

Aging, Fall Risk, and Prevention Through Exercise

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Objectives



1. Describe the body systems and age-related changes (visual, proprioceptive, vestibular, nervous, musculoskeletal)
2. Review intrinsic and extrinsic fall risks
3. State 5 items to assess during a home environmental safety check
4. Understand the role of physical therapy in assessment of balance
5. Describe a comprehensive exercise program (both individualized and standardized programs) to improve balance and decrease falls.

CSM Fall Definition



- Sudden, unexpected change in position-often landing on floor. Other definitions mention coming to rest on a lower surface
- An intercepted fall – someone catching you is still a fall
- A fall without an injury is still a fall
- Height of fall is not a factor in the fall definition

Fall Statistics



- More than 1/3 of adults 65 and older fall each year in the United States.
- Falls are the **second leading cause of injury deaths** in Iowa and leading cause for those over 65.
- Every hour, there are 2 deaths and 251 emergency department visits for falls-related injuries among older adults.
- 20% to 30% of people who fall suffer moderate-to-severe injuries such as bruises, hip fractures, or head traumas.
- Only 50% of those with a fall injury can live independently- 40% of nursing home admissions related to a fall
- Falls are the leading cause of injury hospitalizations and emergency visits in **Iowa costing \$92 million** annually.
 - National cost by 2020 projected to be \$54.9 billion.

Good News



- Injuries from falls are largely a **preventable** community health problem.
- **Fall prevention programs** for high risk older adults have a **net-cost savings of almost \$9** for each \$1 invested.



System Changes: Vestibular



- Vestibular- peripheral and central
- Information from peripheral system transmitted to vestibular nucleus and cerebellum
 - Decrease in hair cells to transmit motion information for processing
 - Degeneration of vestibular nuclear system
 - Pathologies common in older adults: BPPV, Meniere's, bilateral vestibular dysfunction

System Changes: Sensory (cont.)



- Tactile
 - Decrease proprioceptive and cutaneous receptors
 - Increased threshold for firing which delays processing and reaction
- Visual
 - Decrease in lens elasticity and pupil reactivity
 - Leads to decrease in dark adaptation, and depth perception
 - Pathologies- cataracts, glaucoma macular degenerations, diabetes, etc.

System Changes: Musculoskeletal



- Decrease in bone density
- Decrease in range of motion/flexibility
- Muscle
 - Decrease in size of Type I muscle fibers (low force/power/speed and high endurance- ie postural muscles)
 - Decrease in Type II muscle fibers (fast twitch so high in force/power/speed and low endurance)
 - Decrease in strength due to increase in muscle fat and connective tissue and muscle atrophy (sarcopenia)

System Changes: Neuromuscular



- Decrease in number of nerve cells in brain and decreasing weight of brain
- Decrease in cognitive processing and attention span
- Decrease in speed of nerve impulse transmission which slows reaction time (also slowed due to decrease in muscle force production)
- Cardiac- decrease sensitivity of baroreceptors- postural hypotension

System Changes: Impact on Balance



- Vestibulo-ocular reflex impacted so difficulty with gaze stabilization during gait and function
- Vestibulo-spinal reflex provides activation of extensor muscles for postural control and is delayed
- Increase in proprioceptive stimulus to respond to positional changes. Increase in postural sway
- Delayed processing of loss of balance (physical and cognitive)
- Delayed reaction time to respond and decreased muscle forces and motion to self-correct for loss of balance
- Results in decreased equilibrium and righting reactions

Categorize Falls

Intrinsic Factors

- Previous falls- fear of falling
- Lower extremity weakness
- Gait & balance disorders
- Medical conditions: arthritis, diabetes
- Decline in vision
- Functional & cognitive impairment
- Depression
- Dizziness
- Low body mass index
- Urinary incontinence
- Female gender
- Over age of 80



Extrinsic Factors

- Taking over 4 prescription medications
- Stairs
- Clutter
- Wet surfaces
- Loose rugs/carpets
- Cords
- Poor lighting
- Hurrying/rushing

Fall Risk Assessment



Multidisciplinary Approach given wide array of intrinsic and extrinsic factors associated with falls.

