J. Phys. Ther. Sci. 29: 1695–1699, 2017

The Journal of Physical Therapy Science

Review Article

Effectiveness of resistance exercise using elastic bands on flexibility and balance among the elderly people living in the community: a systematic review and meta-analysis

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Abstract. [Purpose] The purpose of this study was to determine the effects of resistance exercise using elastic bands on flexibility and balance among the elderly people living in the community. [Subjects and Methods] Database search was conducted by using PubMed, CINAHL, Embase, RISS, NDSL, NANET, DBpia, and KoreaMed. The meta-analysis, which was based on 19 studies, covered a total of 649 participants and used either the fixed effects or random effects model. [Results] The effect size estimates showed that resistance exercise using elastic bands have significantly increased the functional reach test score (Standard Mean Difference: 1.18, 95% CI 0.48 to 1.89) and timed up and go test score (Mean Difference: 2.89, 95% CI 2.55 to 3.22). [Conclusion] The review findings suggest that resistance exercise using elastic bands is effective for improving the flexibility and balance of the elderly people living in the community. However, further research is deemed necessary by using a large sample size or follow-up measure in order to provide evidence-based recommendations.

Key words: Elastic band, Flexibility, Balance

(This article was submitted May 12, 2017, and was accepted Jun. 15, 2017)

INTRODUCTION

Fall-related injuries are important health concerns worldwide in the elderly people living in the community. According to a previous study, 32% of the elderly aged 65 to 74 years old and 51% of the elderly aged 85 years or older experienced a fall at least once a year[1)]. Approximately 20% to 30% of the elderly with a fall incident also sustained hip fractures and head injuries. These reduced their mobility and independence, thereby resulting in a decreased quality of life and an increased risk of death due to the secondary complications[2)]. For this reason, it is important to develop and implement interventions in order to prevent fall incidents in the elderly people living in the community.

A recent study showed that risk factors for fall incidents can be reduced via exercise intervention[3)]. In particular, elastic bands for resistance exercise are easy to use, convenient to carry, economical, and safe. The elderly people living in the community can easily do this resistance exercise at the comfort of their homes without the assistance of an expert[4)]. In addition, it is suitable for the muscle strengthening of the elderly people, since it is possible to load in all directions, and the intensity of the load can be naturally controlled unlike the exercise device, wherein the load is artificially controlled[5)].

Based on the systematic review and meta-analysis on the physical function of the elderly people living in the community to date, there is a study that evaluated the effect of home-based resistance training on their strength and functional ability[6)], and a study that evalauted the effect of physical activity intervention on their physical function[7)]. However, there have been no studies on the effect of resistance exercise using elastic bands on the flexibility and balance of the elderly. Therefore, this

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study aimed to provide the guideline and direction for interventions that will help prevent fall incidents in the elderly people by verifying the effect of resistance exercise using elastic bands on the flexibility and balance of the elderly people living in the community.

SUBJECTS AND METHODS

This study was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), which is a research guideline for systematic review and meta-analysis. The data selection criteria based on the description form of the systematic literature review, including the Participants, Interventions, Comparisons, Outcomes, and Study design (PICOS), are as follows. Participants (P) refer to the elderly people aged 65 years or older who are living in the community. Intervention (I) refers to the resistance exercise using elastic bands that is given alone or in combination with another intervention. Comparisons (C) refer to the group without an intervention and the group with the aforementioned intervention. Outcomes (O) refer to the studies that measured flexibility or balance in the elderly people by using the Functional Reach Test (FRT), Timed Up and Go (TUG) test, and One Leg Standing Test (OLST). Study design (S) refers to the randomized controlled and non-randomized controlled trials.

The data search was carried out without a limitation in a year and targeted the articles that were published until March 2017. The search databases used were PubMed, CINAHL, Embase, RISS, NDSL, NANET, DBpia, and KoreaMed. The search keywords used were elder, elderly, older, aged, senior, geriatric, resistance, elastic, rubber, thera, latex, band, program, training, test, functional reach, timed up and go, one leg standing, clinical, randomized, controlled trial, random, placebo, etc.

The selected articles were analyzed by using the RevMan 5.3 program of Cochrane Library. The effect size was estimated with the fixed effects model or random effects model, and the mean difference (MD) or standardized mean difference (SMD) was presented. The homogeneity of the studies was tested via I^2 of Higgins.

