Importance of Exercise, Strength Training, Balance and Posture Training for Fall Prevention – Clinical Application

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Part One: Describe physiotherapy screening and assessment of strength, balance and posture for falls prevention

Part Two: discuss the importance of using behaviour change theory and techniques to support uptake and adherence to physical activity programs
Seniors Falls in Canada

1 in 3 older adults fall each year

95% of all hip fractures

$2 Billion in Health Care costs

1/2 Fall at home

50% of older adults will not regain full mobility, 30% mortality
Falls are Predictable and Preventable

- Predictable (78%)
- Non predictable (22%)
If it’s Predictable, then It’s Preventable! Assess for Modifiable Risk factors

Biological
- Strength
- Balance
- Gait
- Age
- Vision/Hearing
- Chronic Illness - cognitive impairment
- Stroke
- Parkinson’s
- Diabetes
- Heart Disease
- Incontinence
- Foot Problems
- Acute illness

Behavioural
- Fear of Falls
- Risky behaviour
- Poor nutrition
- Poor sleep
- Excessive alcohol
- Sedentary behaviour
- Inappropriate use of gait aids
- Overuse of medications - Sedatives - antidepressants - antipsychotics
- Poor footwear/clothing

Environmental
- Clutter
- Stairs
- Poor building codes
- Slippery surfaces
- Rugs, Tripping hazards
- Lack of handrails
- Lack of park benches
- Pavement and road conditions
- Crosswalk time

Socio-Economic
- Living alone
- Lower income
- Poor living conditions
- Social isolation
- Lack of transportation
- Cultural Barriers
- Illiteracy/language barriers

Seniors Falls in Canada
What do Physiotherapists do about Falls? It’s not only about Strength and Balance!
“Neck Up, and Neck Down” Approach

Posture, Balance, Gait, Strength, Biomechanics, Frailty

Behaviour, Motivation, Beliefs, Self-efficacy, Adherence
**Screening for Falls**
*Are you asking the right questions?*

Follow the American/British Geriatrics Society Clinical Guidelines for the Prevention of Falls: ask these simple questions to **every person** 65 years+

1. Have you had a fall in the past year? *(this is the biggest predictor of future falls)*
2. Do you feel unsteady or have any difficulties with walking or balance?
3. Do you worry about falling?

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Yes

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Clinical and Functional Testing
Clinical Assessment

1. **Questionnaires**: Ask the patient to complete a self report measure e.g. The Falls Self Efficacy questionnaire (FES-1)

2. **Document all medications**: especially hypnotics, diuretics

3. **Ask about bladder and bowel**: How many times do they need to get up in the night (sleep interference), and leakage (slip hazard)

4. **Current Activity**: ask what their day is like – this will give an idea of physical activity levels. What do they hope for in the future- what is the reason for the visit, and the future goal

5. **Typical Meals**: is there adequate nutritional intake- any recent unintended weight loss?

6. **Falls**: obtain very specific details about previous falls – especially ask about syncope The “4 W's “- what, when, where, why
Clinical Assessment

Falls
Subjective assessment and History

Functional Status
- Activities of daily living: shopping, finances housekeeping, cooking, transportation, bathing, toileting, stairs, transfers on/off chairs, bed, self care, continence

Medical comorbidities
- Cardiovascular, neurological, orthopaedic, metabolic conditions, visual impairment, fear of falling, malaise, weight loss, frailty

Medications
- Polypharmacy, psychotropics, anti-epileptics, diuretics, alpha-blockers, drugs with anticholinergic side effects

History of Falls
- Circumstances: frequency, time, location, surface, obstacles
  - Associated factors: footwear, walking aids, glasses, medication, alcohol, precipitants
  - Associated symptoms: Dizziness, vertigo, tinnitus, legs giving way, fainting, musculoskeletal pain, instability
Physical Examination

- Weight, height, (BMI)
- Orthostatic BP
- Assess lower extremity muscle strength, especially: hip extensors, hip abductors, back extensors, calf muscles
- Ankle range of movement and strength
- Ask about diet / nutrition
- Balance, Mobility, and Ambulation

CDC STEADI Toolkit
Sarcopenia

**Measure Grip Strength**

Grip strength

♀ 20kg
♂ 30kg

**Measure Gait speed**

Gait Speed metres /sec

1 m/s  < 0.8m/s  < 0.6 m/s

Sarcopenia: European Guidelines
Easy as 1, 2, 3: Clinical Assessment Tools

Timed Up and Go (TUG)

3 metres

4 Stage Balance Test

1. Stand with your feet side by side.
   Time: __________ seconds

2. Place the instep of one foot so it is touching the big toe of the other foot.
   Time: __________ seconds

3. Place one foot in front of the other, heel touching toe.
   Time: __________ seconds

4. Stand on one foot.
   Time: __________ seconds

30 Second Chair Stand

Videos and instructions available: CDC STEADI Toolkit
Balance is Multi-Dimensional: The BESTest assesses 6 main categories for a very comprehensive balance assessment.