Need to prioritize fall risks to determine sequence of referral/interventions. (visual, medications, depression, etc)

Physical Therapy focus



Fall Risk Screening

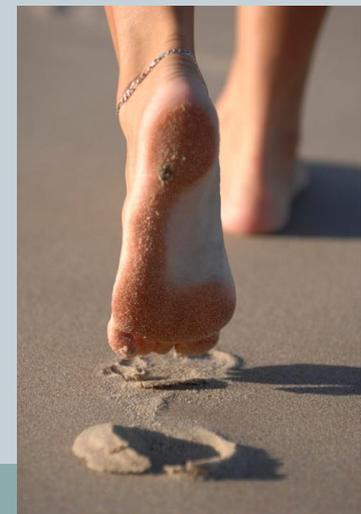


- American Geriatric Society (AGS) published clinical guidelines in 2001 and revised in 2011
- **Screen includes:**
 - Asking the pt if they have fallen in the last 12 months (Y/N)
 - Ask the pt if they are experiencing difficulty with walking or with their balance (Y/N)
 - Observe if walking or balance is compromised (Y/N) by Timed Up and Go test (TUG). Community dwelling older adults < 12 seconds. (Bischoff HA, 2003)
 - If one or more items are positive then a full comprehensive fall risk assessment should be done

Comprehensive Fall-Risk Assessment



- Community- medical review, medications, physical exam, gait/balance exam, home assessment, multidisciplinary
- Hospital- mental status, medications, toileting, 2nd diagnosis, gait/balance exam.
 - consider alarms, environmental modifications
- Additional- vision, HR/BP (orthostasis), foot wear.
- Gait measures suggested by AGS- Berg, POMA, DGI, TUG



What is the best practice to decrease fall-risk?



- Progressive exercise program that has **both** strengthening and balance activities.
 - Balance exercises alone can lower fall risk by 17-25%
 - Strength, stretching, and walking alone do not decrease fall risk.
- Also- frail individuals or those in residential or skilled care may have more falls if provided only with exercise. Probably due to medical complexity and multifactorial reasons for falls
- **Conclusion:** best practice is multi-factorial intervention delivered by multi-disciplinary team with exercise and balance as a part of the approach.

What do 'balance exercises' look like?



- Should be performed in stance, minimal UE support, and progressively challenging
- Balance Training- types
 - **Static activities**-center of mass (COM) moves while feet are stationary. Repetition and challenge more beneficial than duration of intervention. May progress by changing foot placement, surface, sensory cues such as closing eyes.
 - **Dynamic activities**- challenge balance while feet move. Usually functional tasks such as reaching, turning, stairs. Tai Chi
 - **Functional balance activities**- gait training, dual task either cognitive or physical
 - ✦ Dynamic gait training- dance steps, figure 8, obstacle courses, with dual tasks.

Successful Exercise Programs



- Have sufficient intensity to improve muscle strength
- Include dynamic balance activities
- Are regular and sustainable
- Can be done at home or at a center/clinic
- Can be group or individual program
- Are simple and low cost



What is the exercise dose for community dwelling older adults?



- Minimum of 50 hours over 3-6 months. (Best if > 10 weeks)
(Shubert, 2011)
- Interesting to note that individuals that begin a balance exercise program but do not reach the minimum hours may actually be at a higher risk for falling.
- Frequency of exercise ranges from 1-3x/week
- Seems best if exercise follows a standard routine (warm-up, balance, strength) and there is a systematic progression for all exercises



Samples of Exercise



- Walking program: do with concurrent balance training or falls may increase
- Perturbation and Compensatory Step training- inconclusive if training decreases number of falls but may result in improved reaction times and efficiency in recovering
- Yoga
- Tai Chi
- Aerobic exercise
- Bowling, dancing, gardening
- Otago Exercise Program



What are some EB exercise programs for balance?



