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Feature Article

Impact of resistance training on sarcopenia in nursing care facilities: A pilot study

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ABSTRACT

The impact of progressive resistance training on sarcopenia among very old institutionalized adults was investigated. Residents of Nursing Care Facilities were included in a controlled trial of twice weekly resistance and balance exercise program for six months (Age: 85.9 ± 7.5 years, Time in care: 707.1 ± 707.5 days, N = 21 per group). Sarcopenia was measured based on the European Working Group on Sarcopenia in Older People criteria. Of the recruited 42 participants, 35.7% had sarcopenia at baseline, with prevalence increasing in the control group post-intervention (42.9%–52.4%). Following training, the exercise group experienced a significant increase in grip strength when compared to controls ($p = .02$), and a within-group decrease in body mass index and increase in grip strength ($p \leq .007$). Resistance and balance exercise has positive benefits for older adults residing in a nursing care facilities which may transfer to reduce disability and sarcopenia transition, but more work is needed to ensure improved program uptake among residents.

Introduction

Aging is a complex physiological process that can be influenced by intrinsic factors such as genetic, and extrinsic factors such as psychosocial behaviors and environment.[1] Aging is accompanied by the gradual decline in the regenerative properties of cell tissue and may result in a reduction in cognitive, motor and/or sensory function. It is well documented that skeletal muscle tissue has a slow cellular turnover rate and the effectiveness of skeletal muscle regeneration in later life is reduced.[2] The loss of lean tissue, and especially skeletal muscle mass (SMM), with increasing age has received significant research attention due to the disability, morbidity and mortality consequences to the individual.[3] The loss of muscle mass has been reported to begin as early as the fourth decade of life, continue at a rate of 1–2% per decade and decrease by approximately 30% across the lifespan. In contrast, maximal muscle strength capacity peaks around the second or third decade of life and begins a gradual 1.5% decline from the fifth decade culminating in a 50% loss across the lifespan.[4] These muscle strength and mass changes, when combined with a decreased level of activity and sedentary behavior, lead to disability and subsequently loss of independence.[5]

Sarcopenia is a syndrome characterized by a progressive loss of skeletal muscle mass and muscle function. It is associated with an increased risk for falls, fracture, disability, impairment in the ability to perform instrumental activities of daily living, hospitalization,

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Conflict of interest: The primary investigator in the present study (JH) was financially supported to collect the data used in this study and supported in-kind during her PhD study by the company whose equipment was used in the exercise intervention described within. However, all potential conflicts were discussed prior to the undertaking of this study with an understanding that outcomes could not be led by either part. Therefore, we are adamant all conflicts of interest have been disclosed and negated.

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poor quality of life and death.[6] Sarcopenia is not considered to be a "disease" state, but rather a condition of acute functional deficit, disability, co-morbidity and mortality. Without the presence of low muscle mass, sarcopenia is undetectable in the early stages, however, if left untreated sarcopenia has significant consequences and will lead to physical dysfunction.[7] The mechanisms underpinning sarcopenia are complex and multi-factorial, but are reported to include sedentary lifestyle, alteration in endocrine function (insulin, testosterone, growth hormone, insulin like growth factor-1, cortisol), loss of neuromuscular function, imbalance between muscle protein synthesis and breakdown, inadequate dietary protein intake, and genetic factors.[3,7,8] Palus et al[4] reported that based on current definitions over 3% of all adults 65 years and older would have a diagnosis of sarcopenia by 2015. Prevalence of sarcopenia is even greater among older institutionalized adults when compared to their community-dwelling counterparts, with recent studies reporting prevalence rates in persons over 80 years of age to range from 30 to 50%.[9,10] Australian data also suggests that many of these aged care residents have very poor muscular function,[11] with such physical limitations impacting in many ways on their mobility, independence and health status.[12]

To reduce the implications of sarcopenia and improve projected quality of later life outcomes for older adults, effective interventions are needed to counter the age associated loss of skeletal muscle mass and function.[13] One strategy that shows promise in the prevention and reversal of sarcopenia is exercise, in particular resistance training.[3,13] Work by our group has previously demonstrated that with long-term resistance exercise, community-dwelling older adults can significantly increase muscle strength and muscle mass, with gains transferring to improved physical performance.[14] In addition, a number of reviews supporting these benefits across varied populations of older adults, including the pre-frail and institutionalized,[7,15] have reported resistance exercise to be safe and effective with the benefits outweighing the risks.[16] However, while evidence appears strong that resistance training can directly benefit the components that determine sarcopenia, debate continues concerning its appropriateness and impact among older institutionalized individuals.

