SUNFRAIL Transnational Workshop
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«Motor-Cognitive Frailty»

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Speechley/Tinetti’s Frailty Classification based on **falls** and mortality

Table 1. Speechley and Tinetti’s classification system (1991) (7)

<table>
<thead>
<tr>
<th>Vigorous Attributes</th>
<th>Frail Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 80 years of age</td>
<td>Greater than 80 years of age</td>
</tr>
<tr>
<td>Intact Cognition</td>
<td>Impaired Gait/Balance *</td>
</tr>
<tr>
<td>Intact Near Vision</td>
<td>No history of Walking for Exercise</td>
</tr>
<tr>
<td>Frequent Physical Activity other than walking</td>
<td>Use of Sedatives **</td>
</tr>
<tr>
<td></td>
<td>Poor Near Vision</td>
</tr>
<tr>
<td></td>
<td>Lower extremity disability ***</td>
</tr>
</tbody>
</table>

**Vigorous:** $\geq 3$ vigorous and $\leq 2$ frail attributes  
**Frail:** $\leq 1$ vigorous and $\geq 4$ frail attributes  
**Transitional:** Those not meeting the criteria for either vigor or frailty

* Defined as a gross motor impairment  
** Defined as use of: benzodiazepines, anti-depressants, phenothiazines  
*** Reduced limb strength or disability is defined as impairment in ADL’s

Fall:

Symptom of frailty (Speechley & Tinetti, 1991)

Decline in mobility and daily functioning
Risk factors for falls identified in 16 studies: Summary of univariate analysis

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Mean RR</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle weakness</td>
<td>4.4</td>
<td>1.5 – 10.3</td>
</tr>
<tr>
<td>History of falls</td>
<td>3.0</td>
<td>1.7 – 7.0</td>
</tr>
<tr>
<td>Gait deficit</td>
<td>2.9</td>
<td>1.3 – 5.6</td>
</tr>
<tr>
<td>Balance deficit</td>
<td>2.9</td>
<td>1.6 – 5.4</td>
</tr>
<tr>
<td>Use assistive device</td>
<td>2.6</td>
<td>1.2 – 4.6</td>
</tr>
<tr>
<td>Visual deficit</td>
<td>2.5</td>
<td>1.6 – 3.5</td>
</tr>
<tr>
<td>Arthritis</td>
<td>2.4</td>
<td>1.9 – 2.9</td>
</tr>
<tr>
<td>Impaired ADL</td>
<td>2.3</td>
<td>1.5 – 3.1</td>
</tr>
<tr>
<td>Depression</td>
<td>2.2</td>
<td>1.7 – 2.5</td>
</tr>
<tr>
<td>Cognitive Impairment</td>
<td>1.8</td>
<td>1.0 – 2.3</td>
</tr>
<tr>
<td>Age &gt; 80 years</td>
<td>1.7</td>
<td>1.1 – 2.5</td>
</tr>
</tbody>
</table>

Fall Prevention by Resistance Training?

No !?

Cochrane Review 2009:
120 studies, 6700 older participants

Increase of muscle mass and muscle strength, but no decrease of fall rate.

Involved systems for postural control

Motor Control (Brain)

Vestibular system, Cerebellum

Vision & Hearing

Neuro muscular control
Reaction time

Peripheral Sensibility

Muscle strength and power

Gait Variability: Stride-to-Stride Variability

Example: Left Stride Length

Coefficient of Variation (%), CoVar = (SD/M) x 100
# Stride Length Variability and Falls Among Older Community-Dwelling Older Adults

<table>
<thead>
<tr>
<th>Gait Measure</th>
<th>Change</th>
<th>Odds Ratio for Falling (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stride-to-Stride-Standard Deviation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stride Length</td>
<td>+1.7 cm</td>
<td>1.95 (1.08-3.52)</td>
</tr>
<tr>
<td>Double-Support</td>
<td>+0.72%</td>
<td>2.05 (1.11-3.77)</td>
</tr>
<tr>
<td>Stride Velocity</td>
<td>+0.016 m/s</td>
<td>2.30 (1.17-4.51)</td>
</tr>
</tbody>
</table>

Frailty Definition

A stage of physiologic vulnerability resulting from impaired homeostatic reserve and reduced capacity of the organism to withstand stress...

Brain function, cognition, and motor control...

« Multi-tasking »

Model for stress resistance testing
Quantification of functional reserve

Walk and Talk Test

High fall risk if person is stopping when answering a question

Simultaneously Measuring Gait and Cognitive Performance in Cognitively Healthy and Cognitively Impaired Older Adults: The Basel Motor–Cognition Dual-Task Paradigm

Nathan Theill, MSc, Mike Martin, PhD, Vera Schumacher, MSc, Stephanie A. Bridenbaugh, MD, and Reto W. Kressig, MD

Basel Mobility Center

Normal Walking

M.B., 72 years
Multiple falls

Velocity: 123 cm/sec
Cycle time CV: 1%

M.B., 72 years
Multiple falls

**MCI**
Mild Cognitive Impairment

Backward counting out loud

Dual Task-Related Gait Variability and Fall Risk in In-Patients

Table 2B - Risk estimates of the time to a first fall event occurring during hospital stay based on univariate Cox regression models.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Walking alone</th>
<th>Walking backwards counting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient of variation of stride time (coded as a binary variable)*</td>
<td>7.4 (0.9-59.0)</td>
<td>9.1 (1.9-43.8)</td>
</tr>
</tbody>
</table>

CI: confidence interval; HR: hazard ratio. *Binary threshold determined by sensitivity analysis (coefficient of variation >4% while walking alone, coefficient of variation >10% while walking backwards counting).

Gait variability increases as cognition worsens

N = 1153

Cognition

MCI = Mild Cognitive Impairment; AD = Alzheimer’s Dementia

Bridenbaugh SA, Monsch AU, Kressig RW. How does gait change as cognitive decline progresses in the elderly? Alzheimer’s Association International Conference, Vancouver (Can), July 14 – 19, 2012
Motoric cognitive risk syndrome: slow gait + cognitive complaints

N = 26'802
MCR: 4’812
(cognitively normal)

Australia, Belgium, Canada, China, France, Ghana, India, Israel, Italy, Japan, Korea, Mexico, Russia, South Africa, Switzerland, United Kingdom, USA

Stephanie A. Bridenbaugh · Reto W. Kressig
University Center for Medicine of Aging, Basel Mobility Center, Felix Platter Hospital, Basel, Switzerland

Motor cognitive dual tasking

Early detection of gait impairment, fall risk and cognitive decline

Z Gerontol Geriat 2015 · 48:15–21

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