Transforming Everyday Life into Extraordinary Ideas
Advancing best practice in balance and mobility testing for fall risk assessment in older Canadians

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Fall Prevention Community of Practice Webinar
Mar 29th, 2019
Talk Outline

• Importance of balance for falls
• Fall prevention guidelines
• Balance assessment tools and evidence to date for predicting falls
• Introduction to the CLSA dataset
• Preliminary results using CLSA data
• Clinical implications
Poll

- Who is in the audience today?
  A) Physiotherapist
  B) Nurse
  C) Occupational Therapist
  D) Physician
  E) Researcher
  F) Kinesiologist
  G) Government or policy official
  E) Other
The Patient Who Falls
“It's Always a Trade-off”

Mary E. Tinetti, MD; Chandrika Kumar, MD

*JAMA. 2010;303(3):258-266. doi:10.1001/jama.2009.2024*

<table>
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<tr>
<th>Risk Factor</th>
<th>Studies in Which Factor Was Significant&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Ranges of Adjusted Values&lt;sup&gt;d&lt;/sup&gt;</th>
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Even Presidents Need Balance

Slide courtesy of Kathryn Sibley
Balance is a modifiable risk factor

- In a large Cochrane systematic review, compared with control, balance and functional exercises:
  - Reduced the rate of falls by 24% (39 studies)
  - Reduced the number of people experiencing one or more falls by 13% (37 studies)

- Multiple types of exercise (most commonly balance/functional exercises plus resistance exercise):
  - Reduced the rate of falls by 34% (11 studies)
  - Reduced the number of people experiencing one or more falls by 22% (17 studies)

Sherrington et al. Cochrane Database Syst Rev 2019
Fall prevention guidelines

- Produced by a number of different organizations
- American and British Geriatrics Societies (AGS/BGS), National Institute for Health and Care Excellence (NICE), and the CDC Stopping Elderly Accidents, Deaths and Injuries (STEADI) most common
- Tests of balance and mobility recommended by each
Suggested tests:
- Timed Up and Go (TUG)
- Berg Balance
- Performance-Oriented Mobility Assessment (POMA or Tinetti)
1.1.1.2 Older people reporting a fall or considered at risk of falling should be observed for balance and gait deficits and considered for their ability to benefit from interventions to improve strength and balance. (Tests of balance and gait commonly used in the UK are detailed in section 3.3.) [2004]

<table>
<thead>
<tr>
<th>Timed up and go test</th>
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<tbody>
<tr>
<td>Turn 180°</td>
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<tr>
<td>Performance-oriented assessment of mobility problems (Tinetti scale)</td>
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<tr>
<td>Functional reach</td>
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<tr>
<td>Dynamic gait index</td>
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<tr>
<td>Berg balance scale</td>
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</tbody>
</table>
Simplified algorithm

Health provider encounters older patient

Ask patient:
1) Fall in last year?
2) Feel unsteady with standing or walking?

Yes
Conduct balance screening test to determine risk for falls

No
Educate and refer to community exercise program

Above Cut-off
Educate and refer to community exercise program

Below Cut-off
Administer detailed balance assessment and assess other fall risk factors

Balance and strength training fall prevention program and targeted risk factor reduction
Poll

• Do you currently use any of the following balance tests for fall risk screening?
  • Functional reach test
  • Standing balance test (e.g., single leg stance or tandem stance)
  • Repeated chair stand test
  • Timed Up and Go (TUG)
  • Turn 180 test
  • Dynamic gait index
  • POMA/Tinetti
  • Berg Balance
  • Other
  • I do not use a balance test for fall risk screening
Summary of CPG recommended balance tests

- Functional reach
- 4 stage balance test
- 30 second chair stand
- **Timed Up and Go**
- Turn 180 test
- Dynamic gait index
- **Performance-Oriented Mobility Assessment** (aka Tinetti scale)
- Berg Balance
Which test to use and at what cut-off?

