Impact van dementie op de motoriek
evaluatie en aangrijpingspunten voor preventie en revalidatie.

Ivan Bautmans
Frailty in Ageing research group
www.vub.ac.be/FRIA

Dementia

- Subcortical
  Parkinson, Huntington
- Cortical
  Alzheimer
  Vasculair
  Mixed
Stages of dementia

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Subjectively and objectively normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 2</td>
<td>Subjective complaints, objectively normal</td>
</tr>
<tr>
<td>Phase 3</td>
<td>Mild Cognitive Impairment</td>
</tr>
<tr>
<td>Phase 4</td>
<td>Early dementia</td>
</tr>
<tr>
<td>Phase 5</td>
<td>Moderate dementia</td>
</tr>
<tr>
<td>Phase 6</td>
<td>Moderately severe dementia</td>
</tr>
<tr>
<td>Phase 7</td>
<td>Severe dementia</td>
</tr>
</tbody>
</table>

Global Deterioration Scale (GDS)
26-46% less risk for cognitive decline in subjects aged >64yrs compared to passive lifestyle

<table>
<thead>
<tr>
<th></th>
<th>Studies, n</th>
<th>High level of physical activity</th>
<th>Moderate level of physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>10</td>
<td>0.63 (0.56-0.72)</td>
<td>0.70 (0.62-0.79)</td>
</tr>
<tr>
<td>Females</td>
<td>10</td>
<td>0.60 (0.51-0.71)</td>
<td>0.63 (0.54-0.75)</td>
</tr>
<tr>
<td>Sample size</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;3500 subjects</td>
<td>12</td>
<td>0.53 (0.45-0.64)</td>
<td>0.57 (0.48-0.67)</td>
</tr>
<tr>
<td>≥3500 subjects</td>
<td>3</td>
<td>0.70 (0.62-0.79)</td>
<td>0.77 (0.68-0.87)</td>
</tr>
<tr>
<td>Duration of follow-up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 years</td>
<td>9</td>
<td>0.54 (0.44-0.65)</td>
<td>0.55 (0.46-0.66)</td>
</tr>
<tr>
<td>≥5 years</td>
<td>6</td>
<td>0.67 (0.59-0.77)</td>
<td>0.74 (0.65-0.85)</td>
</tr>
<tr>
<td>Method used to determine cognitive function</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MMSE</td>
<td>10</td>
<td>0.64 (0.54-0.75)</td>
<td>0.67 (0.57-0.78)</td>
</tr>
<tr>
<td>Others</td>
<td>5</td>
<td>0.56 (0.46-0.68)</td>
<td>0.57 (0.50-0.80)</td>
</tr>
</tbody>
</table>

MMSE, mini-mental state examination.


Leisure-time physical activity at midlife and the risk of dementia and Alzheimer’s disease

<table>
<thead>
<tr>
<th></th>
<th>Odds ratio (95% CI) for active vs sedentary group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dementia</strong></td>
<td></td>
</tr>
<tr>
<td>APOE €4 carriers (n=439)</td>
<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>0.39 (0.36-0.42)</td>
</tr>
<tr>
<td>Model 2</td>
<td>0.38 (0.35-0.41)</td>
</tr>
<tr>
<td>Model 3</td>
<td>0.41 (0.38-0.45)</td>
</tr>
<tr>
<td>APOE €4 non-carriers (n=813)</td>
<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>0.55 (0.52-0.59)</td>
</tr>
<tr>
<td>Model 2</td>
<td>0.59 (0.56-0.62)</td>
</tr>
<tr>
<td>Model 3</td>
<td>0.60 (0.57-0.63)</td>
</tr>
<tr>
<td><strong>Alzheimer’s disease</strong></td>
<td></td>
</tr>
<tr>
<td>APOE €4 carriers (n=433)</td>
<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>0.23 (0.19-0.27)</td>
</tr>
<tr>
<td>Model 2</td>
<td>0.23 (0.20-0.27)</td>
</tr>
<tr>
<td>Model 3</td>
<td>0.24 (0.20-0.28)</td>
</tr>
<tr>
<td>APOE €4 non-carriers (n=806)</td>
<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>0.54 (0.49-0.59)</td>
</tr>
<tr>
<td>Model 2</td>
<td>0.59 (0.54-0.63)</td>
</tr>
<tr>
<td>Model 3</td>
<td>0.61 (0.56-0.66)</td>
</tr>
</tbody>
</table>

Model 1 was adjusted for age at re-examination, sex, education, follow-up time, and history of locomotor disorders. Model 2 was adjusted for the same variables as model 1 with the addition of midlife body mass index, systolic blood pressure, cholesterol, and history of myocardial infarction, stroke, and diabetes mellitus. Model 3 was adjusted for the same variables as model 2 with the addition of smoking status and alcohol drinking.

