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An elastic band exercise program for older adults using wheelchairs in Taiwan nursing homes: A cluster randomized trial

Kuei-Min Chen [a,*], Chun-Huw Li [b,1], Ya-Hui Chang [a,2], Hsin-Ting Huang [a,2], Yin-Yin Cheng [a,2]

[a] College of Nursing, Kaohsiung Medical University, 100 Shih-Chuan 1st Rd., Sanming District, Kaohsiung 80708, Taiwan
[b] Department of Nursing, Yuhing Junior College of Health Care and Management, No. 15, Lane 420, Dachang 2nd Rd., Sanmin District, Kaohsiung 80776, Taiwan

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ABSTRACT

Background: The number of older adults using wheelchairs in nursing homes is over 50% of that population, and many of them use wheelchairs due to muscle weakness in the lower extremities. Muscles of older adults are trainable, and progressive resistance exercises using elastic bands can increase muscle strength in older adults.
Objectives: To test the effectiveness of six-month Wheelchair-bound Senior Elastic Band exercises on the functional fitness of older adults in nursing homes.
Design: Cluster randomized trial.
Settings: Ten nursing homes, southern Taiwan.
Participants: 127 participants were recruited, and 114 of them completed the study. Inclusion criteria were: (1) aged 65 and over, (2) using wheelchairs for mobility, (3) living in the facility for at least three months, (4) cognitively intact, and (5) heavily or moderate dependency in their activities of daily living. The mean age of the participants was 79.15 (7.03) years, and 98.20% of them had chronic illnesses.
Methods: Participants were randomly assigned to the experimental (five nursing homes, $n = 59$) or the control (five nursing homes, $n = 55$) group based on the nursing homes where they stayed. A 40-min Wheelchair-bound Senior Elastic Band exercise program was implemented three times per week for six months for the experimental group participants. The functional fitness (activities of daily living, lung capacity, body flexibilities, muscle power and endurance) of the participants was examined at baseline, after three months, and at the end of the six months study. The mixed-design, two-way analysis of variance was used to detect the interaction effects, and one-way repeated measures analysis of variance and analysis of covariance were performed to analyze the within-group and between-group differences.

* Corresponding author. Tel.: +886 7 3136900.
E-mail addresses: kmc@kmu.edu.tw, kueimin@yahoo.com (K. M. Chen), numa@ms.yuhing.edu.tw (C. H. Li), hui7742@yahoo.com.tw (Y. H. Chang), qwety789@livemail.tw (H. T. Huang), kuyin3641@yahoo.com.tw (Y. Y. Cheng).
[1] Tel.: +886 917665157.
[2] Tel.: +886 7 3136900.

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Results: At the end of the six-month study, the Wheelchair-bound Senior Elastic Band group had better performances in all of the functional fitness indicators than the control group (all $p < 0.05$).
Conclusions: The Wheelchair-bound Senior Elastic Band exercises significantly improved the functional fitness of the older adults in wheelchairs. It is suggested that the program be incorporated as a part of daily activities for nursing home older adults in wheelchairs.

What is already known about the topic?

- Many of the older adults using wheelchairs in nursing homes were due to muscle weakness in the lower extremities caused by previous falls, strokes, or inactivity.
- Muscles of the older adults are trainable, and progressive resistance exercises using elastic bands can increase muscle strength in older adults.
- The Wheelchair-bound Senior Elastic Band (WSEB) exercise program has been evaluated by experts and pilot-tested with older adults in wheelchairs with positive qualitative feedback.

What this paper adds

- The experimental group had better functional fitness than the control group after six months of the WSEB exercises.
- Nursing home directors could recruit volunteers to teach the WSEB exercise program and lead the older adults to practice the WSEB exercises in groups regularly in the facilities.

1. Introduction

About 5% of the older adults in the US (Karmarkar et al., 2011) and 2.7% in Taiwan (Yang et al., 2011) live in institutional settings. The number of older adults using wheelchairs in nursing homes is over 50% of that population (Kaye et al., 2002), and many of them use wheelchairs due to muscle weakness in the lower extremities caused by previous falls, strokes, or inactivity (Karmarkar et al., 2011). Wheelchair use is one of the barriers to physical activity (Rimmer, 2005), which might lead to further disability and mortality in older adults (Hirvensalo et al., 2000). Shore (2008) has reported that 12.3% of older adults in wheelchairs experienced worsening health. Muscle strength is essential in completing the activities of daily living (Topp et al., 1994), and the muscles of older adults are as trainable as those of younger adults. Progressive resistance exercises, including those using elastic bands, can increase muscle strength and size in older adults (Brown et al., 1990).

Elastic band exercise is documented as a safe and effective strategy to enhance the neuromuscular system, improve the muscle strength and power, and increase the ability to perform functional tasks of older adults (Galvao and Taaffe, 2005). The inherent properties of the elastic band could accommodate the length-tension characteristics of joint and muscle actions (Patterson et al., 2001). By changing the thickness and length of the elastic belt, resistance training can be flexibly adjusted to meet the needs of populations with different levels of body functioning (Damush and Damush, 1999). Evidence-based research supports that elastic band exercises are beneficial for both healthy and frail older adults (Dancewicz et al., 2003; Topp et al., 2002). The resistance exercise program using elastic bands improved maximal voluntary thigh muscle strength (Binder et al., 2005), knee extension and hip extension strength (Dancewicz et al., 2003), and sit-to-stand performance of community-dwelling older adults (Chen et al., 2009). Further, elastic band resistance training improved functional ability (Topp et al., 2005), increased flexibility and range of joint motion (Sugimoto and Blanpied, 2006; Swank et al., 2003), and enhanced gait and balance of older adults (Topp et al., 1993, 1996).

Our research group developed an elastic band exercise program for older adults in wheelchairs, called the Wheelchair-bound Senior Elastic Band (WSEB) exercise program (Chen et al., 2013). The WSEB is different from traditional elastic band exercises in the following ways. First, the WSEB program accommodates the reduced muscle strength and body flexibility experienced by many older adults and is less strenuous. Second, the thickness of the elastic belt is chosen as medium to allow the level of resistance training to be flexibly increased or decreased to accommodate the muscle strength of older adults. Third, the WSEB program accommodates the special characteristics of the wheelchair, and some exercises are executed using the wheelchair's handrails.

The WSEB program has been critically reviewed by a panel of 12 experts and further pilot-tested in a group of 10 older adults in wheelchairs for four weeks (Chen et al., 2013). Positive feedback was reported by the participants after four weeks of pilot-testing, which included having more muscle strength in their hands and legs, increased body flexibility and range of joint motion, and feelings of being more energetic (Chen et al., 2013). However, this positive feedback was qualitative and no objective formal testing was conducted to verify these findings. Therefore, this study aimed to test the effectiveness of six months of WSEB exercises on the functional fitness of nursing home older adults in wheelchairs using objective measurements.

2. Materials and methods

2.1. Design

A cluster randomized trial was used. Ten nursing homes were randomly assigned to either the experimental or control group using a black box drawing method (Polit and Beck, 2012), and the participants were randomly assigned