- Need short, easy to administer tests for screening
- Only 1 CPG includes cut-off values to identify those who are impaired
  - CDC recommends ≥ 12 seconds on the TUG for risk of falling
  - Cut-offs also suggested for the optional 4-stage balance test and chair-stand test

Centers for Disease Control and Prevention Stopping Elderly Accidents, Deaths and Injuries 2019
https://www.cdc.gov/steadi/
The TUG test

Video available at https://youtu.be/BA7Y_oLElGY or on https://www.cdc.gov/steadи/
Evidence for TUG

- Most widely suggested test by CPGs
- Data to support recommended cut-point is limited
  - Based on a single study in which falls were not measured as an outcome¹
  - A recent systematic review evaluating the predictive validity for falls of the TUG showed inconsistent results²

4-Stage Balance Test

- Four standing positions that get progressively harder¹
  - Feet side-by-side
  - Semi-tandem
  - Tandem
  - Stand on one foot (i.e., single leg stance)
- <10 secs in last 2 positions suggested as a cut-off for risk of falling
- No studies supporting this cut-point

¹ Winograd JAGS 1994
Chair Stand Test

- Participants complete as many chair stands as possible in 30 seconds
- Cut-off based on normative data\(^1\)
- Has not been validated against falls

\(^1\) Rikli & Jones, Journal of Aging and Physical Activity 1999
There is a need for research to determine the best balance test and cut-off value for predicting falls.
The Canadian Longitudinal Study on Aging (CLSA) is a potential dataset to look at these issues in a large and random sample of older Canadians.
What is the Canadian Longitudinal Study on Aging (CLSA)?

A research platform – infrastructure to enable state-of-the-art, interdisciplinary population-based research and evidenced-based decision-making that will lead to better health and quality of life for Canadians.
Canadian Longitudinal Study on Aging (CLSA)

- Strategic initiative of CIHR; on Canadian research agenda since 2001
- More than 160 researchers and collaborators – 26 institutions
- Multidisciplinary – biology, genetics, medicine, psychology, sociology, demography, economics, epidemiology, nutrition, health services, and kinesiology
- Largest research platform of its kind in Canada for breadth and depth
- Following 50,000+ Canadians aged 45-85 at baseline for 20 years
Participants aged 45 to 85 at baseline (51,338)

Target: 20,000
Actual: 21,241
Randomly selected within provinces

Target: 30,000
Actual: 30,097
Randomly selected within 25-50 km of 11 sites

Questionnaire
• By telephone (CATI)

Questionnaire
• In person, in home (CAPI)

Clinical/physical tests
Blood, urine
• @ Data Collection Site

Participants aged 45 to 85 at baseline (51,338)

2010 - 2015
2015
2018

Baseline
FU-1
FU-2
FU-3
FU-4
FU-5
FU-6

Active follow-up every 3 years
National Scope

- Home Interviews & Data Collection Site Visits
- Telephone Interviews

Locations:
- Victoria
- Vancouver
- Surrey
- Calgary
- Winnipeg
- Hamilton
- Ottawa
- Montreal
- Sherbrooke
- Halifax
- St. John’s
Baseline questionnaires & Physical assessments

Demographic – Education, Ethnicity, Language, Sexual orientation, Marital status, Nutrition, Smoking, Alcohol, HCU, Medication use, …

Health - Disease symptoms, Sleep, Oral health, Injuries, Falls, Mobility, Mental Health, Depression, PTSD, …

Social – Social networks, support, participation, inequality, Online communication, Caregiving & receiving, Labour force participation, Retirement, Transportation, Mobility, Migration, Built environments, …

Basic Measures – Height, Weight, Hip Circumference, Hearing, Vision

Functional Measures - Timed-up-and-go, Standing balance, 4m walk, Chair rise, Grip strength, Neuropsych testing

Physical Measures - Blood pressure, Spirometry, Carotid ultrasound, ECG, DXA, Tonometry, Fundus photography

Biological samples – Blood sample, Urine sample
Terminology

- **Tracking Cohort**
  - Target - 20,000 participants from all 10 provinces, followed through Computer-Assisted Telephone Interviews (60 minutes at baseline)
  - 21,241 recruited*

- **Comprehensive Cohort**
  - Target - 30,000 participants living within 25 km (or 50 km) of a CLSA Data Collection Site (DCS)
  - Followed through in-home interviews (60 minutes) and physical assessments (2-3 hours) at a DCS
  - 30,097 recruited*
CLSA Data Collection

Data Collection Site

Physical Assessments:
- Height, Weight, Waist-Hip Ratio, BMI
- Bone Density, Body Composition, Aortic Calcification (DXA)
- Blood Pressure, ECG, Carotid Intimal-Medial Thickness
- Pulmonary Function
- Hearing & Vision (Retinal Image, Tonometry, Visual Acuity)
- Grip Strength, TUG, Chair Rise, 4-m Walk, Balance

Cognitive Assessments:
- Neuropsychological Battery
  - Memory
  - Executive Function
  - Reaction Time
  - Prospective Memory

Biospecimen Collection:
- Blood
- Urine
Baseline Falls Data

• In the last 12 months, have you had any injuries that were serious enough to limit some of your normal activities? For example, a broken bone, a bad cut or burn, a sprain or a poisoning.