RESULTS

Database searches identified 1,162 studies. Abstracts of 587 studies suggested that 106 articles were potentially eligible for inclusion; however, only 19 studies met the inclusion criteria (Fig. 1). The total number of study participants was 649 persons (experiment group, 344 persons; control group, 305 persons). The risk-of-bias scores ranged from 8 to 11 out of 12 points (M ± SD, 9.74 ± 1.05) (Table 1). The effect size on FRT was 1.18 (95% CI 0.48 to 1.89), and I^2, which represented heterogeneity, was 83% (Fig. 2). The effect size on TUG was −0.36 (95% CI −0.88 to 0.16), and I^2, which represented heterogeneity, was 85% (Fig. 3). The effect size on OLST was 2.89 (95% CI 2.55 to 3.22), and I^2, which represented heterogeneity, was 64% (Fig. 4).

DISCUSSION

Resistance exercise using elastic bands has been used as an important intervention for the prevention of fall incidents by increasing the equilibrium and balance of the elderly; however, a comprehensive analysis for resistance exercise using elastic bands has rarely been performed. In this study, a systematic review and a meta-analysis were conducted on 19 studies, including a total of 649 participants, in order to determine the effectiveness of resistance exercise using elastic bands on the flexibility and balance of the elderly people living in the community.

The study result showed that resistance exercise using elastic bands was remarkably effective in improving the FRT score (EF=1.18) and OLST score (EF=2.89) of the elderly people living in the community. However, it did not have a statistically significant effect in improving the TUG score. These results were similar to that of the previous study that conducted a meta-analysis on 15 studies and reported that exercise was effective in enhancing the Berg Balance Scale (BBS) score of frail older adults, but it was not effective in improving the TUG performance[8]. De Vries NM et al.[9] reported that physical exercise therapy had a positive effect on the mobility and physical functioning of the elderly people living in the community. Howe TE et al.[10] showed that exercise was effective in improving the TUG (4 studies) and OLST (3 studies) of the elderly people based on the meta-analysis result of