N=1449, age 65–79 years, mean follow-up= 21 yrs

Leisure-time physical activity at midlife ≥2x/week =reduced risk of dementia (-52%) AD (-62%)

Rovio ea Lancet Neurol 2005
Underlying mechanisms

- ↑ blood flow to the brain
- ↓ risk for cerebro-vascular & cardio-vascular diseases/events
- **Neurotrophic effect**
  - Release of Brain Derived Neurotrophic Factor (BDNF)
  - ↑ neuronal growth & survival
- ↓ stress = ↓ cortisol levels


Motor changes accompanying cognitive decline
Subcortical versus Cortical

Subcortical Dementia

• Begin Phase
  apparent motor signs: tremor, chorea
  increased tonus, abnormal gait
  bradykinesia

• End Phase
  fetal posture, rigidity, contractures

Cortical Dementia

• Begin Phase
  Motor signs are hidden
  more cognitive signs

• End Phase
  fetal posture, rigidity, contractures

40 elderly presenting increased fall-risk (aged 80.6±5.4 yrs)
41 old controls (aged 79.1±4.9 yrs)

• Accelerometer in belt in between SIPS
  - Tri-axial accelerometer, sampling rate 100Hz

Bautmans ea Gait & Posture 2011 33: 366-372
Mean of 2 walks (18m)

- Gait Speed (m/s)
- Step Time symmetry (%)
  - \((\Delta \text{ step time L–R})/ \text{ (mean step time L&R)}\)
- Autocorrelation coefficient
  - Step regularity
  - Stride regularity

\[
A_{\text{unbiased}} = \frac{1}{N - |m|} \sum_{i=1}^{N-|m|} x_i x_{i+m}
\]

\(N\) = # measurements
\(m\) = Phase shift in measurements
\(x\) = acceleration

Moe-Nilssen ea. JBiomech 2004

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Gait speed</th>
<th>Step time asymmetry</th>
<th>Step regularity</th>
<th>Stride regularity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CC</td>
<td>ML</td>
<td>CC</td>
<td>ML</td>
</tr>
<tr>
<td>Co-morbidity</td>
<td>-0.08</td>
<td>0.11</td>
<td>-0.12</td>
<td>0.02</td>
</tr>
<tr>
<td>Mobility</td>
<td>0.11</td>
<td>0.11</td>
<td>0.06</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.16</td>
<td>-0.09</td>
</tr>
<tr>
<td>MMSE</td>
<td>0.13(^\d)</td>
<td>0.17</td>
<td>0.18</td>
<td>0.16</td>
</tr>
<tr>
<td>bADL Dependency</td>
<td>-0.40(^\d)</td>
<td>0.29(^\d)</td>
<td>-0.32(^\d)</td>
<td>0.04</td>
</tr>
<tr>
<td>iADL Dependency</td>
<td>0.29(^\d)</td>
<td>0.05</td>
<td>0.16</td>
<td>-0.03</td>
</tr>
<tr>
<td>Grip strength</td>
<td>0.40(^\d)</td>
<td>-0.11</td>
<td>0.23(^\d)</td>
<td>-0.01</td>
</tr>
<tr>
<td>Grip work/kg body weight</td>
<td>0.35(^\d)</td>
<td>-0.25(^\d)</td>
<td>0.14</td>
<td>0.07</td>
</tr>
<tr>
<td>Get-up-and-go</td>
<td>-0.53(^\d)</td>
<td>0.14</td>
<td>-0.21</td>
<td>0.09</td>
</tr>
<tr>
<td>Tinnell balance</td>
<td>0.44(^\d)</td>
<td>-0.15</td>
<td>0.35(^\d)</td>
<td>-0.35(^\d)</td>
</tr>
<tr>
<td>Tinnell gait</td>
<td>0.51(^\d)</td>
<td>-0.34(^\d)</td>
<td>0.54(^\d)</td>
<td>-0.09</td>
</tr>
</tbody>
</table>

Partial correlation coefficients (controlling for age).
\(^\d\) \(p < 0.05\).
\(^\d\) \(p < 0.01\).
Table 7  
Locometrix® parameters in a single-task paradigm (TS).