- **Otago Exercise Program** (Yang XJ, 2012)
 - Home based
 - 17 exercises to be done TIW- add walking BIW- do for 1 year
 - 35% fall and injury reduction- highly effective for those > 80 years old
- **Stepping On**
 - Originally delivered by OTs in Australia
 - 7 sessions for 2 hours each over 2 months
 - Focus on adoption of safety strategies and behaviors
 - 31% fall reduction in community adults (Clemson 2004)
- **Tai Chi**
 - Tai Chi- reduce fall risk by 47.5%
 - Yang form with 24 positions
 - TIW for 6 months
 - Tai Chi for Arthritis (TCA)



Intervention for Older Adults



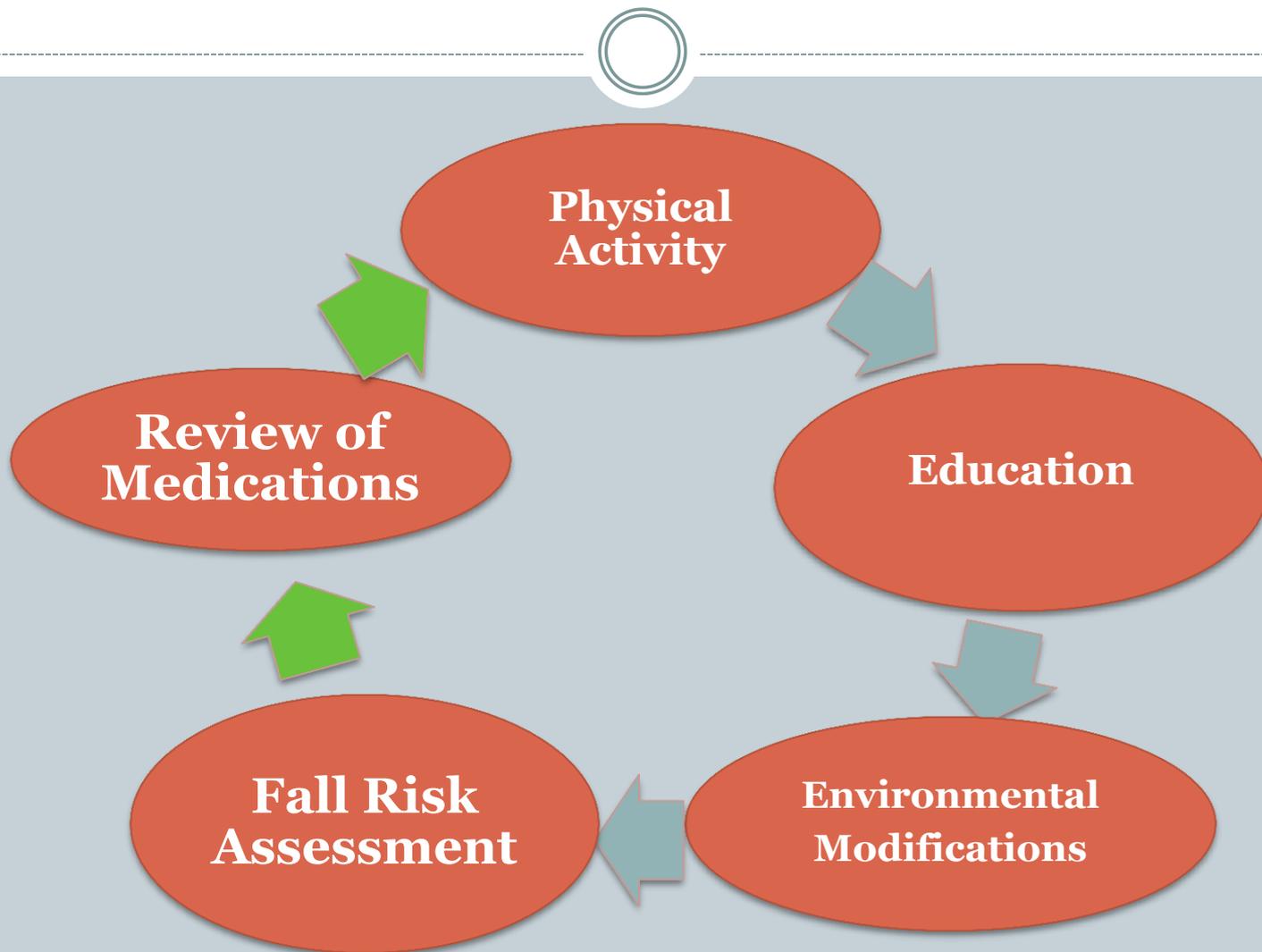
- Hip protector/pad- ‘fallers’ feel safer and more confident to be physically active (Cameron , 2000) Mixed evidence if less fractures with fall protectors. (Santesso N 2014)
- Use of vitamin D plus calcium decreases # of falls in long term care facilities
- Vibrating insoles improved lateral stability in older adults. (Priplata 2003)
- Grab bars, gait assistive devices
- All older adults as fall risk should be offered exercise program for balance, gait, and strength training (AGS clinical practice guidelines)
- Exercise alone not as effective as combined interventions due to multifactorial reasons for falls

