

The Complete Guide to Balance Training - Part 3 of 5

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Interventions to Reduce Fall Risk

In April 2018, the U.S. Preventive Services Task Force released a comprehensive report in the Journal of the American Medical Association on the effectiveness of interventions to prevent falls in community-dwelling older adults. They studied a number of approaches that have been employed with the goal of reducing falls and falls risk, including behavior change interventions, nutritional supplementation, vision and vestibular checkups, medication management, home hazard reduction, and exercise interventions. The findings concluded that physical functioning was a necessity for falls avoidance and that exercise moves the needle the most of all intervention types, reducing falls occurrence by 11% in an analysis of 15 large research studies consisting of almost 5,000 older subjects (18).

In people without osteoporosis or vitamin D deficiency, the report found no evidence to support the use of vitamin D and calcium supplementation to reduce falls and warned that there may be risks posed by such supplementation due to the potential for kidney stones and/or calcification in the blood vessels. Multifactorial programs that blend a number of the different intervention strategies were deemed to be most effective when exercise is part of the intervention strategy (4,6). The list below provides common components of a multifactorial falls prevention program:

- **Behavior Change:** Suggestions on how to increase motivation to reduce falls risk. Common strategies include education on falls

statistics and contributing factors to falls along with success stories of falls risk reduction programs and tips to increase balance confidence. See the National Council on Aging's list of peer support programs [here](https://www.ncoa.org/article/evidence-based-falls-prevention-programs):

<https://www.ncoa.org/article/evidence-based-falls-prevention-programs>

- Home Hazard Reductions: Many older people's living spaces are poorly adapted to reduce falls risk. Installation of grab bars in the tub/bathroom, improved lighting, removal of unstable floor surfaces (e.g., throw rugs), movement of furniture to safer locations, and reduction of clutter are all good ideas. Home hazard inspections are often available at no charge through community non-profit organizations. Check out USC's Fall Prevention Center of Excellence's online resource for options in your area:

<https://homemods.org>

- Medication Management: Many older adults are overmedicated and this increases risk for falls. Psychotropic medications that treat anxiety/depression are related to increased risk for falls, as are several types of blood pressure medications. A pharmacist or primary care physician can assess whether current medications may increase falls risk and suggest alternatives. The STOPP-START Criteria provide guidance on medications shown to be problematic for older adults and should be consulted to ensure that falls risk is as low as possible.

Information can be found [here](https://www.pcne.org/upload/ms2011d/Presentations/Ryan%20pres.pdf):

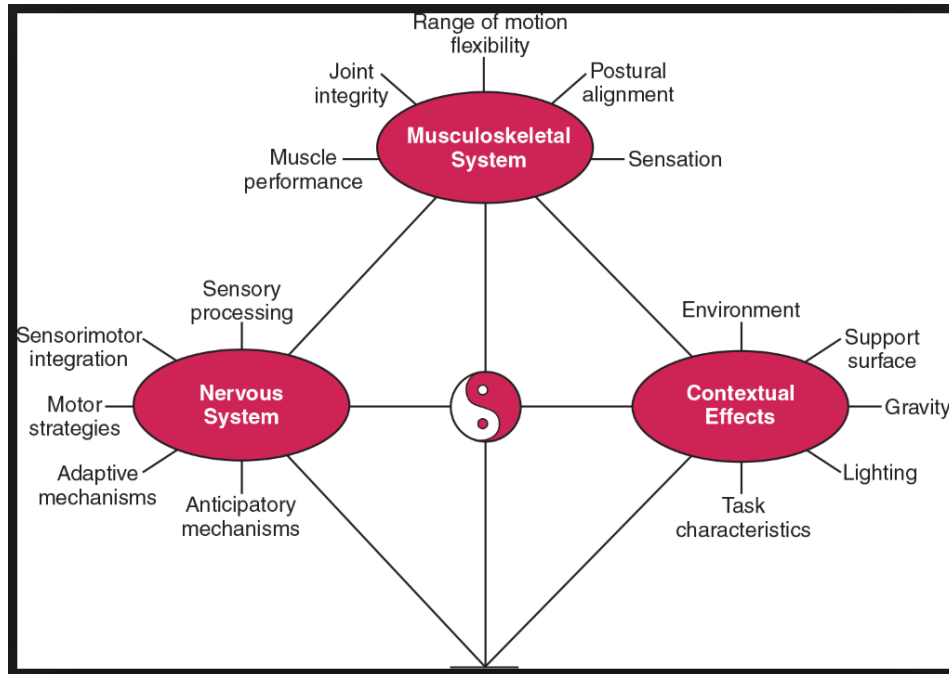
<https://www.pcne.org/upload/ms2011d/Presentations/Ryan%20pres.pdf>