<table>
<thead>
<tr>
<th></th>
<th>Control group (m ± S.D.)</th>
<th>MCI group (m ± S.D.)</th>
<th>AD group (m ± S.D.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed (m/s)</td>
<td>1.4 ± 0.13 (a)</td>
<td>1.22 ± 0.15 (a, b)</td>
<td>1.02 ± 0.36 (b)</td>
</tr>
<tr>
<td>Stride frequency (Hz)</td>
<td>1 ± 0.08 (a)</td>
<td>0.9 ± 0.05 (b)</td>
<td>0.95 ± 0.17 (a, b)</td>
</tr>
<tr>
<td>Stride length (m)</td>
<td>1.41 ± 0.10 (a)</td>
<td>1.36 ± 0.13 (a, b)</td>
<td>1.13 ± 0.45 (b)</td>
</tr>
<tr>
<td>Regularity (dimensionless)</td>
<td>276 ± 35 (a, b)</td>
<td>287 ± 29 (a)</td>
<td>227 ± 82 (b)</td>
</tr>
<tr>
<td>Symmetry (dimensionless)</td>
<td>202.79 ± 31.06 (a)</td>
<td>224 ± 25 (a)</td>
<td>209 ± 77 (a)</td>
</tr>
<tr>
<td>Stops</td>
<td>0 ± 0 (a)</td>
<td>0 ± 0 (a)</td>
<td>0 ± 0 (a)</td>
</tr>
</tbody>
</table>

A different letter represents a significant difference (£p < 0.05) between the groups.


N=474, MMSE ≥16/30, followed for 13 years

Figure 1. Cumulative risk (1 - cumulative survival) curves of developing individual domain motor signs (MOSIs) and any MOSIs y-axes. The time axes (x) show years from first evaluation until development of signs (or last evaluation).

Figure 2. Mean scores for individual motor sign (MOSI) domains and total MOSIs (y axes) over the course of follow-up in years (x axes). Regression lines are derived from the generalized estimating equation models.

Scarmea ea. Neurology 2004
Table 2. Final Results After 4 Delphi Questionnaires

<table>
<thead>
<tr>
<th>Group median</th>
<th>Description of phenomenon Paratonia is (Group median cut-off point 3,5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>A resistance to passive movement</td>
</tr>
<tr>
<td>5</td>
<td>An involuntary resistance</td>
</tr>
<tr>
<td>4</td>
<td>A form of hyperonia</td>
</tr>
<tr>
<td>3,5</td>
<td>A variable resistance during passive movement</td>
</tr>
</tbody>
</table>

**Influencing factors (Group median cut-off point 3)**

| 5            | The nature of the paratonia may change with progression of the demen- |
|              | tising illness (e.g., early in the course of degenerative demen- |
|              | tias, active assistance (Mitigation) is more common and later of |
|              | the disease, active resistance is more common)                      |
| 4.5          | The degree of resistance varies depending on the speed of move- |
|              | ments: slow → decrease, fast → increase                             |
| 4            | The degree of paratonia is proportional to the amount of force ap- |
|              | plied                                                                  |
| 4            | Paratonia increases with progression of the dementia                 |

**Differentiating elements (Group median cut-off point 3,75)**

| 5            | No clasp-knife phenomenon                                             |
| 5            | The resistance to passive movement is in any direction                |

We asked the participants to provide a cut-off score for each category. Items with a score equal to or higher than this cut-off score were considered as meeting the criteria for a proper definition of paratonia.

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**Figure 1.** Assessing paratonia with the PAI by conducting passive movement of the shoulders, elbows and hips in flexion and extension.

