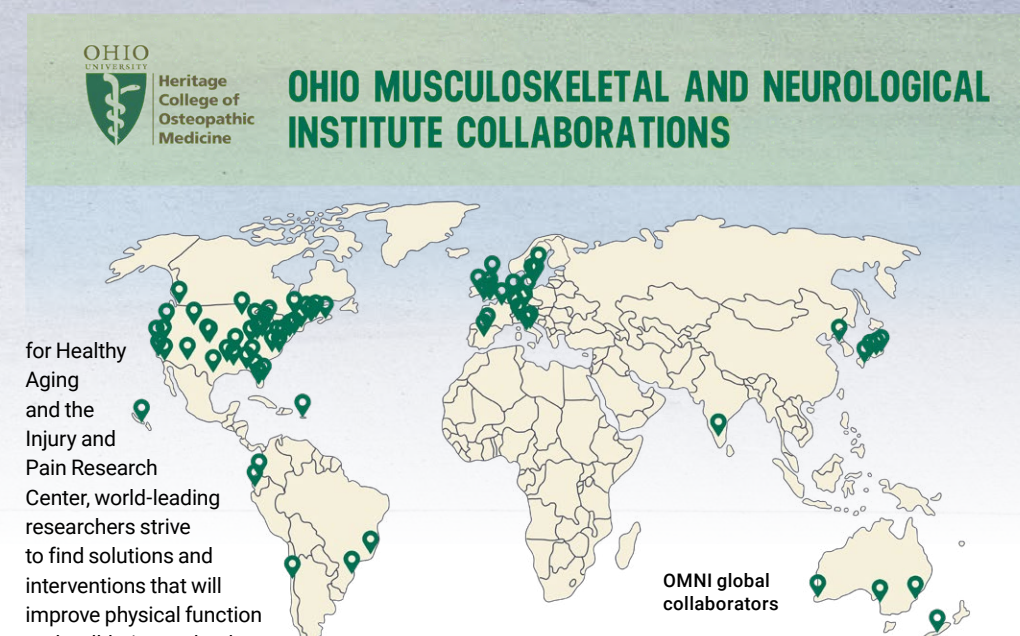
Live longer, live stronger

The Ohio Musculoskeletal and Neurological Institute

- Musculoskeletal conditions and neurological disorders affect millions of people, inhibiting their ability to work and quality of life.
- There is a worldwide need for research to improve their prevention, diagnosis, and treatment.
- The Ohio Musculoskeletal and Neurological Institute's (OMNI) vision is to improve human longevity and function – live longer, live stronger.
- At OMNI, interdisciplinary experts in the fields of musculoskeletal health, neuroscience, biomaterials, genetics, health psychology, exercise physiology, rehabilitation, and geriatrics work in state-of-the-art laboratories to achieve this.
- OMNI's laboratories boast a robust research operation with approximately \$30 million in active funding. Additionally, the Institute publishes several hundred scientific journal articles annually. In this article, we will delve deeper into some of OMNI's groundbreaking research.

Approximately 1.71 billion people worldwide suffer from musculoskeletal conditions, a figure set to rise as the population grows and ages. These conditions, such as low back pain, knee injuries, fractures, and osteoarthritis, significantly diminish quality of life and societal participation. The second leading cause of death, globally, neurological disorders impact the brain and nervous system, including conditions like dementia and movement disorders. Age being a primary risk factor, there's a clear, urgent need for more research into diagnosing, treating, and preventing these pervasive disorders that affect individuals globally, irrespective of income level.

At the Ohio Musculoskeletal and Neurological Institute (OMNI), leading researchers are doing just that. Part of Ohio University, OMNI's mission is to advance the diagnosis, treatment, and prevention of musculoskeletal and neurological disorders, helping patients live longer and stronger. Under two interdisciplinary research centers, the Center



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and clinical research laboratories led by investigators and scientists with decades of experience in these areas, and always with the aim to get science from 'bench to bedside,' from research lab to real life.

A testament to the importance and ingenuity of the research at OMNI is the high level of extramural funding the Institute has received



over the years (upwards of \$50 million to date), while OMNI trainees have received training grants from prestigious agencies including the National Institutes of Health (NIH) and the American Heart Association. Ten OMNI researchers have had their work cited more than 2,000 times, and five have received over 10,000 citations; recognition that the work done in the OMNI laboratories is highly relevant in the field as well as cutting-edge. In addition, seven OMNI researchers been ranked in the top 2% worldwide in their field, based on career citations. The full research team includes experts in neuroscience, skeletal muscle physiology, gerontology (study of aging), musculoskeletal diseases, orthopedics, functional biomechanics, health psychology, and behavioral medicine. These scientists have delivered hundreds of talks nationally and internationally, including to organizations such as the NIH and the U.S. Food and Drug Administration (FDA).

