

# Variations in Muscle Strategies for Mitigating Fall Risk in Postmenopausal Women with Osteoporosis during Head/Knee-Level Tasks

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## Abstract

The reaching-transporting task as an essential daily activity impacts balance control and falling in older women. This study investigated the different muscle strategies during the head/knee level of the functional reaching-transporting task in postmenopausal women with osteoporosis. Osteoporotic women have more muscle activities during the reaching-transporting task, especially at the knee level, compared to the head level. Their muscle weakness may lead to insufficient stability during the task and cause disturbance and falling, which requires further investigation.

## Introduction

Osteoporosis is characterized by micro architectural deterioration of bone tissues and bone mass loss, leading to bone fragility and susceptibility to fracture. Fractures are more common in women than men, related to lower bone mass and less competing mortality, primarily in postmenopausal women, due to the osteoporosis associated with estrogen deficiency. It was reported that, for women over 50 years, the lifetime risk of a fracture due to osteoporosis is 50%. Fractures, as serious, costly events, result in disability and mortality; therefore, the study of fracture-related parameters to screen women at risk for fractures has been considered for a long time. Falling is reported as the leading cause of eighty percent of all non-spine fractures and over ninety percent of hip fractures in older adults. In this regard, postural stability has been proposed as an essential factor for functional independence in older adults, and impaired postural control is a major risk factor for falls.

Postural control is different in individuals with osteoporosis than in general older individuals. Individuals with osteoporosis are more likely to present higher sway velocities and a higher number of falls. Furthermore, the fear of falling is common in women with osteoporosis-related to the knowledge of being at risk for falls and fractures, which may lead to restricted activity levels and an increased risk of falls. A study of community-dwelling older adults found that a substantial proportion of falls occurred during tasks such as carrying an object, reaching, or leaning. Such actions as lean and reach, bending, stooping, and high reach tasks reportedly account for a substantial proportion of activities of daily living (ADL) in community-dwelling older adults [1]. These activities require shifting the center of gravity (CoG) within the base of support (BoS). Once the CoG moves outside the BoS, the stability limits for the currently executed balance strategy are exceeded. If the appropriate motor strategy is not implemented, the individual may stumble or fall in an attempt to regain balance. Also, incorrect weight transfer and stability control during these voluntary movements have been reported as a possible cause of falling and fractures in older adults. Osteoporotic people with bone fragility are probably at greater risk of fractures due to falling contributed to such incorrect strategies, especially while performing high-risk tasks based on evidence, such as reach-lean-bending and stooping tasks.

Older adults use unique balance strategies related to postural instability during ADL, such as more reliance on hip strategy and increased muscle coactivation that affect static and dynamic postural control ability. The reaching-transporting task as an essential component of daily activities can challenge the balance control of these people due to the production of joint torque and changes in posture

[2]. Recording the activity of leg muscles, which may have a crucial role in maintaining the upright posture and consequently controlling the center of pressure (CoP) within BoS, may determine the muscle contracting strategies during FR and transporting tasks in people with osteoporosis.

We proposed bone mineral density (BMD) and level of reaching interact with the EMG activity of two paired agonist-antagonist groups composed of vastus lateralis (VL)- biceps femoris (BF) and tibialis anterior (TA)- gastrocnemius lateralis (GL), during the execution of the FR and transport task.

## Material and Methods

### Muscle activation patterns:

EMG data were analyzed to determine variations in muscle activation patterns during task performance. Specifically, researchers looked for differences in muscle recruitment and timing among participants.

**Joint kinematics:** Motion analysis data were used to assess joint kinematics, including joint angles, range of motion, and movement speed during the tasks.

**Statistical analysis:** Statistical software was employed to analyze the collected data. Descriptive statistics, such as means and standard deviations, were calculated for muscle activity and joint kinematic variables. Inferential statistics, including t-tests and correlation analyses, were used to identify significant differences and relationships between variables.

**Ethical considerations:** The study was conducted in accordance with ethical guidelines, and all participants provided informed consent before participating. Ethical approval was obtained from the institutional review board.

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## Discussion

The main role of this study was to explore the connection of BMD status and the degree of coming to shipping errands (head/knee) on leg muscle exercises [3-5]. Additionally, we surveyed FES and MVIC in light of their significance in postural control. It tends to be useful to know this relationship for recommending restoration practices and the ergonomic plan of the home climate for osteoporotic ladies in danger of postural precariousness, falling, and cracks. In the arriving at stage, our outcomes showed that the PRMS and TPRMS were by and large more noteworthy in the leg muscles of the osteoporotic people no matter what the arriving at level. Besides, as per the Melancholy examination, the movement of the VL in the arriving at stage was essentially connected with the BMD condition; the PRMS was higher in osteoporotic members at both arriving at levels. Our findings confirmed that women with osteoporosis have significantly weaker leg muscles. What's more, the osteoporotic ladies announced higher anxiety toward falling scores than non-osteoporotic ladies. As indicated by Nagai et al., apprehension about falling is related with expanded muscle coactivation during strolling [6,7]. Thus, moderate solidifying procedures, for example, strong coactivation, the higher interior focal point of consideration, further engine unit enrollment to give required force by powerless muscles, decrease of the scope of movement and joint precise speeds, and increasingly slow deliberate developments presumably connected with the higher apprehension about fall in the more established grown-ups.

## Conclusion

Compared to age-matched non-osteoporotic individuals, osteoporotic individuals had higher PRMS values recorded during reaching and transporting of objects at the head and knee levels. It might add to the coactivation technique used by osteoporotic ladies because of the shortcoming of the muscles and the higher apprehension about falling. An expansion in PRMS and diminished TPRMS values at the knee level undertaking may be related with selecting the bigger quicker

engine units to give higher extensor minutes expected to expand the lower furthest point for shipping errands. The prevention rehabilitation program and ergonomic considerations for the arrangement of household items can benefit from these findings. Having data about the more steady circumstance of coming to moving errands and careful procedures through expanding the leg muscle movement might be useful to more readily plan family courses of action. For example, putting shelves and other household items at the right height might be a safe and ergonomic way to keep osteoporotic women from falling, but more research is needed to confirm this. Standing weight move preparing at various levels and during utilitarian action is prescribed for osteoporotic ladies to diminish the gamble of falling.

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