- An involuntary variable resistance during passive movement
- There is no clasp-knife phenomenon
- The resistance to passive movement is in any direction
- Resistance must be felt in either one limb in two movement directions or in two different limbs
- The degree of resistance correlates with the speed of movement (e.g., a low resistance to slow movement and a high resistance to fast movement)

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Hobbelen ea. J Geriatric Physical Therapy 2006

Hobbelen ea. IntPsychogeriatr 2008
Management of motor deficits in elderly with cognitive decline

Rehabilitation for older people in long-term care
Forster ea Cochrane review 2010, Age&Ageing 2010

- 49 trials involving 3611 participants
- overall mean age = 82 yrs (69-89)
- 30 to 45-minute sessions, 3x per week
- physical rehabilitation
  - worthwhile and safe,
  - reducing disability,
  - few adverse events
- no recommendations for best intervention
Frail Institutionalized Older Persons
A Comprehensive Review on Physical Exercise, Physical Fitness, Activities of Daily Living, and Quality-of-Life

ABSTRACT

Evidence-Based guidelines

- **Strength:** Type: progressive resistance training; intensity: 40%–80% of 1 RM; volume: increasing from one set of eight repetitions to three sets of eight repetitions; frequency: three times a week; duration per session: 60 mins; total duration: at least 10 wks.

- **Balance:** Type: adjusted at individual needs and possibilities, balance exercises progressively challenging; balance exercises refer to exercises that challenge one’s balance, like standing with feet together without assistance of hands, walking on a parkour with obstacles etc.; frequency: three times a week; duration per session: 60 mins; total duration: 3 mos.

Evidence-Based guidelines

- **Endurance.** Type: progressive resistance training; intensity: 80% of 1 RM; volume: increasing from one set of eight repetitions to three sets of eight repetitions; frequency: three times a week; duration per session: 60 mins; total duration: 10 wks.

- **Functional performance.** Type: progressive resistance training or progressive functional training (i.e., walking, stepping, game-like exercises, and sport-like exercises); intensity for progressive resistance training: 40%–80% of 1 RM; volume for progressive resistance training: increasing from one set of eight repetitions to three sets of eight repetitions; intensity for progressive functional training should be increased over time based on individual needs and abilities.


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Evidence-Based guidelines

- **ADL performance.** Type: progressive resistance training; intensity: 40%–80% of 1 RM; volume: increasing from one set of eight repetitions to three sets of eight repetitions; frequency: three times a week; duration per session: 60 mins; total duration: 10 wks.

- **Quality-of-life.** Type: combination of progressive resistance training and progressive functional training; intensity: 40%–80% of 1 RM; volume: increasing from one set of eight repetitions to three sets of eight repetitions; frequency: three times a week; duration per session: 60 mins; total duration: 6 mos.

Exercise & Dementia

- MMSE = 17.8 ± 7.2 (mild – moderate)
- 6 weeks strength training (theraband)
  - Feasible 2 à 3 sessions per week

Walking the line: a randomised trial on the effects of a short term walking programme on cognition in dementia

L H P Eggermont,1 D F Swaab,2 E M Hol,2 E J A Scherder1,3

- 97 older nursing home residents with moderate dementia (age 85 yrs; mean Mini-Mental State Examination 17.7)
- randomly allocated to
  - walking for 30 min, 5 days a week, for 6 weeks.
  - control = social visits in the same frequency
- NO SIGNIFICANT EFFECTS ON COGNITION
- ? TOO LOW EXERCISE INTENSITY?
Review of Effects of Physical Activity on Strength, Balance, Mobility and ADL Performance in Elderly Subjects with Dementia

Christiaan G. Blankevoorta Marieke J.G. van Heuvelena Frökje Boersmaa
Helga Luninga Jeltsje de Jongc Erik J.A. Scherdera,d

aInstitute of Human Movement Sciences and bDepartment of General Medicine and Geriatrics, University Medical Center Groningen, Groningen; cNursing Home Vlerackers, Mental Health Center Drenthe, Assen; and dDepartment of Clinical Neuropsychology, VU University Amsterdam, Amsterdam, The Netherlands

Systematic review including 16 clinical trials

Evidence-Based guidelines

Practical guidelines

- Offer exercise in all stages of dementia
- Use multicomponent interventions
- A duration of 12 weeks or more
- Exercise at least 3 times a week
- Exercise 45–60 min/session

Blankevoort ea Dement Geriatr Cogn Disord 2010;30:392–402
ES 0.2=small effect; 0.5=medium effect; >0.8=large effect

