Fall Risk and Exercise Training for Older Adults

What is a Fall?

"A person descending abruptly due to the force of gravity and striking a surface at the same or lower level."

CDC, 2010

Here are the facts

In 2019, over 8 million older American had a fall-related injury

- Resulting in more than 34,000 deaths (93 older adults per day)

More than 1 in 3-4 older adults (28%) fall each year

- Approximately 36 millions falls annually

Falls in older adults cost healthcare system approximately $50 billion dollars in 2015

- Medicare and Medicaid handle over 75% of these costs

Why Do Falls Occur?

- Most falls occur during routine activities
- Falls are multifactorial meaning:
  - Not caused by one issue
  - Combination of multiple things
- Falls are
  - Common
  - Predictable
  - Preventable, **AND**
  - **Not a normal part of aging!**

Causes & Risk Factors

- Environmental hazards
- Muscle weakness
- History of falls
- Gait deficit
- Balance deficit
- Visual deficit
- Vitamin D deficiency
- Arthritis
- Foot deformities or pain
- Depression
- Cognitive impairment
- Age > 80 years
- Medications
- Cardiovascular deficits

Bedrest and Inactivity

Overwhelming evidence that bedrest induces changes in body composition and skeletal muscle performance
(DiGirolamo et al., 2021)

- Metabolism disorder
- Loss of aerobic capacity
- Insulin resistance
- Fat infiltration
- Fibrosis
- Reduced neural activation

5 days of bedrest led to 14-16% reduction in knee extensor power

5-13% in general for older adults vs. 68% in nursing home residents

Musculoskeletal System - Sarcopenia

- Type of persistent muscle atrophy characterized by gradual loss of skeletal muscle mass and function
    - Frequently identified as hallmark sign of frailty
    - Risk of negative outcomes
- Typically refers to muscular cross-sectional area that is >2 SD below a young reference population mean
- Type II fibers affected greater than type I fibers
- Treatable, preventable

Age-related Changes in Static Posture

- Increased kyphosis in relaxed and erect posture
  (Gong et al., 2019; Hinman, 2004; Kuo et al., 2009; Singh et al., 2010)
  - Can lead to decreased cervical ROM
    (Quek et al., 2013)
- Forward head posture
  (Kuo et al., 2009)
  - Increased lower cervical flexion
  - Increased upper cervical extension
- Decreased lumbar flexion
  (Kuo et al., 2009)

What is Balance?

The ability to control and maintain body's position as it moves through space

- Requires coordination of sensory systems, neurological and muscle response
  - Vision, Proprioception, Vestibular
- Balance is a skill – a learned motor pattern
  - Practicing it makes it better

Age-related Changes in Gait

Reduction in speed and stride length

(Herssens et al., 2018; Hollman et al., 2011; Ko et al., 2012; Osoba et al., 2019; Salzman et al., 2010; Virmani et al., 2018)

- Increased stance width with more double support
- Forward posture
- Less force at toe off
- Pelvic rotations and flexion/extension reduced
  (Van Emmerik et al., 2005)

Most gait disorders are multifactorial

- Pain, cardiopulmonary issues, strength, flexibility, sensory impairment, fatigue
- Importance of knee extensor strength
  (Ko et al., 2012)
- Cognitive performance related to gait speed and stride length
  (Holtzer et al., 2012; Mantel et al., 2019; Trapuzzano et al., 20

Screening Questions

- Two or more falls in prior 12 months?
- Presents with acute fall?
- Difficulty with walking or balance?
- Worried about falling?

Medications and Falls

- **Polypharmacy** (4 or more prescription medications)
- **Antiepileptics** (except for seizure or mood disorders)
- **Antipsychotics**
- **Benzodiazepines** (e.g., alprazolam, lorazepam, clonazepam, diazepam)
- **Antihistamines** (e.g., Benadryl, Tylenol PM)
- **Hypnotics** (e.g., “Z-drugs”, zolpidem, zaleplon)
- **Antidepressants** (e.g., TCAs, SSRIs, SNRIs)
- **Opioids**
- **Dextromethorphan/Quinidine** (Neudexta)

AGS, 2019

Strength

Chair stand test

- 30-second test
- Timed 5-repetition test
- Timed 10-repetition test

Standing heel-rise

Balance

- One-leg Stance Test
- Four-square Step Test
- Functional Reach
- Berg Balance Scale
- Fullerton Advanced Balance Scale

Berg Balance Scale

- **14-item scale to measure balance impairment in older adults**
- **Equipment required**
  - Chair, stopwatch, ruler, step, slipper/shoe
- **Score ranges 0-56 with higher scores indicating better**
  - Cut-off score of 45/56 *(Berg et al., 1992)*

Gait Assessment

- **Speed**
  - Single best predictor of decline in health and function
  - < 1.0 meter/second predicts falls, functional limitations, hospitalization, and death *(Cesari et al., 2005)*
  - Norms similar over 8- and 20-foot distance *(Bohannon, 2008)*
- **Other parameters**
  - Rhythm
  - Cadence
  - Step
  - Stride

Management of Falls in Older Adults

- **Multi-component interventions tailored based on evaluative findings** *(Avin et al., 2015)*
- **Medications**
- **Medical Comorbidities**
- **Vision**
- **Environmental Modifications**
- **Emerging technology**
- **Exercise**
- **Balance & Agility**
- **Strength & Power**

Benefits of Physical Activity in Older Adults

Overall health and morbidity

- Lower risk of early death, coronary artery disease, cerebrovascular disease, HTN, dyslipidemia, DM, CA