Here, we take a closer look at research conducted by the team's principal investigators: Brian C. Clark, Leslie A. Consitt, Christopher R. France, Dustin R. Grooms, Graciela Muniz-Terrera, Janet E. Simon, Julie A. Suhr, Thomas J. Rosol, Nathaniel J. Szewczyk, and Susan H. Williams, as well as junior investigators Cory W. Baumann, Nichólas Karayánnis, and Shouan Zhu.



Brian C. Clark

Brian C. Clark is Professor of Physiology and Neuroscience as well as the OMNI Executive Director and Harold E. Clybourne, D.O. Endowed Research Chair. Since being a graduate student, Clark has had continuous funding, and over the last 20 years has secured or managed a total of \$30 million. Following his appointment as Executive Director, OMNI has seen its citation rate increase 10-fold, while extramural grant funding has increased 50-fold. Clark has previously explained that when he was still a graduate student, it was assumed that muscle weakness and loss of mobility were just unavoidable parts of the aging process. Research at Clark's Neuromusculoskeletal Research Laboratory has proven that this is not the case. The lab aims are to improve the diagnosis, treatment, and prevention of sarcopenia, frailty, and osteoporosis, extending life span and improving healthy aging.

“When I was a graduate student, it was assumed that muscle weakness and loss of mobility were just unavoidable parts of the aging process. Our research has proven that this is not the case.”



Leslie A. Consitt

Associate Professor Leslie Consitt holds the Ralph S. Licklider, D.O. Endowed Fellowship in Enhanced Metabolic Aging. The Consitt lab is focused on identifying the causes of metabolic disease in aging and obese populations. Her research focuses on gaining a better understanding of the cellular and molecular mechanisms that contribute to skeletal muscle insulin resistance and impaired lipid metabolism (the breakdown and storage of fats). Her lab's research was some of the first to report that older individuals can receive improvements in insulin sensitivity with strength training. Dr. Consitt has built a research career over the past 15 years performing translational research with the ability to study an individual's health and metabolism from the whole-body level down to the molecular and cellular level where her laboratory has experience manipulating specific proteins and genes of interest in human cell culture models.

“We know that as we get older, insulin becomes less effective in the muscle and we become more susceptible to type 2 diabetes; however, my research is helping to understand how this happens.”

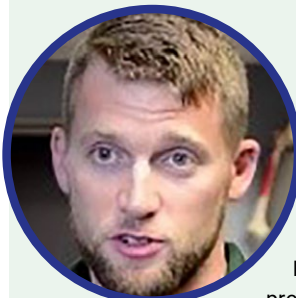


Christopher R. France

Distinguished Professor Chris France is an expert in health psychology, pain, and blood donor motivation. As Director of the Clinical Psychophysiology Research Lab, he oversees investigations into some fascinating topics including the effect of resilience on coping with acute and chronic pain, the relationship between pain-related fear and patterns of movement, the use of virtual reality to restore spinal motion and reduce pain-related disability, and strategies to motivate new and existing blood donors and to enhance their donation experience (e.g., by reducing fear and the risk for adverse reactions such as faintness)

so that they are encouraged to become regular, lifelong donors. The lab has developed the first clinical assessment of pain-related resilience (now translated into eight languages), the ‘Pain Resilience Scale,’ while their blood donor research has led to changes in how blood collection agencies in the US and around the world approach education and recruitment of prospective blood donors.

“One of the biggest challenges faced by researchers in my field today is a decreasing public confidence in the perceived value of science and higher education.”

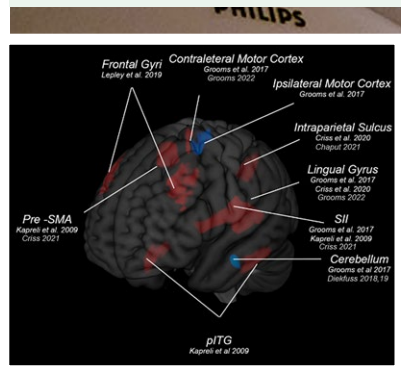


Dustin R. Grooms

Professor Dustin Grooms’ work focuses on the neurological and biomechanical changes after musculoskeletal injury, with over \$7 million in funding from the Department of Defense and National Institutes of Health. Breakthroughs from his current projects include the discovery of the neuroplasticity (the brain’s ability to reorganize or form connections) associated with knee anterior cruciate ligament injury and the use of virtual reality, sensory reweighting

therapy (to improve a patient’s function), as well as cognitively loaded return-to-activity testing to improve orthopedic therapy. The Neuromuscular Biomechanics and Health Assessment Lab he co-directs with Dr. Janet Simon provides the movement performance and functional data for his work while the Musculoskeletal and Neuroimaging Research Core provides research access to a cutting-edge 3T Philips Achieva MRI.