[f](https://www.pcne.org/upload/ms2011d/Presentations/Ryan%20pres.pdf)

- Sensory System Checkups: Changes to vision with age can occur rapidly. An annual checkup with an optometrist is recommended. Also, reductions in hearing increases the risk for falls, an appointment with an audiologist can detect hearing & vestibular impairments that increase falls risk.
- Exercise: This must be the centerpiece of any falls risk reduction program. Exercise can improve stability, balance, lower body strength, and gait; all of which are implicated in falls risk.

Exercise Interventions to Train Balance and Reduce Falls Risk

A substantial number of falls (over 40%) have been determined to be avoidable by engaging in regular physical activity and exercise (4). It takes time, though, for exercise to reduce falls. Sherrington (19) reported that at least 50 hours of exercise training are needed to be completed in order to see a reduction in falls occurrence. However, the selection of the correct exercise components is not simple because the concept of balance itself is not simple as can be seen by the graphic below.



Achieving balance requires different capabilities in different situations. This is because balance can be defined as the ability for the body maintain postural control which is determined by the relationship between Center Of Pressure (i.e., the location on the ground that reflects the body's center of mass) and Base Of Support (the contact points between the body and the ground). At its endpoints, we find what is known as Limits of Stability – the point beyond which the body must move off its base and reestablish it elsewhere in order to maintain postural control (20). In activities where the body must stay stationary, we need to express what is known as Static Balance. In activities where the body is in motion, we must express what is known as dynamic balance. Therefore, the next logical question is: what programmatic elements should be included in a training program for balance and fall risk reduction?

A comprehensive review of the research in this area has indicated that the mode of exercise is an important consideration when addressing falls risk (21). The most effective types of exercise are individual training or group-based classes that include challenging static and dynamic balance, improving the flexibility and stability of joint motions (i.e., joint mobility), gait enhancement exercises, and lower body muscle strength and power training components (22). Sensorimotor exercises are also important due to the deficits that typically occur in the vestibular and somatosensory systems with age. Cardiovascular training programs alone have not shown to be effective at improving balance measures or reducing falls, but such programs (e.g., walking or aquatic exercise) can be an excellent complement to balance training programs for overall physical functioning (4).

Key points when designing an exercise program to reduce falls risk for an older client/patient:

- If someone is falling regularly (i.e., more than 1 fall per month), the person should be referred out for evaluation by a physician or health care professional to identify underlying conditions/pathologies that need to be medically treated.
- The exercises chosen for the program should be chosen from the results of physical assessments.
- The program should include a combination of exercises for joint mobility and stability, sensory stimulation, muscle strength and power, static balance, dynamic balance, and gait enhancement.
- The exercise program should include exercises that are challenging but not dangerous. Easy exercises will not result in any improvement

in fitness, whereas overly challenging exercises could cause an unwanted injury or fall to occur.

- Progression of program components/exercises are likely to occur at different rates, so frequent re-assessment is essential to properly progress the exercise program as a whole.
- The exercise program should include at-home exercises to supplement the training program, particularly for exercises that do not need extensive recovery time.