Psychological well-being

- Decrease depression and anxiety
- Increase self-efficacy and self-esteem

Increase strength, balance, aerobic capacity

- Reduce risk of falls and functional decline

Cognitive benefits

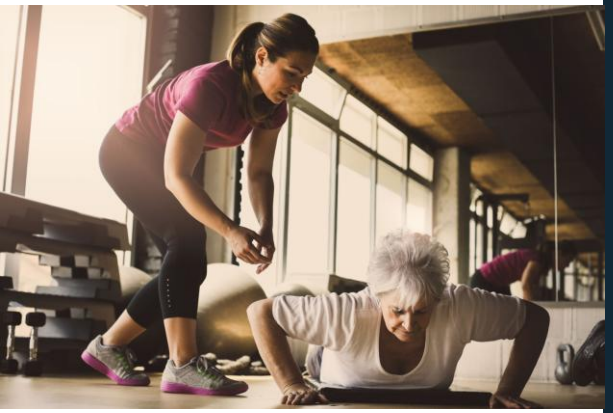
- Slow decline or improve executive function

Task Specific Functional Training

- Desired movement is overloaded to challenge whole neuromuscular system

- Progression of functional training
  (Fragala et al., 2019; vanBeveren & Avers, 2012)
  - Simple to complex movements
  - Normal pace to increased or slower movements
  - Stable to unstable or compliant surfaces
  - Eyes open to eyes closed
  - Working over base of support to outside

Strength Training



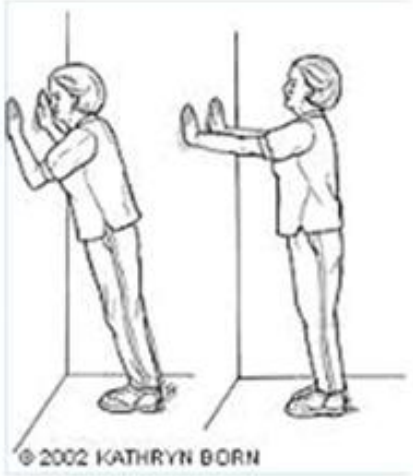
- 2-3 days per week
- Moderate intensity at 60-80% of 1 RM, 8-12 RM, or 5-6/10 on RPE scale (1-2 sets)
- May start at 40-50% of 1 RM or 15 RM if untrained, sedentary
- Progressive resistance training and functional strengthening program
- Should include power training exercises
- Speed-dependent resistance training with concentric phase performed as fast as possible and focused on lower limbs

Avers & Brown, 2009; Chodzko-Zajko, 2013; Fragala et al., 2019; Izquirerdo et al. 2021

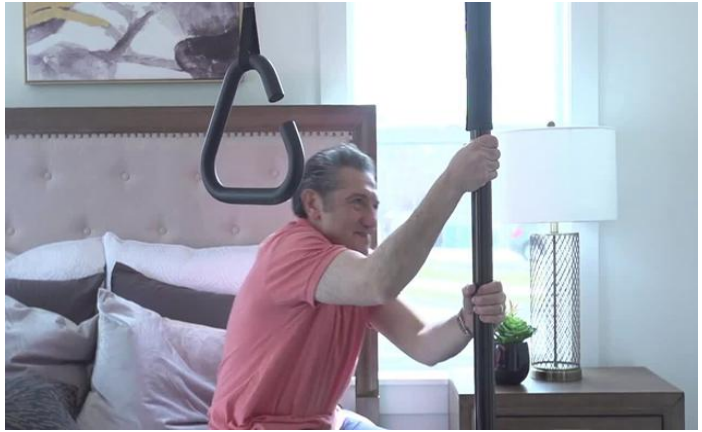
Plyometrics

- Wall push up away from wall
- Medicine ball throwing
- Alternating lateral hopping
- Jumping

Modified Push-up



Modified Pull Exercises



Resisted Walking

Balance Exercises

- **Static activities**
  - Continuous support
  - Alternating support
  - No support
- **Dynamic activities in base of support**
  - Modify support surface (firm vs. compliant)
- **Dynamic activities outside of base of support**
  - Modify support surface (firm vs. compliant)
- **Continuous moving activities**
  - Obstacle courses
  - Agility training

Flexibility Training

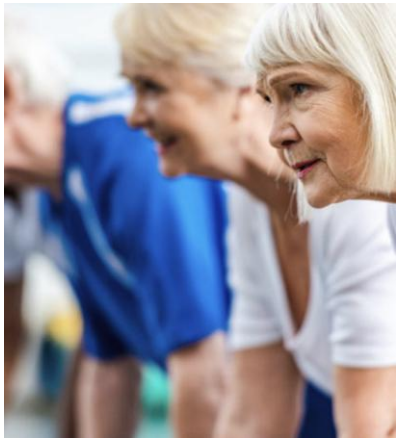
- ≥ 2 days per week
- Stretch to feeling of tightness or slight discomfort
- Hold static stretch for 30 to 60 seconds
- Any physical activity that maintains position using slow movements

Aerobic Training

- **≥ 5 days per week for moderate intensity OR**
  - 5-6/10 on RPE scale
  - 30-60 minutes per session in bouts of at least 10 minutes each
- **≥3 days per week for vigorous-intensity**
  - 7-8/10 on RPE scale
  - 15-30 minutes per day
- **Any activity that does not impose excessive orthopedic stress**

Chodzko-Zajko, 2013; Izquirerdo et al. 2021

High-Intensity Interval Training (HIIT)



- HIIT training improves cognitive flexibility and reaction time in older adults when compared to moderate intensity continuous training or resistance training
(Mekari et al., 2020)
- Protocols generally well-tolerated by older adults and have many health advantages
(Marriott et., 2021)

Thank you

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