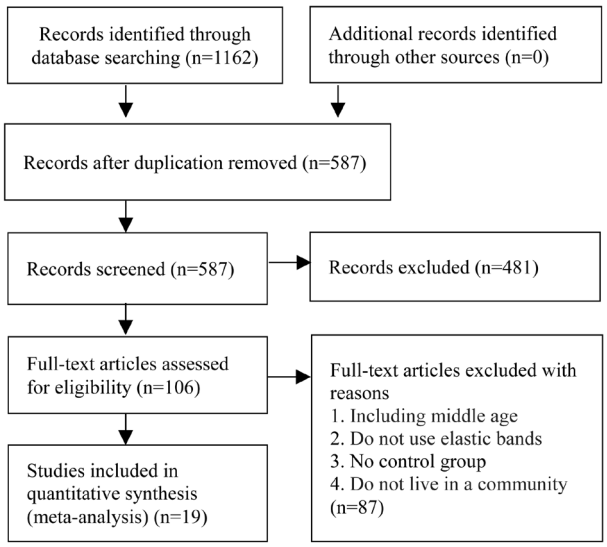

Fig. 1. Flow diagram of the study selection process

Table 1. Characteristics of included studies

First author and year	Study design	Participants			Interventions							Comparisons	Scale	Total risk-of-bias score
		Total N (eN/cN)	Mean age	% of females	Type	Dur. week	Freq./ week	N. of Ses.	Min	Repeated time	RPE			
Cyarto 2008a	RCT	86 (38,48)	79.0	82.6	RE	20	2	40	60	30	NR	Walking	TUG, OLST	11
Cyarto 2008b	RCT	129 (81,48)	78.0	78.3	RE	20	2	40	60	30	NR	Walking	TUG, OLST	11
Han 2008	RCT	24 (12,12)	74.9	100	RE	8	3	24	60	20–30	12–14	Usual care	TUG, OLST	10
Haseqawa 2014	NRCT	52 (32,20)	72.3	59.6	RE	9	3	27	90	12	13–17	SE	TUG	10
Hwang 2013	NRCT	22 (11,11)	78.8	NR	RE	12	3	36	60	8–36	11–16	Usual care	FRT, OLST	8
Kang 2011	NRCT	20 (10,10)	77.6	100	PNF+RE	6	3	18	30	15	NR	PNF	FRT, TUG	9
Kim 2008	RCT	30 (15,15)	75.6	NR	RE	9	3	27	50	36	NR	Usual care	FRT, TUG, OLST	11
Kim 2012	RCT	16 (8,8)	72.6	62.5	RE	9	3	27	40	30	13-14	Usual care	FRT, TUG	10
Kim 2013	NRCT	22 (11,11)	70.4	100	RE+SE	12	3	36	50	30	NR	SE	TUG, OLST	9
Kim 2014	NRCT	28 (14,14)	75.8	74.1	RE	8	2	16	50	30	NR	Fall education	FRT, TUG, OLST	10
Kyung 2014	NRCT	24 (12,12)	65.1	100	RE	8	3	18	60	45	12–14	Usual care	OLST	8
Lee 2009	NRCT	24 (12,12)	70.5	100	RE	8	3	24	50	20–30	12–14	Usual care	FRT, TUG, OLST	11
Lee 2014	RCT	20 (10,10)	69.0	NR	RE	8	2	16	30	20	NR	Usual care	FRT	10
Lee 2015	RCT	20 (10,10)	73.5	100	RE	8	4	24	40	15	11-13	Usual care	OLST	9
No 2013	NRCT	16 (8,8)	67.1	100	RE	12	3	36	50	NR	NR	Usual care	FRT	9
Park 2009	NRCT	22 (11,11)	73.3	100	RE	8	3	24	50	45	NR	Usual care	OLST	10
Skeleton 1995	RCT	40 (20,20)	79.5	100	RE	12	1	12	60	8	NR	Usual care	FRT	11
Yoo 2014	NRCT	30 (15,15)	≥80	NR	RE	12	2	24	60	24–48	NR	Usual care	FRT, TUG	8
Yu 2013	RCT	24 (12,12)	65.3	41.6	RE+SE	5	3	15	NR	6	NR	SE	TUG	10

RCT: randomized controlled trials; NRCT: non-randomized controlled trials; NR: not reported; RE: resistance exercise; SE: stretch exercise; PNF: proprioceptive neuromuscular facilitation; RPE: rate of perceived exertion; FRT: Functional reach test; TUG: Timed up & go test; OLST: One leg standing test