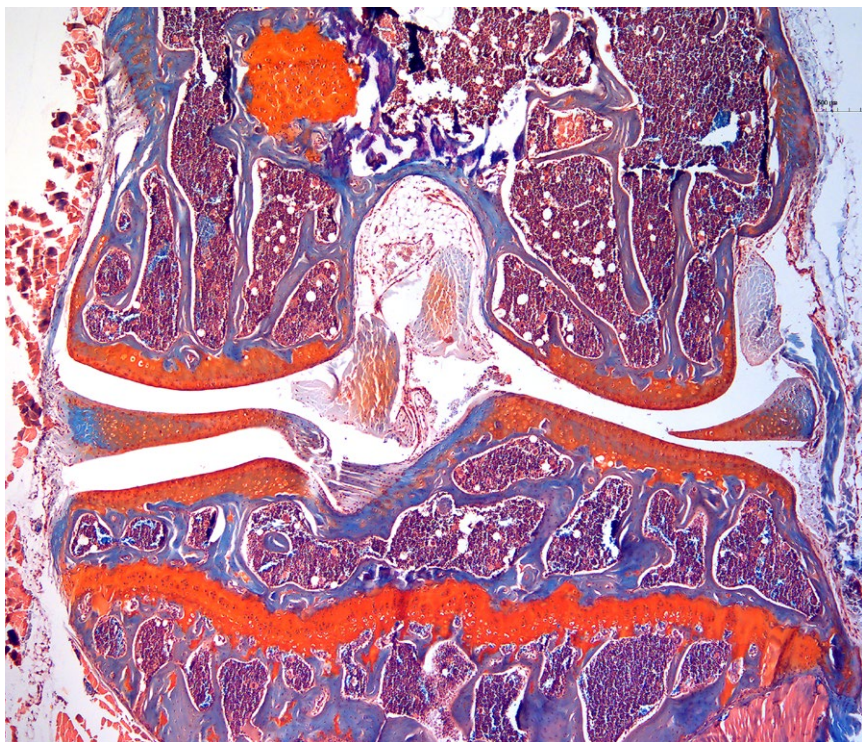
“Breakthroughs from current projects include the discovery of the neuroplasticity (the brain’s ability to reorganize or form connections) associated with knee anterior cruciate ligament injury and importantly how we can influence brain activity to improve patient care.”



Graciela Muniz-Terrera

Dr. Muniz-Terrera holds an Osteopathic Heritage Foundation Ralph S. Licklider, D.O. Endowed Professorship in Health and Aging. She is a trained methodologist and epidemiologist whose work focuses on dementia prevention and brain health. She is particularly interested in modifiable risk factors for dementia, including diet, physical activity, and social and cognitive engagement. Her work is largely international and includes multiple collaborations with colleagues based in low- and middle-income countries. She is also the lead methodologist in various longitudinal studies of older adults and has led initiatives related to data harmonisation and reproducible research.

“There are multiple challenges in our research, but a key one is how to contribute and support individuals with dementia in disadvantaged settings and populations.”



Microscope image of a mouse knee joint. Shouan Zhu, Osteoarthritis Research Laboratory.



Dr. Janet Simon evaluates health-related quality of life of athletes who experience sports injuries.



Janet E. Simon

Dr. Janet Simon is a specialist in measuring the outcomes of rehabilitation and health-related quality of life in high school and college athletes who experience a sport-related injury. Her focus is on the development of patient-based outcomes instruments which can be used to assess the end results of healthcare services. She co-runs the Neuromuscular Biomechanics and Health Assessment Laboratory with Professor Grooms. This lab's mission is to find the risk factors,

mechanisms, and preventative measures for musculoskeletal injury. With a recent grant, the lab has been investigating the recovery of function after lower extremity injury. Individuals who have a lower extremity injury experience degraded function in both limbs (injured and uninjured); the lab has been studying whether returning to pre-injury function resulted in better outcomes and has already found that it leads to better outcomes (quality of life) at return to activity and six months later.



