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, NANE, 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

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 year1). 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 complications2). 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 intervention3). 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 expert4). 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 controlled5).

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 ability6), and a study that evaluated the effect of physical activity intervention on their physical function7). 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
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, NANE, 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 I² 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 I², which represented heterogeneity, was 83% (Fig. 2). The effect size on TUG was −0.36 (95% CI −0.88 to 0.16), and I², which represented heterogeneity, was 85% (Fig. 3). The effect size on OLST was 2.89 (95% CI 2.55 to 3.22), and I², 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 performance¹⁰. 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
| First author and year | Study design | Total N (eN/cN) | Mean age | % of females | Type | Dur. week | N. of Ses. | Min | Repeated time | RPE | Comparisons | Scale | Total risk-of-bias score |
|-----------------------|--------------|----------------|-----------|--------------|------|-----------|------------|-----|---------------|-----|-------------|-------|-------------------------|
| 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      | RE           | RE   | 12        | 3          | 36  | 60            | 8–36 | 11–16 | Usual care | FRT, OLST | 9     |
| 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
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. 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. 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\(^1\), and OLST is a significant and easy-to-administer predictor of injurious falls\(^2\). 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.

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REFERENCES

1) Zijlstra GA, van Haastregt JC, van Eijk JT, et al.: Prevalence and correlates of fear of falling, and associated avoidance of activity in the general population of community-living older people. Age Ageing, 2007, 36: 304–309. [Medline] [CrossRef]
2) Public Health Agency of Canada: The facts: seniors and injury in Canada. http://www.phac-aspc.gc.ca/seniors-aines/publications/public/injury-blessure/safealive-secure/chap2-eng.php (Accessed Apr. 19, 2017)
3) Gillespie LD, Gillespie WJ, Robertson MC, et al.: Interventions for preventing falls in elderly people. Cochrane Database Syst Rev, 2001, 3: CD000340. [Medline]
4) Wessner B: An elastic band exercise programme improves functional fitness in older adults. Evid Based Nurs, 2016, 19: 64. [Medline] [CrossRef]
5) Patil P, Rao S: Effects of Thera-Band® elastic resistance-assisted gait training in stroke patients: a pilot study. Eur J Phys Rehabil Med, 2011, 47: 427–433. [Medline]
6) Thiebaud RS, Funk MD, Abe T: Home-based resistance training for older adults: a systematic review. Geriatr Gerontol Int, 2014, 14: 750–757. [Medline] [CrossRef]
7) Chase JD, Phillips LJ, Brown M: Physical activity intervention effects on physical function among community-dwelling older adults: a systematic review and meta-analysis. J Aging Phys Act, 2017, 25: 149–170. [Medline] [CrossRef]
8) Chou CH, Hwang CL, Wu YT: Effect of exercise on physical function, daily living activities, and quality of life in the frail older adults: a meta-analysis. Arch Phys Med Rehabil, 2012, 93: 237–244. [Medline]
9) de Vries NM, van Ravensberg CD, Hobbelen JS, et al.: Effects of physical exercise therapy on mobility, physical functioning, physical activity and quality of life in community-dwelling older adults with impaired mobility, physical disability and/or multi-morbidity: a meta-analysis. Ageing Res Rev, 2012, 11: 136–149. [Medline] [CrossRef]
10) Howe TE, Rochester L, Neil F, et al.: Exercise for improving balance in older people. Cochrane Database Syst Rev, 2011, 11: CD004963. [Medline] [CrossRef]
11) Oh SL, Kim HJ, Woo S, et al.: Effects of an integrated health education and elastic band resistance training program on physical function and muscle strength in community-dwelling elderly women: Healthy Aging and Happy Aging II study. Geriatr Gerontol Int, 2017, 17: 825–833. [Medline] [CrossRef]
12) Krebs DE, Jette AM, Assmann SF: Moderate exercise improves gait stability in disabled elders. Arch Phys Med Rehabil, 1998, 79: 1489–1495. [Medline] [CrossRef]
13) Behman AE, Light KE, Flynn SM, et al.: Is the functional reach test useful for identifying falls risk among individuals with Parkinson’s disease? Arch Phys Med Rehabil, 2002, 83: 538–542. [Medline] [CrossRef]
14) Vellas BJ, Wayne SJ, Romero L, et al.: One-leg balance is an important predictor of injurious falls in older persons. J Am Geriatr Soc, 1997, 45: 735–738. [Medline] [CrossRef]