Fall Prevention Guidelines



- Recurrent fallers should be offered long term exercise and balance training
- Evidence best to support balance training, less evidence for resistance and aerobic training.
- Interesting to note- QOL measures didn't improve with exercise

Takes a Team to Decrease Fall Risk



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Resources



The American Physical Therapy Association:

<http://www.moveforwardpt.com/>

Centers for Disease Control and Prevention:

[http://www.cdc.gov/HomeandRecreationalSafety/Falls/adultfalls.html/](http://www.cdc.gov/HomeandRecreationalSafety/Falls/adultfalls.html)

Center for Healthy Aging:

<http://www.healthyagingprograms.com/content.asp?sectionid=107>

National Council on Aging: <http://www.ncoa.org/>

References



- Cameron ID, Stafford B, Cumming RG, Birks C, Kurrle SE, Lockwood K, et al. Hip protectors improve fall self-efficacy. *Age Aging* 2000; 29(1):57-62
- Kinne B. Postural control and the aging process. *Gerinotes* 2014; 21(5):26-27
- Li F, Harmer P, Fisher KJ, McAuley E, Chaumeton N, Eckstrom E, Wilson NE. Tai chi and fall reductions in older adults: A randomized controlled trial. *J Gerontol A Biol Sci Med Sci*
- Province M, Hadley EC, Hornbrook MC. The effects of exercise on falls in elderly patients: A preplanned meta-analysis of the FICSIT trials? *JAMA* 1995; 273:1341-7.
- Santesso N, Hip protectors for preventing hip fractures in older people. *J Evid Based Med.* 2014;7(2): 149
- Shubert TE. Evidence-based exercise prescription for balance and falls prevention: a current review of literature. *J Geriatr Phys Ther* 2011;34 (3):100-108.
- Wolf SL, Barnhart HX, Kutner NG, McNeely E, Coogler C, Xu T. Reducing frailty and falls in older persons: An investigation of Tai Chi and computerized balance retraining. Atlanta FICSIT Group. *Frailty and Injuries: Cooperative Studies of Intervention Techniques.* *J Am Geriatr Soc* 1996; 44:489-497.
- Yang XJ, Hill K, Moore K, Williams S, Dowson L, Borschmann K, et al. Effectiveness of a targeted exercise intervention in reversing older people's mild balance dysfunction: a randomized controlled trial. *Phys Ther* 2012; 92(1): 24-37