Preface

The term "neuromuscular system" used in the book title reflects the idea that apart from the bony skeleton, the human movement apparatus is comprised of skeletal muscles which are controlled by the neuromuscular system (i.e., brain and spinal cord sensorimotor nerve activity supports both muscle and bone quality). The main focus of this book is on recent principal findings (e.g., last 10–15 years) of the authors' major research fields in normal skeletal muscle and neuromuscular system adaptation to disuse related to Space Life Sciences by using animal research (mice and rats), human ground-based experiments (bed rest analogue to spaceflight), and the outcome of various physical countermeasures on structure, function, and cell signaling pathways of disused skeletal muscle experiments on the ground, and in actual spaceflight (International Space Station, biosatellites). This work led to some new fundamental insights, ideas, and hypotheses, and provides some future outlooks that should help to find optimized physical countermeasure protocols, e.g., more compliant to potential users and strengthening key cell signaling pathways in the neuromuscular system, e.g., nitric oxide (NO) and Homer. Some of the new insights gained from space related research might have some impact on the current understanding, in particular of human performance control and adaptation on Earth as well as in Space. We here propose a unique exercise countermeasure protocol against disuse-induced skeletal muscle atrophy and neuromuscular impairments using whole body vibration which was tested for its feasibility to prevent disuse atrophy mainly in two bed rest studies at the Charité Univertsitätsmedizin Berlin (Principal Investigator: D. Felsenberg), in cooperation with European Space Agency (ESA), German Space Agency (DLR e.V.), and industrial partners (Novotec Medical Inc., Pforzheim, Germany).

The various countermeasure protocols used in bed rest are considered as clinically controlled pioneer human studies on the ground that may help to alleviate bone and muscle loss and to support neuromuscular control to minimize risk of injury in crew members during their mission duties in Space and thereafter. We think that some of our findings from fundamental ground-based human research, for example, the anti-atrophic effects of vibration stimulation on skeletal muscle and

neuromuscular key cell signaling pathways during longer periods of disuse, share the potential of being translated in routine preventive care in normal everyday life (fitness) or may be implemented as additional therapeutical tools to routine rehabilitation protocols in various clinical settings (e.g., physiotherapy, neurological or neuromuscular diseases, and osteoporosis) as well as chaperoning healthy aging on Earth.

This book is directed to all interested readers, to specialists but also to novices in the field.

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