http://www.bestest.us
Fear of Falling - FoF

Falls Self Efficacy Scale

FES-1

http://www.profane.eu.org/fesi.html
Maintaining postural control

- Biomechanics
  - skeletal integrity
  - posture
  - strength
  - flexibility

- Sensory Processes
  - vision
  - vestibular
  - sensation

- Cognitive Processes
  - Motor planning
  - Attention
  - higher brain center co-ordination (basal ganglia, frontal cortex, cerebellum)

A Fine Balance

Horak 20006
Proactive and Reactive Postural Control

**Proactive postural control:**
Postural actions that are planned in advance
e.g. getting up
from a chair, navigating in a busy grocery store,
known changes in floor surface

**Reactive Postural Control:**
Unanticipated postural reactions
e.g. not seeing a step in sidewalk, stair is
narrower than thought

You won’t have time to think about loss of
balance when it happens...
you need to react FAST- improves with training

Shumway-Cook A, Woollacott 2007,
Muehlbauer et al. 2012,
Posture and the limits of Stability

Image credit: Blausen.com Wikimedia commons
Exercise works for Falls Prevention works.....but **only if**

**Principle of overload**

**Principle of specificity**

Balance : Moderate to high **challenge** at least 3 times /week

Strength : Moderate to high **intensity** at least 3 times per week

“If strength training isn’t challenging, it is a waste of time and money: you will still have weak muscles, and you will still be at risk of falling”

The American Physical Therapy Association “Choosing Wisely” campaign
Balance Training

What does the evidence say?

2 out of 3: *Moderate* challenge

All 3: *High* Challenge

Remove the use of hands

Move the centre of mass

Narrow the Base of support
Strength Training…. What does the evidence say?

1 repetition maximum (RM): The amount of weight you can lift only once

**Moderate Intensity**
40-60% of 1 RM

- **If 1 RM is 10 lbs**
  - 4-6lbs
  - 2 seconds to lift,
  - 2 seconds to lower
  - 10-15 times until muscle fatigues
  - Wait 2 minutes between sets

**High Intensity**
> 60% of 1 RM

- More than 6lbs
- 2 seconds to lift,
- 2 seconds to lower
- 8-12 times, until muscle fatigues
- Wait 2 minutes between sets
# Strength Training Recommendations

<table>
<thead>
<tr>
<th>Exercise Variables</th>
<th>Recommendations</th>
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<tbody>
<tr>
<td>Intensity</td>
<td>Beginner: 12-13 RPE* (somewhat hard) Advanced: 14-16 RPE (hard)</td>
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<tr>
<td>Quality</td>
<td>Technically correct, full range of motion</td>
</tr>
<tr>
<td>Speed of movement</td>
<td>2 secs concentric, 2 secs eccentric</td>
</tr>
<tr>
<td>Frequency</td>
<td>3 times/week</td>
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<tr>
<td>Repetitions</td>
<td><strong>Beginner</strong> 10-15 (moderate resistance until muscle fatigue) <strong>Advanced</strong>: 8-12 (high resistance until muscle fatigues)</td>
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<tr>
<td>Rest</td>
<td>2 mins between sets</td>
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Gschwind et al. BMC Geriatrics 2013,
Functional Strength
Gait Pattern Enhancement and Variation

Goal: To achieve a gait pattern that is efficient, flexible and adaptable to changing environmental demands

<table>
<thead>
<tr>
<th><strong>Motor System:</strong> Responds to task demands</th>
<th><strong>Sensory (Vision, Vestibular and somatosensory): Responds to changes in Environment</strong></th>
<th><strong>Cognitive: single to dual tasks</strong></th>
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<tbody>
<tr>
<td>Base of support: wide to narrow, solid to unstable Seated to standing</td>
<td>Reduce vision (dark glasses)</td>
<td>Concurrent tasks</td>
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<tr>
<td>Change foot position- wide, to semi-tandem, tandem, to one leg</td>
<td>Impede hearing</td>
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<tr>
<td>Change body and arm positions: weight shifts side to side, heel to toe raises</td>
<td>Increase visual flow (e.g. people walking past)</td>
<td>Walk while asking what they had for breakfast</td>
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<tr>
<td>Ankle hip and step strategies</td>
<td>Stable to unstable surface e.g. floor to foam, concrete to grass/sand</td>
<td>Walk while counting backwards by 10’s, 2’s, 5’s</td>
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<tr>
<td>Increase reps, timing, speed, change order of activities</td>
<td>Walking with head turns</td>
<td>Walk and recite a poem</td>
</tr>
<tr>
<td>Add heavier weights, elastic bands, gym balls</td>
<td>Vision/ Vestibular training e.g. juggling a ball</td>
<td>Walk while picking up items in a certain sequence</td>
</tr>
<tr>
<td>Proactive postural control: Standing up from chair, stepping over obstacles</td>
<td>Eye and Head movements (tracking objects)</td>
<td>Walk and add tasks e.g. holding parcels, a cup of water, while reciting poem</td>
</tr>
<tr>
<td>Reactive Postural control Reaction to controlled external push or pull) varying in speed, amplitude and direction on ankle, hip, trunk or shoulder level</td>
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</tbody>
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Adapted from Gschwind et al. 2013 and FallProof!™

