What is Balance?

- Balance is also known as postural stability: “generic term used to describe the process in which the body’s position is maintained in equilibrium” (Kisner & Colby, *Therapeutic Exercise*, page 260).

- Balance can be stationary or moving
What is Balance?

Not slipping or falling
Why Is Balance Important?

- Humans MOVE to get around!
- The ability to transfer and walk safely depends on coordination among sensory, nervous, cognitive, cardiopulmonary, musculoskeletal, and contextual effects (environment, lighting, support surface, specific task).
Terms and Definitions

- **Center of Mass**
  Point where body mass is concentrated also referred to as the Center of Gravity.

- **Base of Support**
  - Contact area with supporting surface
  - Feet together, Feet apart, Standing on 1 Foot
Terms and Definitions

- **Stability Limit**
  Maximum distance a person can lean in any direction without changing the base of support. 8 degrees forward & 4 degrees backward & 16 degrees lateral is maximum limit when standing.

- **Mobility**
  - Ability to move independently & safely from one place to another.
Types of Balance Control

- **Static Balance**—maintain stable position at rest—sitting or standing.

- **Dynamic Balance**—stabilize body when support surface moving or when body moving on stable surface—sit-to-stand or walking.

- **Automatic**—maintain balance in response to unexpected external perturbations—standing on bus, train.
What Happens If We Lose Our Balance?
What Are the Statistics on Falls?

- More than 1/3 of community living adults age 65 & older fall each year.

- 10% falls result in significant injury: fracture, serious soft tissue injury, traumatic brain injury

- Similar injury rates: males & females
Losing Balance--Consequences of Falls

- Injuries resulting from a fall rank as the sixth leading cause of death in this population.
- Estimated costs for 2.6 million, medically treated, non-fatal, fall-related injuries in the US is approximately $19 billion. Estimated $43.8 billion in 2020.
- Elderly fallers are likely to lose confidence, restrict activity levels, and decline in functional activity and independence.
Risk Factors for Falls

- Previous falls--#1 Risk Factor
- Decreased Strength—upper or lower body
- Walking Speed/Use of Assistive Devices
- Balance Impairments
- Depression
- Visual Impairment
- Difficulty with Basic Activities of Daily Living
- Specific Medications (antihypertensive, antidepressants, tranquilizers, sedatives & > 4 Medications)
- Cognitive impairment
- Age ≥ 80 years old
- Aerobic Endurance/Muscular Endurance—falls increase when fatigued
Fear of Falling/Balance Confidence

- Older individuals can develop “fear of falling” after 1 or more falls.
- Can lead to ↓ confidence in ability to perform tasks, restrict activities, social isolation, functional decline, depression & ↓ QOL.
- “Fear of falling” associated w/ greater fear of institutionalization than fear of injury.
- FF demonstrate perceived stability limits from actual limits & gait changes
Balance Control--Interactions of the Musculoskeletal & Nervous Systems
Sensory Systems

1. Vision—usually rely most heavily.

Movement, position in space & location relative to objects.

Navigate safely, changes in surfaces, avoid obstacles.
2. Somatosensory—spatial location & movement relative to support surface.

Position & movement of body segments relative to each other.

In absence of vision, somatosensory system becomes primary source of information for upright balance & moving in a dark environment.

Fastest processing
Sensory Systems

- 3. Vestibular—housed in inner ear and used when head is moved.
  - Works with vision to determine if our body or the world is moving when we turn quickly---Merry Go Round anyone??
  - Important to maintain upright balance if vision or somatosensory systems are not working properly, are distorted or inaccurate.
- Slowest processing
Sensory Deficits

- **Somatosensory:** peripheral neuropathy--Reduced ability to feel contact on floor.
- **Visual:** acuity, contrast sensitivity, peripheral, depth, cataracts, glaucoma, macular degeneration.
- **Vestibular:** viral infection, traumatic brain injury or aging may experience vertigo (dizziness) & postural instability.
- **All these deficits increase risk of falls**
Sensory Deficits

- Sensory conflict can occur when information provided by 1 or more sensory systems is not in agreement with information from 1 or both of the other sensory systems.

