Otago Home-Based Strength & Balance Retraining Improves Executive Functioning in Older Fallers

Teresa Liu-Ambrose, PhD, PT
Background

• Falls among seniors is a major health care issue

• 30% of community dwelling seniors aged 65 and older fall annually
  • 5th leading cause of death
  • 3rd cause of chronic disability
Background

• Falls are not random events

• Key risk factors include:
  • Reduced physiological function
    • Weak muscles
    • Poor balance
  • Reduced cognitive function
    • Annual incidence between 70% to 85%
What We Know

• Exercise can effectively reduce both falls risk factors and falls in older people by ameliorating physiological impairments
  • Stephen Lord, AUS
  • John Campbell, NZ
What We Don’t Know

• Can exercise effectively reduce falls in older people by improving cognitive function?
  • Alternate or synergistic mechanism to improved physiological function
    • Few exercise trials of falls prevention included measures of cognition

• Aerobic exercise improves cognitive performance, brain function, and brain structure among healthy community-dwelling seniors
  Colcombe et al., 2004 & 2006
Action Seniors!

- Among seniors who present to a health care provider with a fall, does a home-based strength and balance-retraining program reduce falls risk and improve cognitive performance?
  - Specific focus on executive functioning

*Liu-Ambrose, Donaldson, et al., JAGS, 2008*
Action Seniors!: Design

• 12-month single-blinded randomized controlled trial:
  • Otago Exercise Program & Guideline Care
  • Guideline Care
Action Seniors!: Entry Criteria

- Present to a health care provider (ED or GP) with a fall
  - Attended one of the VCHA’s Falls Prevention clinics
- Not living in care facility
- 70 years and older
- MMSE > 24
- PPA > 1.5 or TUG > 15 sec or 1 non-syncopal fall in previous year
- Able to ambulate 3 meters with or without assistive device
- No contraindications to exercise
Intervention: Otago Exercise Program (OEP)

- Home-based
- PT or Nurse delivered
  - Progressive resistance and balance training program
  - 3x per week
  - Walking (30 min @ 2x/week)
- 4 visits in the first 2 months (every other week)
- A ‘booster visit’ at 6-months

Campbell et al., 1997 & 1999
Outcome Measures

• Physiological Falls Risk
  • baseline, mid-point, final

• Key Processes of Executive Functioning
  • baseline & mid-point

• Falls
  • 12 months
Outcome Measure: Physiological Falls Risk

- Physiological Profile Assessment (PPA)
  - Normative data to identify people at risk of falls
  - Predictive accuracy of 75% in prospective studies

Lord et al., 1991 & 1994
Edge Contrast Sensitivity

Postural Stability (eyes open on foam)

Dominant Quadriceps Strength

Proprioception

Hand Reaction Time

PPA Falls Risk Score
Fall Risk Score (in Standard Deviations)
Outcome Measure: Executive Functioning

- **3 Key Processes**
  - Response inhibition
    - Stroop Colour-Word Test
  - Set shifting
    - Trail Making B Test
  - Working Memory
    - Verbal Digit Span Backward Test
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Trail Making B Test

B

6

3

A

C

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4

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Verbal Digit Span Backward Test

- 4 – 8 – 2
- 9 – 3 – 1
- 6 – 3 – 4 – 7
- 9 – 7 – 2 – 5

Try:
- 9 – 1 – 5 – 4 – 7 – 3 – 2
- 2 – 3 – 7 – 4 – 5 – 1 – 9
Falls

• “…unintentionally coming to the ground or some lower level other than as a consequence of sustaining a violent blow, loss of consciousness, sudden onset of paralysis as in stroke or an epileptic seizure.”

• Monthly diaries & follow-up telephone interviews
Results: Participants

- 74 participants randomized
- All participants underwent PPA assessment
- Cognitive assessment
  - Baseline = 59
  - Six Months = 52
Results:
PPA and Executive Functioning

• At six months:
  • No significant between-group difference in PPA scores
    • 5% improvement in OEP
    • 0% change in CON
  • A significant between-group difference in response inhibition (Stroop CW Test)
    • 13% improvement in OEP
    • 10% deterioration in CON
Results: Falls

- At 12 months:
  - Using negative binomial regression, the unadjusted incidence rate ratio of falls in the OEP group, compared with the CON group was 0.56. The adjusted incidence rate ratio was 0.47.
Discussion

• Why a significant reduction in falls without a significant improvement in physiological function?
  • A 5% improvement in PPA may be sufficient to reduce falls
    • Threshold effect as proposed by John Campbell
  • The meta-analysis of the OEP (4 RCTs)
    • Falls were significantly reduced by 35%
    • Postural sway significantly improved by 9%
    • No significant improvement in knee extension

Robertson et al., 2002
Discussion

- Response inhibition highly relevant to falls prevention

- Performance on the Stroop Colour-Word Test:
  - Independently associated with falls in an urban rehabilitation setting
  - A significant determinant of successful obstacle avoidance
    - Tripping is an important factor in large percentage of falls

Rapport et al., 1998
Persad et al., 1995
Conclusions

• The OEP, may reduce falls not only by improving physiological functions as demonstrated by previous studies, but also by improving cognitive performance.
Acknowledgements

- Participants
- Colleagues
  - Meghan Donaldson
  - Karim Khan
  - John Campbell
  - Stephen Lord
  - Wendy Cook
  - Peter Graf
  - Yasmin Ahamed
- Michael Smith Foundation for Health Research
- CIHR
- Vancouver Foundation