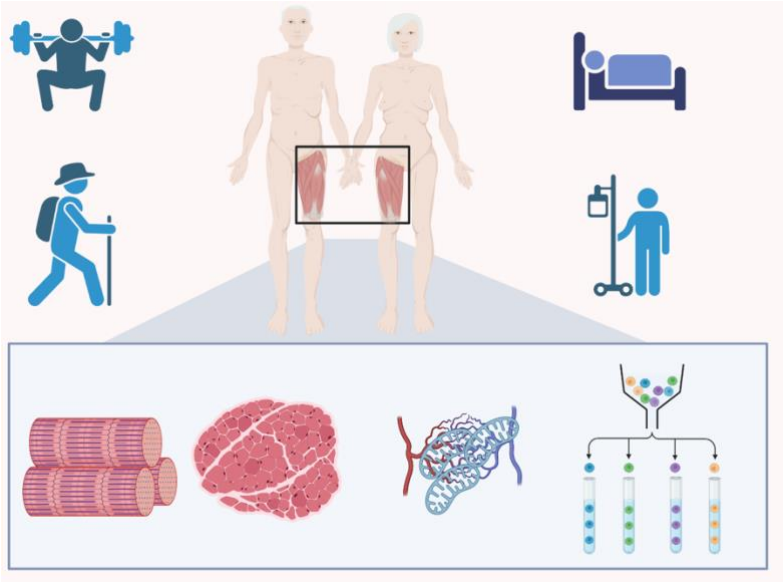
Title:
Impact of exercise and disuse on healthy aging: a translational approach to define neuromuscular changes according to sex-related differences
(borsa di dottorato D.M. 118)

PI and name of the lab:
Simone Porcelli – Human Integrative Physiology of Exercise Lab - Human Physiology Unit

Research Theme/Topic:
Human Physiology, Muscle bioenergetics, Mitochondria, Neuromuscular Junctions

Main Abstract:
Aging is characterized by decline in neuromuscular control and progressive loss of muscle mass, strength, and power, resulting in reduced mobility, loss of independence, higher rates of hospitalizations, and increased mortality from all causes. Significant functional consequences in activities of daily living are usually not observed in subjects younger than 65 years of age. However, muscle strength/power reduction is accelerated and becomes faster than the average muscle mass loss after 50 years of age and denervation-reinnervation processes begin as early as 50 to 60 years, resulting in fewer surviving motor units and impared muscle function. Moreover,



neuromuscular changes can be exacerbated by short or long period of inactivity or illness. Finally, several confounding factors, such as different physical activity levels or sex, may contribute to (or compensate for) the observed age-related reductions in neuromuscular function. The project aims to evaluate gender differences in neuromuscular changes related to aging and the beneficial effect of exercise by directing attention to motor function, nervous system-muscle interaction, and muscle energy metabolism with an integrated approach. Changes and interactions among neural, structural, and metabolic variables in young and elderly subjects undergoing to different disuse models (steps reduction and bed rest) or exercise training (resistance and endurance) will be investigated. The project will enable the Ph.D. student to combine in-vivo experimental approaches such as surface electromyography, nerve and muscle electrical stimulation, maximal oxygen consumption assessment, and near-infrared spectroscopy, with ex-vivo techniques on muscle tissue samples such as high-resolution respirometry and single fiber mechanics study, evaluation of myonucleus transcriptional profiles with sn-RNAseq, as well as classical confocal microscopic analysis, Western blot, and RT-PCR. The results will extend the current understanding of the physiological determinants of neuromuscular alterations also in light of new technologies that allow discriminating transcriptional adaptations of specialized nuclei, within muscle fibers.

Techniques:
Evaluation of cardiorespiratory and metabolic responses, near infrared spectroscopy, high-density EMG, proteomic and quantitative electrophoresis, Western blot, RT-PCR, high-resolution respirometry, sn-RNAseq, single muscle fibers mechanics, metabolomics.

References

Crimmins EM. Gerontologist. 2015 Dec;55(6):901-11. doi: 10.1093/geront/gnv130.
Brocca L et al. J Physiol. 2015 Dec;593(24):5361-85. doi: 10.1113/JP271188.
Elam C et al. J Musculoskelet Neuronal Interact. 2022 Dec;22(4):486-497.
Porcelli S et al. J Appl Physiol. 2010 Jul;109(1):101-11. doi: 10.1152/japplphysiol.00782.2009.
Hunter SK. Acta Physiol 210:768–789, 2014.