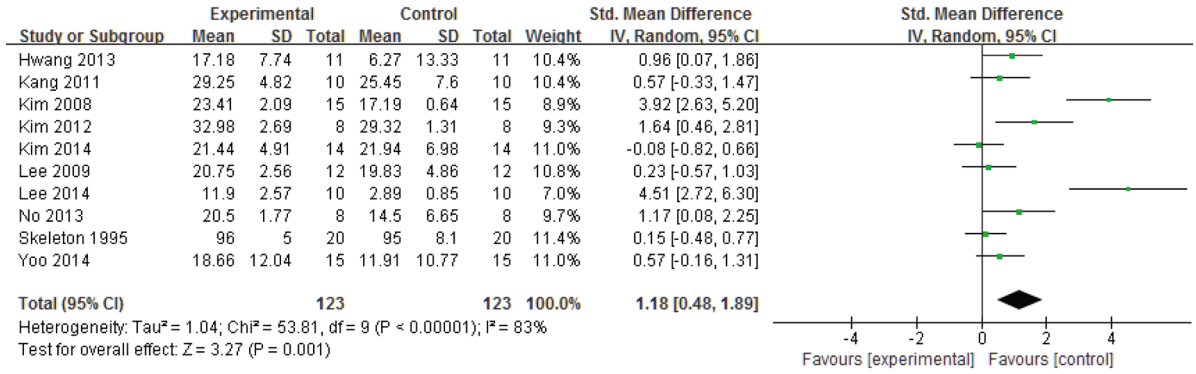

Fig. 2. Forest plot of FRT

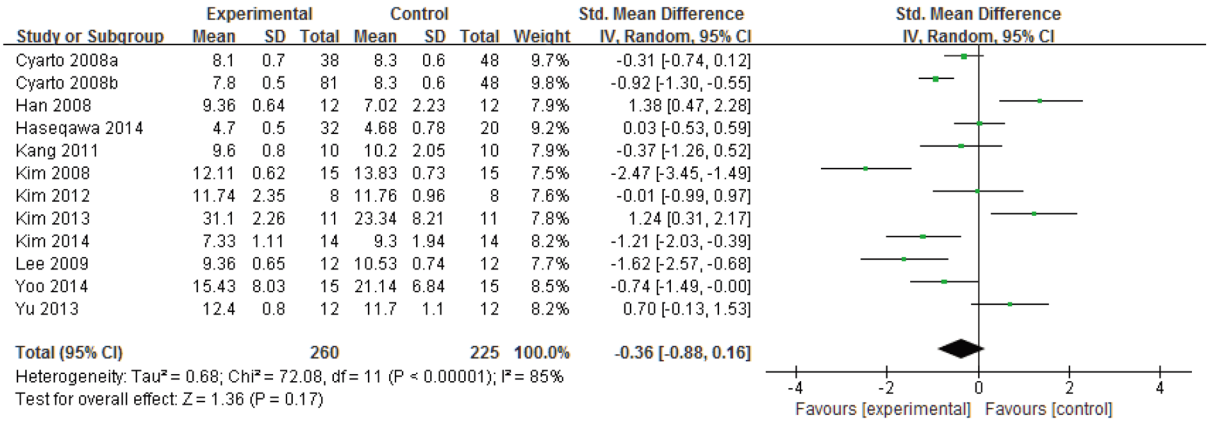

Fig. 3. Forest plot of TUG

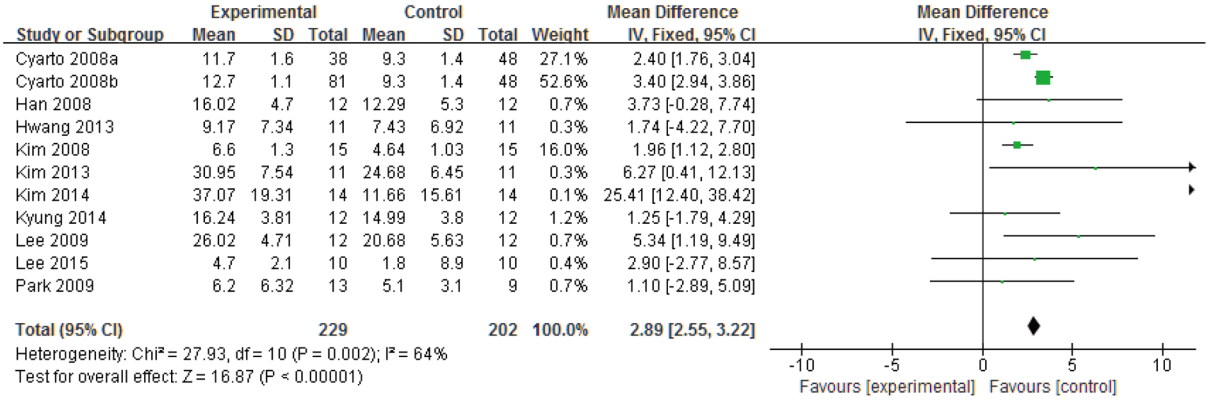

Fig. 4. Forest plot of OLST

the previous articles. Oh et al. reported that the muscle strength of the elderly improved by 9.8% to 23.5% after 18 weeks of elastic band resistance training[11]. Another study showed that the elastic band resistance exercise increased the muscle strength of the inactive, yet healthy, elderly people and frail elderly people by 3–17% and 6–18%, respectively[12]. Therefore, it is believed that the improved muscle strength due to the resistance exercise using elastic bands might have directly or indirectly influenced the improvement of the balance and flexibility of the elderly people. A systematic review for the effect of resistance exercise using elastic bands on the muscle strength of the elderly is also necessary.

According to the previous studies, the risk of a fall incident is higher in the group with less than 25.4 cm FRT, as compared to the group with greater than 25.4 cm[13], and OLST is a significant and easy-to-administer predictor of injurious falls[14]. Based on the results of this study, the resistance exercise using elastic bands need to be actively utilized in order to improve the FRT and OLST of the elderly people living in the community.

This is the first meta-analysis study to comprehensively determine the effect of resistance exercise using elastic bands in order to improve the balance and flexibility of the elderly people living in the community. Nevertheless, there are some limitations. First, long-term effect was not analyzed, since the sample size was small and the follow-up measure was not performed. After further studies are conducted in the future, it is deemed necessary to perform another systematic review. Second, fail safe numbers (FSN) that examines how many unpublished studies would have been needed to jeopardize the results was not calculated. Future research can utilize FSN or different statistical methods to consider publication bias.

ACKNOWLEDGEMENT

This study was supported by 2016 Research Grant from Kangwon National University (No. 620160144).

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