• If yes → was the injury caused by a fall?
Baseline Falls Data

- How many falls?
- What was the most serious injury due to a fall?
- Receive medical attention from health professional?
  - If yes → hospitalized? Follow-up care?
- Where did it happen?
- What were you doing when you were injured?
18 Month Falls Data

• In the last 12 months, have you had any falls that were serious enough to limit some of your normal activities? For example, a broken bone, a bad cut or burn, a sprain or a poisoning.
Data Access
CLSA Data Access

- Designed as a research study, funded as a research platform
- Data available to researchers and trainees based in academic settings and research institutes in Canada and elsewhere
- 2019 application deadlines:
  - June 5
  - September 25
Data Access Fees

- **Partial Cost Recovery Model**
  - **Alphanumeric data**
    - $3,000 for a straightforward alphanumeric dataset
    - Graduate students using data solely for thesis research & Postdoctoral fellows using data solely for the postdoctoral project are eligible for a fee-waiver. Trainees must be enrolled at a Canadian institution or be supported by Canadian funds if working outside Canada.
  - **Images & raw data**
    - Additional fees of $1,000 per application are associated with the request for images & raw data.
Approved Projects Keywords

Keywords:
- Dementia
- Multimorbidity
- Prevalence
- Nutrition
- Support
- Cognition
- Disability
- Depression
- Healthy Aging
- Chronic Disease
- Social Isolation
- Age
- Frailty
- Risk Factors
- Norms
- Older Adults
- Sarcopenia
- Social Participation
- Support
- Social Isolation
- Physical Function
- Health Status
- Lifestyle
- Physical Activity
- Loneliness
- Spirometry
- Healthy Cities
- Successful Aging
- Idiopathic
- Aging
- Arthritis
- Activities of Daily Living
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Resources: www.clsa-elcv.ca
Addressing evidence gaps in fall risk assessment for older Canadians: preliminary results

Marla Beauchamp, Ayse Kuspinar, Lauren Griffith, Sohel Nazmul, Jinhui Ma, Parminder Raina
Rationale for our project

• The CLSA includes three of the most commonly used tests for fall risk screening
  • Timed Up and Go
  • Single Leg Stance Test
  • Chair-Rise Test
• All three tests are suggested as possible fall risk screening tests by various CPGs
• Limited data on cut-off values and predictive validity for falls
Objective

• To determine the optimal balance screening test for fall risk assessment in older Canadians

• 1) determine the accuracy of three commonly used screening tests of balance and mobility for predicting falls in the CLSA;

• 2) establish cut-off scores on the screening test(s) for identifying fallers in different age and sex strata
Methods

• Analysis of individuals over age of 65 enrolled in the comprehensive cohort of the CLSA
• Primary measures: Timed Up and Go, Single Leg Stance, and Chair Rise Test at baseline.
• Outcome: Falls at 18-months follow-up using data from the Maintaining Contact Questionnaire
• Analysis: Accuracy and cut-off values for fall prediction will be measured by the area under the curve (AUC) of the receiver operating characteristic (ROC) curve for each test in different age and sex strata
## Sample characteristics (n=11172)

