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Does Spinal Mobility Influence Balance in the Elderly?

Mini review

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Abstract

Falls among the elderly are a major public health concern, with impaired balance being a key contributor. While the decline in muscle strength and cardiopulmonary capacity is well-established as a factor in falls, the role of spinal flexibility in maintaining balance is less understood. This study aims to investigate whether spinal mobility influences balance in individuals over 65 years old, addressing a gap in current research. A systematic review of seven studies indicates a significant correlation between reduced spinal mobility, particularly in the lumbar region, and impaired balance. Strengthening spinal muscles and improving flexibility may play a critical role in preventing falls among the elderly.

Introduction

As populations age, there is an increase in age-related health concerns, particularly falls, which affect nearly 40% of individuals over 65 years of age. Falls can lead to severe injuries, including fractures, disability, and decreased quality of life. While the loss of muscle strength and cardiovascular function are recognized risk factors, the contribution of spinal flexibility to functional tasks such as balance and gait remains under-researched. This article aims to explore whether spinal mobility plays a significant role in balance among the elderly, as aging leads to spinal degeneration, reduced intervertebral disc hydration, and muscular atrophy, all of which may impair balance control.

Methods

A systematic literature review was performed following the PICOS (Population, Intervention, Comparison, Outcome, Study design) criteria. Databases such as PubMed, PEDro, and Embase were searched for studies published until August 2024. Studies were included if they involved individuals aged 65 or older, assessed spinal mobility, and measured balance through either static (e.g., stabilometry) or dynamic (e.g., Timed Up and Go test) tests. Articles were excluded if they focused on pathologies like scoliosis or Parkinson's disease or involved surgical interventions. Quality was assessed using the PEDro scale for randomized controlled trials, the ROBIN-I tool for non-randomized studies, and the AXIS tool for cross-sectional studies. The Newcastle-Ottawa Scale (NOS) was used for cohort studies. A total of 7 studies were selected, with sample sizes ranging from 24 to 620 participants, aged 63 to 91.

Results

The seven studies included 1,307 participants in total, assessing a variety of balance measures and spinal mobility. Four studies used radiographic analysis of spinal angles, while others employed tools like SpinalMouse® and MediMouse® to assess flexibility. Balance was measured using stabilometry, Functional Reach Test (FRT), and dynamic tests like the Timed Up and Go (TUG) test.

Quality Assessment

The overall quality of the studies was mixed, with most studies rated as having moderate to low methodological quality.

Cross-sectional studies: five of the seven studies were cross-sectional, and their quality was assessed using the AXIS tool. Common weaknesses identified were:

1. Selection Bias: Several studies did not adequately describe the selection process or provide justification for the sample size, raising concerns about the representativeness of the population.

2. Measurement Bias: Instruments used to assess spinal mobility and balance were inconsistently validated across studies.

3. Non-response bias: Most studies failed to account for non-responders or non-participants, which could affect the generalizability of the results.

Cohort study: One cohort study (Imagama et al. 2013) was assessed using the NOS. It received a moderate score of 5 out of 8 stars, los-

ing points for selection bias (insufficient description of the comparison group) and bias in outcome assessment (relying on self-reported measures without independent verification).

Risk of bias: The ROBIN-I tool used for non-randomized studies revealed that study was vulnerable to bias due to lack of blinding and inadequate adjustment for confounding factors. study did not account for variables such as physical activity level or pre-existing musculoskeletal conditions, which could impact both spinal mobility and balance.

Spinal Flexibility

Multiple studies reported that reduced lumbar spine flexibility, particularly in extension and lateral flexion, significantly correlated with poor balance performance. [1] found a positive correlation between lumbar flexion and improved FRT results, while [2]demonstrated that individuals with greater lumbar mobility exhibited better postural control.

Balance Impairment

[2] reported that elderly fallers had significantly less spinal mobility and back extensor strength compared to non-fallers. Additionally [3] showed that thoracolumbar misalignment and diminished lumbar lordosis were associated with impaired balance and increased fall risk.

Muscle Strength

Reduced extensor muscle strength was also identified as a contributing factor to balance issues[4]linked back muscle strength to balance, suggesting that weakened paravertebral muscles limit postural compensations, thus increasing fall risk[5]confirmed that loss of spinal muscle strength after the age of 65 was a more critical factor in balance deficits than age alone.

Discussion

The reviewed studies suggest a clear association between spinal mobility and balance, particularly in the lumbar region. Reduced flexibility, combined with weakening of spinal extensors, limits the elderly's ability to maintain postural stability, increasing their risk of falls. The lumbar spine's role is crucial, as its flexibility is essential for dynamic tasks like walking and transitioning between positions (e.g., sitting to standing).

Importantly, muscle strength in the back and trunk also plays a role. Sinaki et al. (cited by Kasukawa) showed that reduced extensor strength increases fall risk due to the inability to compensate for spinal misalignments. Gender differences were observed, with women, who are more prone to osteoporosis and kyphotic posture, experiencing greater balance impairments due to reduced back extensor strength and more pronounced spinal deformities[6,7].

Conclusion

This review highlights the importance of spinal flexibility and muscle strength in maintaining balance in the elderly. Specifically, lumbar spine mobility plays a significant role in dynamic balanceand reduced spinal extensor strength exacerbates balance issues. Interventions aimed at improving spinal flexibility and strengthening back muscles could be key strategies in fall prevention for older adults.

Further research, particularly randomized controlled trials, is needed to confirm whether improving spinal flexibility directly enhances balance and reduces fall risk in the elderly.

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