**How to progress Balance and Gait Training**
Brisk walking should not be recommended for high risk individuals.

Increasing general physical activity
Low intensity strengthening exercises
Balance exercises that are not challenging

The Bottom Line

Effective for Fall Prevention
Multi modal challenging balance exercises
High intensity strengthening exercises
Interventions than are more than 3 hours per week
More than 50 hours over a year
The protective effects wear off when you stop exercising
– It’s for Life!

Not effective for Fall Prevention
Brisk walking should not be recommended for high risk individuals
Increasing general physical activity
Low intensity strengthening exercises
Balance exercises that are not challenging

Jury still out: Residential Care patients, recently discharged from acute care patients

Sherrington 2016
Examples of Evidence Based Fall Prevention Programs

**Low risk of Falls**
- Tai Chi: Moving for Better balance
- FallProof! (Rose 2011)

**Moderate risk of Falls**
- Tai Chi: Moving for better balance
- Fallproof!
- Stepping on (Clemson)
- LIFE program (Clemson)

**For older adults at high risk of Falls**
- Otago Home exercise program

*This list is not exhaustive*
Adherence to Physiotherapy

**Compliance:** “The extent to which the patient’s behavior matches the prescriber’s recommendations.”

**Adherence:** “The extent to which the patient’s behavior matches agreed recommendations from the prescriber.”

Horne et al., 2005

“…..adherence requires the patient's agreement to the recommendations.”

WHO 2003
Adherence to Physiotherapy

For group based programs, factors associated with lower adherence:

- flexibility component
- longer duration (> 20 weeks)
- two or less sessions/week

McPhate et al., 2013
Systematic Review
Adherence to Physiotherapy

Based on 20 studies, strong evidence for the following barriers to adherence to outpatient physiotherapy treatment:

- “low levels of physical activity at baseline (4 trials, 728 participants) or in previous weeks (2 trials, 883 participants),
- low self-efficacy (6 trials, 1296 participants),
- depression (4 trials, 1367 participants)
- anxiety (2 trials, 159 participants),
- helplessness (2 trials, 792 participants),
- poor social support or activity (6 trials, 2286 participants),
- greater perceived number of barriers to exercise (3 trials, 857 participants)
- increased pain levels during exercise (2 trials, 159 participants)”

Jack et al., 2010
Systematic Review
How best support behavior change?
Behavior Change
Theory & Techniques
Behavior Change Theory

Theories you may know:

- Transtheoretical Model of Change  
  Diclemente & Proshaska
- Social Cognitive Theory  
  Bandura
- Health Action Process Approach (HAPA)  
  Schwarzer
Intentions → GAP → Behavior
Conscious - Motivational

- Self-efficacy
- Outcome expectancy
- Risk Perception
- Social Norms

Intentions

Behavior
Conscious - Volitional
(self-regulating factors)
Behavior Change Theory & Techniques and Physiotherapists

- Only 6 studies

- Stress and anxiety are common symptoms after musculoskeletal injury

- Commonly reported techniques:
  - goal setting,
  - positive self-talk
  - effective communication
  - variation in exercises

- Despite the use of goal setting, variation exists in how to set goals.
  - No discussion on action and coping plans and how to monitor behavior.

  Alexanders et al., 2015
What are Behavior Change Techniques? (93 BCTS)

“an observable, replicable, and irreducible component of an intervention designed to alter or redirect causal processes that regulate behavior [...] an ‘active ingredient’.”

Michie et al., 2013
EFFECTIVE BCTS

Associated with a higher-self efficacy effect sizes:
- Set graded tasks
- Prompt **self-monitoring** of behavioral outcome
- Provide information on where and when to perform the behavior (**action planning**)  
  - Motivational interviewing

Associated with higher physical activity behavior effect sizes:
- Barrier identification/problem solving (**coping planning**)  
  - Provide rewards contingent on successful behavior  
  - Model/demonstrate the behavior  

French et al., 2014
Goals and Planning

Feedback and Monitoring

Associations
**Action Plans:** planning when and/or where you will perform the activity

**Coping Plans:** develop strategies to overcome barriers

**Feedback and monitoring:** activity monitors: self-monitoring of behavior

**Associations:** prompts and cues

**IF** it is raining outside **THEN** I will do my activities indoors
- Adherence rates are sub-optimal

- Behavior theory and techniques may strengthen adherence to physical activity (exercise) programs

- Details related to program content and delivery is important to inform practice and research

Take Home Messages