Fall Prevention Exercise Program Elements

As stated previously, fall risk is strongly related to overall physical function. These specific physical factors have been shown to work together to reduce fall risk: Joint Mobility (both range of motion and stability), Sensory Function, Muscle Strength and Muscle Power, Static Balance, Dynamic Balance and Gait. Think of each of these factors as parts of an interconnected chain. If one factor is ignored by exercise programming, it will be the weakest link and the entire chain will eventually fail. Below is a description of each exercise domain:

Joint Mobility – this term refers to the ability for the joints of the body to move in all planes of motion and also to be stable throughout the range of motion. From a fall prevention perspective, the ankle and the hip joints are essential for balance maintenance and risk reduction because they function to make postural adjustments when the body's center of gravity is shifted (23). Both open chain (feet off the ground) and closed chain (feet on the ground) exercises can help to enhance joint mobility. Open chain exercises

are particularly helpful in enhancing the neural drive from the brain to the muscles that stabilize the joint and also loosens the soft tissue structures that increase joint motion. Closed chain exercises provide a gravitational challenge to the joints of the body, requiring them to maintain stability throughout the range of motion (24).

Sensory Stimulation - as described earlier, the integration of vision, vestibular function, and somatosensory function is essential in the maintenance of balance and prevention of falls. Although humans primarily rely on vision to maintain balance, problems with vestibular or somatosensory function can be devastating as evidenced by the correlation between vertigo (vestibular dysfunction), peripheral neuropathy (somatosensory dysfunction), and falls occurrence (6,9). Training the vestibular system by head motions during movement or static challenges has been shown to improve the integration of the body's balance control mechanisms and reduce fall risk (25). Additionally, visual tracking training has shown to be valuable in a similar fashion (26). And, improving joint mobility in the ankle, knee, hip, and spine can improve sensory information coming into the central nervous system through joint mechanoreceptors and soft tissue receptors. This improves the function of the somatosensory system and results in better resultant movement strategies that maintain balance (10).

Muscle Strength & Power – this is an essential part of any older adult's training program. It was shown in classic research studies that heavy resistance training can increase both force production (i.e., maximal strength) and muscle mass (27,28). A focus on both concentric and

eccentric strength training is recommended because older adults need to both produce force (concentric) and also control the effects of gravitational force (eccentric). Additionally, muscle power training has been shown to increase rate of force development and that has a significant effect on lowering falls occurrence (29). A stumble or trip accelerates the body toward the ground, and muscle power and eccentric control is necessary to stop that process and avoid a fall.

Static Balance – this is the ability to maintain a stationary lower body stance, which can be challenged by a limited base of support, an unstable surface, and/or movement of the upper body. A common exercise for static balance is standing on one leg without moving, however falls almost always are in response to movement. So static balance is more effectively trained by moving the body while being challenged to maintain a stationary stance. Research has shown that sport performance is not improved through training in a proprioceptively enriched environment because the speed at which sensorimotor integration occurs takes longer than high velocity sports movements (30). However, when enriched environments contribute to slower velocity movement challenges, static balance can be improved through enhancements to postural control and neuromuscular efficiency.

Dynamic Balance – this is expressed in the ability to maintain balance during movement or immediately following movement. Movement can either be planned or unplanned, such as when someone trips or is bumped into by someone else. Planned movements, such as walking or changing direction, can take many different forms and therefore need to be trained with different movement patterns (15,17,31). Unplanned perturbations

require the body to react quickly and implement a recovery strategy to regain balance. Muscle power is therefore an important aspect of dynamic balance training as well (11,12,14).

Gait Enhancement – gait itself requires most of these other exercise domains due to the number of processes involved with ambulation. For example, the stance phase of the gait cycle involves balance while the swing phase involves muscle power, yet the both are happening at the same time bilaterally (17). Challenges in environmental conditions, such as busy sidewalks or uneven surfaces, require gait strategies to be changed and expanded for use when necessary. Additionally, the cognitive aspect of gait (i.e., planning, dividing attention...etc.) can further challenge the older adult (16). Gait enhancement training therefore can be achieved by practicing different walking directions, speeds, and stepping lengths and dual-task cognitive challenges, such as mathematics or memory tasks can be employed while exercising