Julie A. Suhr

Dr. Julie Suhr's students say she keeps 'the psychology in neuropsychology.' She accomplishes this in her research by studying the effect of both neurological and psychological variables on clinical presentations in a variety of medical, neurological, and psychological conditions. Since the late 90s, Suhr's lab has provided free cognitive screening for older members of the community, which has in turn led to some exciting projects, looking into, for example, the earliest risk factors for cognitive decline. Particularly exciting current projects include the use of technology, such as cell phones, to help motivate people towards behavior changes that will minimize their risk for dementia. During the COVID-19 pandemic, it was a challenge to gather data from older adults safely but validly, leading to a shift to virtual assessments. However, Dr. Suhr points out, 'We took this challenge as an opportunity to reach beyond the local community of older adults to the whole state of Ohio for provision of free cognitive screens and free workshops on dementia prevention.'

"Since the late 90s, Suhr's lab has provided free cognitive screening for older members of the community."



Nichólas Karayánnis

The mission of Dr. Karayánnis' laboratory is to provide precise patient-treatment matching of adaptive mind-body interventions for older adults living with spinal pain. Ultimately, the lab intends to leverage mechanistic studies and pragmatic clinical trials to refine the content and delivery of psychologically and somatically informed rehabilitation to enhance spinal motor control, cultivate eudaimonia (a state of health and happiness), and promote healthy aging. One current project, 'Project Soma' is investigating brain cortical activity responses during various meditation practices, including yoga.

"We aim to provide precise patient-treatment matching of adaptive mind-body interventions."



Susan H. Williams

Susan Williams is a Professor of Anatomy who studies the physiology and biomechanics of feeding, with the goal of understanding the sensory and motor processes involved in manipulating food in the oral cavity during chewing and transporting it to the pharynx and esophagus during swallowing. Her interest in feeding physiology and biomechanics is inspired by both evolutionary and clinical considerations of the anatomy of the head and neck, and trying to understand how the anatomical complexity of this region contributes to function and dysfunction in feeding. Mammals, including humans, are odd in the way food is managed from ingestion to the swallow, and the anatomy of some species, including humans, is not ideal when one considers that a poorly timed swallow relative to inhalation, or taking a breath, can lead to aspiration, or even asphyxiation and death. Currently, Williams is working with a clinician whose expertise is managing feeding and swallowing disorders in children to better understand how long-term use of reduced-texture diets during childhood impacts the ability to control movement of food through the oral cavity and pharynx. One of the biggest challenges within their research is the imaging of fast and complicated movements of structures inside the head, often with little consensus as to the best way to model the movements they see.

"We use advanced technology such as high-speed x-ray or fluoroscopy video recorded simultaneously in two views to acquire 3D kinematic data, to develop biomechanical models that inform future therapies."



Cory W. Baumann

Assistant Professor Cory Baumann is a physiologist who is interested in the role of skeletal muscle in health and disease. In particular, he studies the effects of aging on skeletal muscle form and function and how this contributes to the development of frailty. He is also interested in approaches to reduce the disease progression of muscle diseases, such as muscular dystrophy. Dr. Baumann's laboratory goal is to find the sites and mechanisms which increase the stress buffering of the neuromuscular system, hoping that this can be applied to improve function and health in aging, frail and myopathic (disease of the muscles) populations. The key is to find out why skeletal muscle from these populations is less resilient, stress resistant, and adaptable. To do this, the lab uses a variety of state-of-the-art equipment and techniques to assess muscular function in mice.

"The key is to find out why skeletal muscle from these populations is less resilient, stress resistant, and adaptable so we can target the root cause."



Thomas J. Rosol

Thomas Rosol is a Professor of Biomedical Sciences with over 300 publications and is an expert in endocrine and bone pathology, toxicologic pathology (the science of poisons and disease), cancer metastasis, drug discovery and safety, and food safety. The Rosol Laboratory (funded by the NIH for 30 years) is currently interested in both early- and late-stage prostate cancer. A new radioactive drug is being developed by the lab for early-stage disease limited to the prostate gland that

will bind only to cancer cells and will likely require only a single treatment for a prolonged effect. Late-stage prostate cancer involves metastasis to multiple bones and brings severe bone pain to the patients. The Rosol Lab aims to identify the reasons prostate cancer specifically targets bone and how to slow or prevent bone metastases. Rosol has identified that dogs are the only animals that develop spontaneous prostate cancer with bone metastasis, allowing the lab to develop five cell lines from spontaneous dog cancers that can be studied effectively in mice.

