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**Title**

Effect of vibration on postural control and gait of elderly subjects: a systematic review

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**Summary**

Gait and balance disorders are common in the elderly populations, and their prevalence increases with age. This systematic review was performed to summarize the current evidence for sub-threshold vibration interventions on postural control and gait in elderly.

**Introduction/ basics**

A recent technology that has developed over the last few years is based on sensory improvements that can be achieved by applying subsensory stimuli to sensory afferents . The presence of subsensory mechanical noise under the soles of the feet significantly reduces postural sway via Stochastic Resonance (SR). SR has been identified by Collins et al. as a mechanism improving signal detection and transmission of information emerging from the tactile sensors when noise is added to the system. Well et al. (1996) showed that random vibration enhances the detection of weak touch when added to the foot soles. Insoles or footwear can be used for the application of a subsensory mechanical noise signal to the soles of the feet. Some studies investigated to enhance plantar-surface somatosensation feedback are the use of a somatosensory enhancing insole .

**Material method; implementation/ process**

A review of intervention studies including the following words in the title/abstract: insole, foot and ankle appliances, vibration, noise and elderly related to balance and gait. Databases searched included PubMed, ISI Web of Knowledge, Ovid, Scopus, and Google Scholar. 15 articles were selected for final evaluation. The procedure was followed using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses method.

Study Selection

Studies were eligible for inclusion in this review if the following information was in the title or abstract: (1) participants were older subjects (healthy elderly, stroke and diabetic subjects); (2) the intervention included vibratory insoles, footwear, vibration, noise and stochastic resonance; (3) any outcome measure of balance and gait. The full text version of all studies were obtained, checked once more against the inclusion criteria, and then assessed for method quality.

## Results

The following text summarizes the results demonstrated by studies investigating the effects of vibration stimuli (mechanical noise) on balance and gait of elderly people. Outcome measures were postural sway, including Center of Pressure (CoP) excursion and velocity, standardized clinical or laboratory patient-based measure of balance such as Timed Up and Go (TUG), Functional Reach (FR), One Leg Standing (OLS) and gait variables such as walking speed/velocity, stance time, step width and length and cadence.

There was reduction in center of pressure (CoP) velocity and displacement especially with eyes-closed by using vibration in healthy elderly subjects and this effect was greater in elderly faller and patients with more balance deficiency. Vibration programme training increased speed of walking, cadence, step time and length in stroke subjects. The vibratory insoles significantly improved performance on the Timed Up and Go and Functional Reach tests in older people.

## Discussion/ conclusion; conclusion for the practice

The purpose of this review was to evaluate the effects of vibration stimulus on balance control and walking in elderly subjects. This review showed that input noise could enhance balance control in healthy elderly people as well as in patients with central or peripheral nerve damage due to stroke or diabetes. However, there was controversy about effectiveness of subsensory vibration on gait parameters of elderly subjects.

### Suggestion for future studies

- It will be interesting to examine effect of vibratory devices in other patient populations, such as patients with multiple sclerosis or Parkinson's disease
- Long-term studies are needed to establish the clinical value of the stochastic resonance on balance and falling rate.

- It is suggested to design anatomical shoe with vibration mechanism (instead of insole or sandal) that practical in activity daily living of elderly subjects.

Conclusion: Vibration was effective on balance improvement in elderly subject especially elderly with more balance deficiency and it can improve gait parameters in patients with greater baseline variability. Noise based devices and vibratory insole or footwear could ameliorate age-related impairment. Use of vibration reduces CoP velocity and displacement in hence improve balance. Vibrating footwear can increase speed of walking, cadence, step time and length in stroke subjects. However, long-term studies to show clinical value of this technique are needed.

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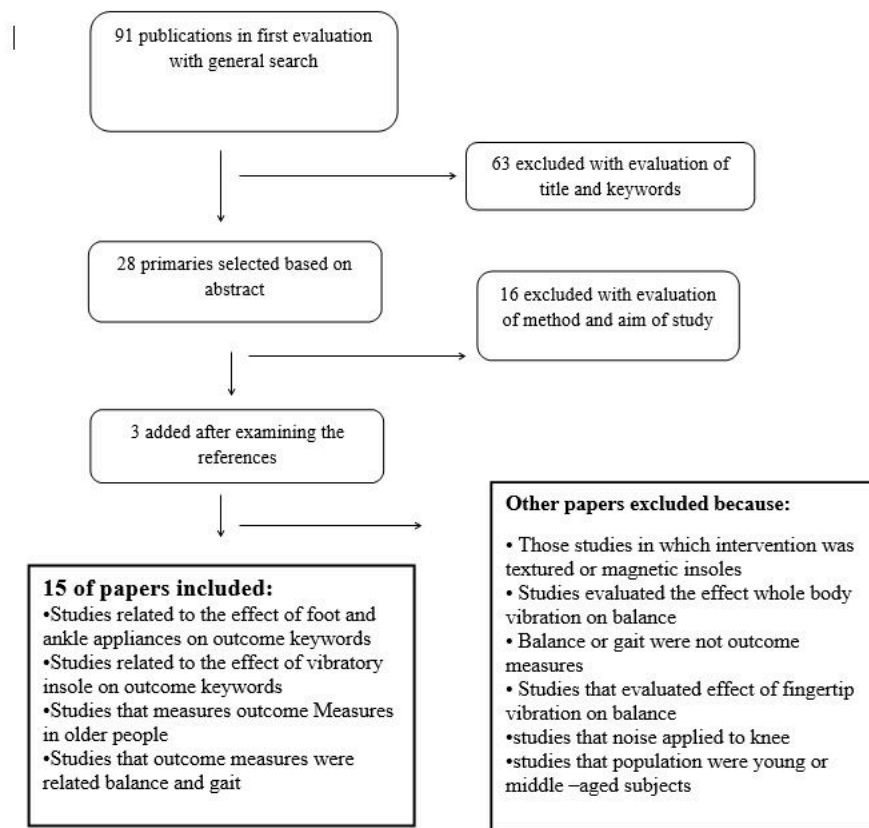


Figure1. The procedure was followed using the PRISMA flowchart