Supporting the concept of resistance training as a countermeasure to sarcopenia, Cruz-Jentoft et al[17] recently identified nutrition and exercise as evidence-based interventions. Nevertheless, of the seven exercise studies identified in their review all were considered only moderate quality, and of the four that delivered resistance training only two reported a change in muscle mass, the primary component in sarcopenia diagnosis. Given the quality of these works and that large significant changes in muscle mass have been reported previously,[7,8] more work is needed with greater consideration to dosage, treatment durations and the target age group. To this end, the aim of the present study was to pilot an investigation into the impact of resistance training on sarcopenia status in older adults residing in a nursing care facilities.

Methods

Design and recruitment

This investigation of the influence of resistance training on sarcopenia and its components employed a two-group controlled trial design of aged care residents to an exercise (EX) or usual care control (CON) group. Data are generated from a sub-study conducted within a larger falls prevention trial. A detailed account of the parent study protocol has been presented previously.[18] In brief, the parent study is a single-blind, two group, cluster randomized trial aiming to recruit 300 residents across 20 aged care facilities in New South Wales and South East Queensland (Australia). EX participants undertake 50 h of progressive resistance and balance training twice weekly over a six month period, with groups assessed before and after the intervention period for number of falls (primary variable), quality of life, functional performance (Short Physical Performance Battery), falls efficacy and cognitive wellbeing. The facility inclusion criteria was: high care and low care residents; $\geq$15 residents willing to participate; service manager consents to trial participation and staff time allocation for project tasks (i.e. approaching potential participants, assisting with supervision, etc.). For residents, the inclusion criteria were permanently residing in the facility, able to understand English and follow instructions, and able to supply informed or substitute decisions maker consent. Residents were excluded if they had terminal or unstable illness, significant advanced cognitive decline (Mini-mental State Examination $\leq$15),[19] hemiplegia preventing them from using the resistance training equipment, Parkinson's Disease, were permanently wheelchair or bed bound or had performed a balance and/or resistance training program in the past 12 months that was similar in design and dosage to the trial protocol. To promote project uptake and adherence, all facilities staff participating in bringing residents to and from trainings, and/or assessments, undertook project training seminars, and exercise and assessment sessions are grounded in evidence via lessons learnt by our group from previous nursing care deliveries.[20,21]

For this sub-study, four facilities agreed to participate and eligible residents from the parent study who did not have a pacemaker were recruited and consented into the study. This process involved residents being informed by staff about the project and given a participant information sheet to read. Interested residents were then requested to sign a consent form, following which they were contacted by the research team to schedule a baseline assessment. In addition, the resident's medical practitioner was contacted for a medical clearance to participate in the exercise program. This study had ethical clearance from the University of Queensland Human Research Ethics Committee.

For the parent study, following the baseline assessment a two facility computer-generated cluster randomization was undertaken allocating facilities to either the EX or CON group. For the sub-study, due to the EX group numbers being greater and to balance group sizes, individuals who were initially allocated to the EX group but attended no exercise sessions were re-allocated to the CON group for analysis.

Intervention

The EX facilities were provided with twice weekly progressive resistance and balance training up to 50 h over a six month period, while individuals in the control facilities continued with their usual care routine. Resistance training was by air-pneumatic equipment (HUR Health and Fitness Equipment, Australia) specifically designed for rehabilitation and commonly used in very old adults with disability and care needs. Lower- and upper-body, and the trunk exercises included: elbow and shoulder extension (dip), leg press, knee extension and flexion, hip abduction and adduction, abdominal curl and back extension. Following a reduced sets and repetitions two week conditioning period, participants were prescribed 2–3 sets per exercise at a resistance they could complete 10–15 times[22] with a perceived rate of exertion of 12–14 on the Borg Scale.[23] Balance exercises included: heel and toe raises, varied directional quick stepping, reaching, single leg standing, static balance, heel to toe walking and complex cross over stepping activities.[24] Exercise intensity was progressed for the resistance training exercises by increasing the load when participants could comfortably complete 3 sets of 10 repetitions or by increasing repetitions with the same load to 3 sets of 15 repetitions. For the