<table>
<thead>
<tr>
<th></th>
<th>Women (n=5575)</th>
<th>Men (n=5597)</th>
<th>Total (n=11172)</th>
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<tbody>
<tr>
<td><strong>Mean no. of chronic conditions</strong></td>
<td></td>
<td></td>
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<tr>
<td>• 65-74 [mean (SD)]</td>
<td>4.8 (3)</td>
<td>4.1 (2)</td>
<td>4.5 (3)</td>
</tr>
<tr>
<td>• 75-85 [mean (SD)]</td>
<td>5.6 (3)</td>
<td>5.0 (2)</td>
<td>5.3 (3)</td>
</tr>
<tr>
<td><strong>Education Level (secondary school or less)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 65-74 [n (%)]</td>
<td>605 (19)</td>
<td>452 (14)</td>
<td>1057 (17)</td>
</tr>
<tr>
<td>• 75-85 [n (%)]</td>
<td>663 (28)</td>
<td>456 (19)</td>
<td>1119 (24)</td>
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<tr>
<td><strong>Depressive symptoms</strong> (CES-D ≥10)</td>
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<tr>
<td>65-74 [n (%)]</td>
<td>552 (18)</td>
<td>311 (10)</td>
<td>863 (28)</td>
</tr>
<tr>
<td>75-85 [n (%)]</td>
<td>466 (20)</td>
<td>270 (12)</td>
<td>736 (32)</td>
</tr>
<tr>
<td><strong>Vision (fair or poor)</strong></td>
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<tr>
<td>65-74 [n (%)]</td>
<td>241 (8)</td>
<td>246 (8)</td>
<td>487 (16)</td>
</tr>
<tr>
<td>75-85 [n (%)]</td>
<td>279 (12)</td>
<td>230 (10)</td>
<td>509 (22)</td>
</tr>
</tbody>
</table>
## Performance on the TUG at baseline

<table>
<thead>
<tr>
<th></th>
<th>Women (n=5575)</th>
<th>Men (n=5597)</th>
<th>Total (n=11172)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TUG</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 65-74 [mean (SD)]</td>
<td>9.8 (2.3)</td>
<td>9.7 (2.3)</td>
<td>9.7 (2.3)</td>
</tr>
<tr>
<td>• 75-85 [mean (SD)]</td>
<td>11.3 (3.6)</td>
<td>11.0 (3.1)</td>
<td>11.1 (3.3)</td>
</tr>
</tbody>
</table>
Falls at baseline

<table>
<thead>
<tr>
<th></th>
<th>Women (n=5575)</th>
<th>Men (n=5597)</th>
<th>Total (n=11172)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>History of any injurious fall</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65-74 [n (%)]</td>
<td>184 (6)</td>
<td>137 (4)</td>
<td>321 (5)</td>
</tr>
<tr>
<td>75-85 [n (%)]</td>
<td>156 (7)</td>
<td>108 (5)</td>
<td>264 (6)</td>
</tr>
</tbody>
</table>
Falls at 18 months

- Any falls between baseline and 18 month follow-up (maintaining contact questionnaire)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Women N (%)</th>
<th>Men N (%)</th>
<th>Total N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>65-74</td>
<td>419 (13)</td>
<td>289 (9)</td>
<td>708 (11)</td>
</tr>
<tr>
<td>75+</td>
<td>339 (14)</td>
<td>276 (12)</td>
<td>615 (13)</td>
</tr>
</tbody>
</table>
## Cut-off values for falls on the TUG

<table>
<thead>
<tr>
<th>Age</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cut-off</td>
<td>AUC*</td>
</tr>
<tr>
<td>65-74</td>
<td>11.2 secs</td>
<td>0.61</td>
</tr>
<tr>
<td>75-85</td>
<td>11.4 secs</td>
<td>0.62</td>
</tr>
</tbody>
</table>

*adjusted for education, # chronic condition, depression, cognition, vision, pain and medication
Summary

• These results are preliminary
• CLSA is a high functioning sample, different from a clinical sample
• Nevertheless the data highlight the need for age and sex specific cut-off values
• Consider the need to examine alternate measures for predictive accuracy
Conclusion

- Balance testing is recommended as part of first-level screening for fall risk in community-dwelling older adults
- No consensus on which test to use and at what cut-off value
- TUG is most commonly recommended
  - One cut-off value (e.g., 12 seconds) may not be appropriate across different age and sex groups
- Need for further research to guide balance testing for fall risk screening in older adults
Implications for practice

- For high functioning community-living older adults:
  - TUG ≥ 11 seconds predicts falls in older women
  - TUG ≥ 10 seconds for men 65-74 yrs
  - TUG ≥ 12 seconds for men 75+

- Interpretation of balance scores should be based on a combination of:
  1) Existing research on cut-off values
  2) Clinical observation and judgement
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www.clsa-elcv.ca
QUESTIONS?