<table>
<thead>
<tr>
<th>Outcome measures</th>
<th>Number of studies</th>
<th>ES</th>
<th>Methodological quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gait speed (normal)</td>
<td>6</td>
<td>0.29 (−0.11 to 0.50)</td>
<td>18.8 (9–23)</td>
</tr>
<tr>
<td>Gait speed (fast)</td>
<td>2</td>
<td>0.14 (0.10 to 0.19)</td>
<td>12.1 (9–15)</td>
</tr>
<tr>
<td>Endurance</td>
<td>5</td>
<td>1.08 (0.31 to 3.79)</td>
<td>12.7 (4–17)</td>
</tr>
<tr>
<td>Functional mobility</td>
<td>6</td>
<td>0.28 (−0.25 to 2.37)</td>
<td>18.2 (9–23)</td>
</tr>
<tr>
<td>Lower-extremity strength</td>
<td>7</td>
<td>0.85 (−0.04 to 3.14)</td>
<td>13.3 (4–17)</td>
</tr>
<tr>
<td>Balance</td>
<td>5</td>
<td>1.76 (−0.24 to 3.59)</td>
<td>12.1 (9–17)</td>
</tr>
<tr>
<td>ADL</td>
<td>4</td>
<td>0.68 (0.11 to 5.06)</td>
<td>20.5 (14–23)</td>
</tr>
</tbody>
</table>

ES = Effect size (Cohen’s d). Methodological quality score based on the DB questionnaire, theoretical range 0 (lowest quality) to 26 (highest quality). Figures in parentheses indicate ranges.

Blankevoort ea Dement Geriatr Cogn Disord 2010;30:392–402

**Strength training**
Functional strength training

Endurance training
Passive interventions?

Fetal Posture

- Treatment targeting output
  countering contractures by means of forced passive mobilization

- Treatment targeting input
  Increasing stability and tactile input = PDL
Consequences

- Institutionalized elderly
  - Dementia >50%
  - Alterations in muscle tonus (paratonia)
  - Changes in posture
  - Dysphagia (bolus<20ml)

ANTEROPPOSITION

High cervical: Extension
Middle cervical: Flexion
Low cervical: Flexion

EXTENSION

High cervical: Extension
Middle cervical: Extension
Low cervical: Extension
Kyphotic

High cervical: Flexion
Middle cervical: Flexion
Low cervical: Flexion

Posture - dysphagia

• Guidelines dysphagia
  – Rehabilitation
    • exercises for strength, coordination, …
  – Compensation
    • Posture, volume, taste, consistency

HOW?
Aim of the study

• Correction of head posture by manual mobilizations
  – Feasibility
    • Compliance / refusal / …
  – Influence on dysphagia
    • Bolus volume
      1ml, 3ml, 5ml, 10ml, 15ml, 20ml
Participants

• Eligibility
  – Elderly (>65yrs) nursing home residents (AZ-Damiaan, Tremelo, Belgium, 450 beds)
  – cognitive impairment due to dementia (MMSE<24/30)
  – known dysphagia (logopedist)

• Exclusion
  – No postural alteration
  – Refusal

Methods

• Enrolled
  – 10 female, 6 male
  – mean age = 85 ± 6 years
  – mean MMSE = 8 ± 6 /30

• Randomized controlled trial
  – 1 week (3 sessions) cervical mobilisation
  – Control (socializing visit)

• Cross-over design
• Independent therapists
• Blinded assessors
• Intention to treat analysis
Fig. 1. Randomized controlled trial with cross-over design. All participants (n=16) were randomly divided into 2 groups. Group 1 started with one week mobilization, followed by one week wash-out and one week control. Group 2 started with one week control, followed by one week wash-out and one week mobilization.

Fig. 3. Gentle cervical spine mobilization. The participant was seated comfortably with his head supported against the chest of the therapist, who maintained the head in his hand and arm. The therapist gently mobilized the head and cervical spine in order to correct the posture (i.e. centring the head in a neutral position above the shoulders). The mobilization consisted of free passive movements of the head without active participation of the patients and without supplementary traction or other components. Mobilization was performed within the available range of movement, without eliciting muscular defence or complaints from the patients.
Feasibility

• 90% sessions successfully performed
  – 3 sessions impossible due to patient's hostility
  – 2 sessions impossible due to illness

• no complications

Improvement of dysphagia limit following cervical mobilization.

* outlier, *extreme, † significant improvement (p<0.05), § significant difference in evolution between mobilization and control (p<0.05).
CONCLUSIONS

• Physical exercise = counterstone for prevention and management of cognitive decline
• Motor alterations occur with cognitive disorders
  – “hidden” in early stage (fall risk!)
  – Worsen with pathologic evolution
  – End stage = fetal posture
• Physical activity feasible & effective in all stages of dementia
• Gentle passive mobilizations can be integrated in PDL-strategy

Thank you!

www.vub.ac.be/GERO