

## High-Force Eccentric Exercise for Sarcopenia

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### Introduction

Muscle wasting (sarcopenia) with its concomitant weakness has been viewed as a nearly inevitable consequence of aging, resulting in an average of 50% of total muscle mass lost by the end of the 8<sup>th</sup> decade of life. This process is often accelerated by cardiopulmonary pathologies that do not allow individuals to exercise at levels necessary to reverse this process. As muscle strength and mass decrease many elderly become increasingly incapacitated by frailty and a decreased ability to perform normal daily activities. Negotiating stairs safely, specifically descending stairs, involves controlled lengthening muscular contractions (eccentric contractions) in the legs to avoid falls. Both electromyographic and biomechanical evidence demonstrate the elderly have the greatest difficulty performing sub-maximal eccentric muscular tasks and that this muscular deficit may be the single biggest contributor to falls while descending stairs. These falls can be life threatening and often result in a loss of independence. Consequently, novel interventions are needed that target these documented problems (muscle wasting accelerated by cardiopulmonary limitations and eccentric muscle dysfunction). The purpose of this study is to exploit a unique countermeasure that first, is user friendly, hence likely to have high subject compliance, and second, specifically targets the kind of muscular activity that limits functional abilities and is most affected by the normal progress of age-induced sarcopenia. High-force, chronic eccentric training, which has never been exploited as an intervention tool, may be ideally suited to these elderly individuals.

### Methods

In establishing the practicality and acceptance level of eccentric training in “high-fall risk” elderly subjects with sarcopenia exaggerated by cardiopulmonary problems, we assigned subjects (mean age 78 y/o) to either a weight training resistance program or an eccentric cycle ergometry program for 10 weeks (3x/week). Before and after a 5-week ramping up of the eccentric workload, and an additional 5 weeks of training at high eccentric workloads, we measured locomotor muscle size, strength and whole body performance measures. We determined if high-force eccentric training is possible in high-fall risk elderly individuals without inducing muscle damage or injury by measuring muscle force production, levels of creatine kinase and cytokines in the blood and the subject’s perception of leg pain or any cardiopulmonary complications. Questionnaires were used to determine if this training is perceived by the elderly to be non-strenuous, i.e., of low-exertion and hence preferable to other exercise modes and whether their balance and quality of life improved.

### Results

Elderly, frail individuals respond to chronic eccentric training in an apparently identical fashion as do young, healthy ones. In this study, the eccentric workload (measured as the total eccentric work) was progressively ramped such that following 5 weeks the training workload had increased over 10-fold. This large increase in eccentric work occurred with no measurable evidence of muscle injury and with minimal discomfort. Further, as had occurred in young subjects, it occurred under conditions of low metabolic demand (as measured by minimal increase in heart rate) and what were perceived to be low rates of exertion. Despite the perceived low intensity of this exercise, all subjects in this study experienced large increases in isometric strength.

### Discussion

This novel form of chronic, high-force eccentric training may be ideally suited for strength training in elderly exercise-intolerant subjects.

### References

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