“Many young scientists are being recruited to exciting careers in industry and less are considering academic careers. Therefore, it is critical that we create opportunities for young scientists to be successful in our universities.”



Nathaniel J. Szewczyk

Professor Nathaniel Szewczyk’s field of interest is muscle health. His laboratory investigates how genes, nutrients, toxins and the environment can contribute to both the health and

ill-health of muscles using animal models and human subjects. Some of their most recent work includes projects on the role of sulfur in mitochondrial diseases, diagnostics and treatments for Duchenne Muscular Dystrophy (DMD), countering neuromuscular decline with age (and with spaceflight!), and the molecular mechanisms underlying the loss of muscle function with lack of use. A priority goal for the lab’s DMD research is to understand if the increased anesthesia sensitivity in patients is caused by the same molecular alteration present in primary mitochondrial disease. If it is, the current clinical guidelines for personal anesthesia dosing and monitoring that already exist for patients with primary mitochondrial disease can be adopted for DMD patients.

“Muscle blows my mind. You can see how tiny molecules generate force to produce movement in people.”



Shouan Zhu

Assistant Professor Shouan Zhu is looking into mechanisms of osteoarthritis during aging and obesity, with a special focus on the role of cellular metabolism in osteoarthritis pathogenesis. Osteoarthritis had been considered a ‘wear and tear disease’, but the Osteoarthritis Research Laboratory’s findings show that risk factors such as aging and obesity also impair the metabolic functions of cells inside the joint. Osteoarthritis is now considered a whole-joint and systemic disease. The lab also recently discovered a detrimental role of excessive growth hormone on joint health. The lab uses a variety of cutting-edge research techniques such as genetically modified mouse models, Seahorse respirometry (measurement and analysis of respiration), and mass spectrometry-based metabolomics (chemical processes of metabolites).

“Many of our research projects have paradigm-shifting potential.”



Points of Pride

Can you give us an example of an OMNI research project which has now been put into practice with patients?

Our pain research has had a direct impact on psychological approaches to chronic pain management by developing the first clinical assessment of pain-related resilience, the Pain Resilience Scale. It’s now been translated into eight languages. This instrument is used internationally in clinical and clinical research settings to evaluate a patient’s tendency to approach chronic pain using adaptive psychological strategies, and to monitor their progress in using such strategies in the course of treatment. Our blood donor research has led to changes in how blood collection agencies in the U.S. and around the world approach education and recruitment of prospective blood donors, with an emphasis on providing empirically validated strategies to identify and address common donor concerns such as fear of blood, needles, pain, and potential adverse reactions such as lightheadedness or fainting.

- Distinguished Professor Chris France

Is there an ongoing research project which you feel has particular potential to change the face of its field?

OMNI is working on many projects that have potential to change the field. One project in particular, funded by the Department of Defense and National Institutes of Health, investigates how

the brain changes after common knee injuries and how new augmented reality interventions can help the brain recalibrate its control of the knee after injury.

- Professor Dustin R. Grooms

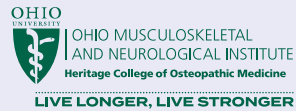
What are the biggest challenges facing musculoskeletal and neurological disorder researchers today?

Researchers in the musculoskeletal rehabilitation field face challenges in understanding the complex mechanisms underlying various conditions, making personalized treatment plans, integrating evidence-based practices into clinical settings, and fostering multidisciplinary collaboration among healthcare professionals in the research setting. Additionally, the field grapples with the integration of emerging technologies, the need for cost-effective interventions, tracking long-term outcomes, and addressing ethical considerations. With an aging population, there is a growing demand for effective rehabilitation strategies, adding complexity to the field’s research priorities. Overcoming these challenges is essential to improving patient outcomes and advancing musculoskeletal rehabilitation.

- Dr. Janet E. Simon

“We developed the Pain Resilience Scale, now translated into eight languages.”

Details



Ohio Musculoskeletal and Neurological Institute
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Funding

- American Federation of Aging
- American Heart Association
- American Society for Bone and Mineral Research (ASBMR)
- Arthritis National Research Foundation (ANRF)
- Hevolution Foundation
- National Institute on Aging (NIA)
- National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)
- National Center for Complementary and Integrative Health (NCCIH)
- National Institute of Child Health and Human Development (NICHD)
- National Heart, Lung, and Blood Institute (NHLBI)
- Rheumatology Research Foundation (RRF)
- U.S. Department of Defense, DoD