- Example: Crowded stores, malls with people in and out of visual field. Pushing a cart provides stabilization.
Biomechanical and Movement Deficits

- Musculoskeletal impairments include poor posture, decreased flexibility & strength.
- Neuromotor impairments – coordination, pain, weak CORE muscles.
- Spinal changes alters center of mass.
- Weak ankle strength & flexibility.
Deficits with Aging

- Strength declines with age. Loss of fast twitch motor units
- Endurance decreases with age
- Visual changes
- Decrease reaction time, movement time & response time
- Reduced balance when challenged w/stronger & faster force.
- Spinal flexibility shows greatest decline w/age compared to all other joints
- Ankle joint flexibility, critical for postural control, also declines
- Declines in all sensory systems
- Decline in ability to anticipate changes in environment or task.
Can Age Related Changes in Balance Be Reversed?

- Growing research evidence suggests that exercise can reverse, or at least slow the rate of decline.
Can Age Related Changes in Balance Be Reversed?

- Research suggests that in healthy adults, adults with existing balance problems and older adults, moderate to large improvements in balance & mobility and a reduction in fall risk or fall incidence with consistent, specific exercise.
Falls: How Can Older Adults Prevent Them?

- Exercise regularly/Balance Exercises
- Ask doctor or pharmacist to review medicines—both prescription and over-the-counter—to reduce side effects and interactions.
- Have eyes checked by an eye doctor at least once a year.
- Improve the lighting in the home.
- Reduce hazards in the home that can lead to falls.
- KNOW YOURSELF—Balance changes?

http://www.cdc.gov/HomeandRecreationalSafety/falls/adultfalls.html
Recommendation (Sherrington)

Exercise must provide a **moderate or high challenge** to balance in order to be effective

1) Reducing base of support
2) Movement of the center of gravity – control of body position while standing
3) Reducing need for upper limb support with exercises in standing or decrease reliance on arms.
Exercise Training

Comprehensive program includes:

1. Flexibility*
2. Muscle Strength/Endurance*
3. Walking Pattern/Variation**
4. Postural Training**
5. Multisensory Training**
6. Center of Gravity Control Training**

*exercises included in lecture
**a few exercises included but mostly physical therapy treatment
**General Exercises to Improve Balance (flexibility/strength)**

- **Chair**
  - Knee Extension/Flexion
  - Toe/Heel Raises/Circle
  - Hamstring Stretch
  - March in Place
  - Hip Out/Together
  - Draw In (10x10sec)
  - Seated Sit-ups
  - Chair Push Up
  - Sit To Stand
  - Head/Neck Flexibility
  - Upper Body Flexibility

- **Standing**
  - Lower Leg Stretch
  - Toe/Heel Raises/Circle
  - Hamstring Stretch
  - March in Place
  - Hip Pendulum
  - Wall Squats
  - Wall Push Up
  - Front/Side Lunges
  - Head/Neck Flexibility
  - Upper Body Flexibility
Balance Training

Sit To Stand

Toe Raises, Wall Squats & Wall Push Ups
General Exercises to Improve Balance

- Do not bounce when stretching.
- Hold stretch for 10-30sec (can go up to 60sec), to point of tightness, minimum of 2-3 days/week but most effective 6-7 days/week.
- Non stretching exercises should be performed 10-20 times each, minimum of 2-3 days/week but most effective 3-5 days/week.
- Make sure to exercise both arms/legs.
- Can provide resistance--hand, theraband, stability ball, cuff weights to make exercise more challenging.
Head/Neck/Upper Body Flexibility

- Chin to chest
- Neck Rotation
- Ear to Shoulder
- Shoulder Roll
- Chest Stretch
- Lateral Shoulder
- Roll Down
- Seated Trunk Rotation

- Side Stretch
- Overhead Reach
- If Ankle Flexibility is a problem—ankle alphabet, Towel Crunch, Marble Pick-up
Exercise Training—Physical Therapy or Balance Programs

- Walking Pattern/Variation—directional change, start/stop, gait pattern variations, obstacle avoidance.
- Postural Training—working on ankle, hip & step strategies for postural control.
- Multisensory Training—eyes closed/alter support surface/alter base of support.
- Center of Gravity Control Training—manipulating seated support surface or standing surface—stability ball, dyna-disc
In Conclusion

Balance & mobility can be improved through balance training to reduce the risk of falls.
References

References

