Longitudinal patterns of sedentary behaviour in the first year after stroke

Zoë Tieges, Gillian Mead, Mike Allerhand, Fiona Duncan, Frederike van Wijck, Claire Fitzsimons, Carolyn Greig, Sebastien Chastin

Sedentary behaviour

Definition
Cluster of behaviours adopted in a sitting or lying posture with low energy expenditure (e.g. watching television, travelling by car)
What sedentary behaviour is NOT

- A lack of physical activity or exercise

- Current physical activity recommendations for older adults are 150 min/week of moderate intensity activity

... so you could do adequate physical activity but have substantial sedentary time ('active couch potato')

Why care about sedentary behaviour?

- Poor health outcomes independently of physical activity

- High levels of sedentary behaviour negatively impact
  - Bone mineral density
  - Metabolic health
    - e.g. association between TV viewing and type-2 diabetes and obesity
  - Vascular health

  Even among those who do adequate physical activity

- Major modifiable risk factor for chronic disease and mortality, independent of physical activity levels
Stroke

- Sudden onset focal neurological disturbance of vascular origin lasting more than 24 hours
- Main cause of adult disability in the UK
- Two main types: haemorrhagic (about 15%) and ischaemic (about 80%)

Sedentary behaviour after stroke

- Stroke survivors are predisposed to a sedentary lifestyle
  - Long-term disabilities: reduced mobility, poor balance etc.
- This may increase vascular risk, including risk of new stroke
- Beneficial role of physical activity in stroke rehabilitation and prevention
- Sedentary behaviour: equally important therapeutic target?

Patterns of sedentary behaviour after stroke!
Moore et al. (2013) study

Physical Activity, Sedentary Behaviour and Metabolic Control following Stroke: A Cross-Sectional and Longitudinal Study

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- Longitudinal study (N=25)
- Patients assessed at 1 week, 3 months and 6 months after stroke
- Body worn sensor; Sedentary time (<3 MET) and number of breaks
- Modest decrease in sedentary behaviour at 3 months, but no further reduction at 6 months

Need for larger
longer-term
more in-depth studies!
Sedentary Behavior in the First Year After Stroke: A Longitudinal Cohort Study With Objective Measures

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Study objective

To quantify longitudinal changes in the amount and pattern of sedentary behaviour after stroke

- To ascertain whether reducing sedentary behaviour might be a new therapeutic target
- Objective measurement in free-living conditions
- Study sample followed for one year
- Controlling for age, sex, stroke severity and functional ability
Study design and participants

- Participants with a recent acute stroke
- Longitudinal cohort study of fatigue after stroke
- Assessments: 1, 6 and 12 months following stroke

Exclusion criteria
- Subarachnoid haemorrhage (unless secondary to intraparenchymal haemorrhage)
- Severe dysphasia/cognitive impairments
- Medical instability, and/or too unwell to participate

Written informed consent obtained from all participants

Measurements

- Sedentary behaviour
  Body worn sensor

- Functional independence
  Nottingham Extended Activities of Daily Living Questionnaire (NEADL)

- Functional capacity
  6-minute walk distance (6MWD)
Sedentary behaviour metrics

1. **Total sedentary time (h/day)**
   - Summation of sedentary bouts, averaged across days

2. **Median sedentary bout length**
   - Length of sedentary bout that corresponds to 50% of accumulated sedentary time
   - Lower median sedentary bout length is better for health

3. **Fragmentation index**
   - Ratio of number of sedentary bouts / total sedentary time
   - Summarizes the pattern of accumulation of sedentary time
   - A higher fragmentation index is better for health
Statistical analyses

- Linear mixed effects models
  - Estimate longitudinal changes in sedentary behaviour

- Covariates
  - Age, sex, stroke severity (National Institute of Health Stroke Scale)
  - NEADL score and 6-min walk distance (functional ability)

- Continuous variables centered around their average value

- Main predictor ‘time’; random intercept and random slope of time

- Dependent variables standardized into S.D. units at baseline

Results

- EFAS study N=136
- Valid activPAL data N=96 (at least 1 assessment) 71%
  - 1 month N=75
  - 6 months N=64
  - 12 months N=58
### Patient characteristics

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>N</td>
<td>96</td>
</tr>
<tr>
<td>Male</td>
<td>64</td>
</tr>
<tr>
<td>Age (years)</td>
<td>72.2 (IQR 64-80)</td>
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<tr>
<td>NIHSS score</td>
<td>2 (IQR 1-3)</td>
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<tr>
<td>Mild stroke (NIHSS ≤4)</td>
<td>79</td>
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<tr>
<td>Moderate stroke (NIHSS&gt;4)</td>
<td>15</td>
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<tr>
<td>Unknown</td>
<td>2</td>
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<tr>
<td>Previous stroke</td>
<td>20</td>
</tr>
<tr>
<td>MMSE score</td>
<td>27 (IQR 25-29)</td>
</tr>
<tr>
<td>In hospital at 1 month</td>
<td>12</td>
</tr>
</tbody>
</table>

### Sedentary behaviour metrics

Stroke patients: 19.4 h per day (81%)
Healthy older adults: ~17 h (71%)
**Sedentary behaviour metrics**

**Median sedentary bout length**

Average weighted median bout length = 1h 42min

**Fragmentation Index**

1h of sedentary time accumulated in 2.3 bouts
### Total sedentary time

<table>
<thead>
<tr>
<th></th>
<th>Estimate (Std. Error)</th>
<th>Estimate (Std. Error)</th>
<th>Estimate (Std. Error)</th>
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<tbody>
<tr>
<td><strong>Model 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Intercept)</td>
<td>0.52 (0.31)</td>
<td>-0.26 (0.32)</td>
<td>-0.43 (0.34)</td>
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<tr>
<td>time</td>
<td>-0.10 (0.18)</td>
<td>-0.16 (0.28)</td>
<td>0.08 (0.21)</td>
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<tr>
<td>age</td>
<td>0.00 (0.01)</td>
<td><strong>0.02 (0.01)</strong> *</td>
<td>-0.02 (0.01)</td>
</tr>
<tr>
<td>sex</td>
<td>-0.41 (0.21)</td>
<td>0.15 (0.22)</td>
<td>0.36 (0.24)</td>
</tr>
<tr>
<td>severity</td>
<td><strong>0.11 (0.05)</strong> *</td>
<td>0.07 (0.05)</td>
<td>-0.09 (0.05)</td>
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<tr>
<td>time x age</td>
<td>0.01 (0.01)</td>
<td>-0.01 (0.01)</td>
<td>-0.01 (0.01)</td>
</tr>
<tr>
<td>time x sex</td>
<td>0.01 (0.12)</td>
<td>0.18 (0.19)</td>
<td>-0.04 (0.14)</td>
</tr>
<tr>
<td>time x severity</td>
<td>-0.04 (0.03)</td>
<td><strong>-0.09 (0.04)</strong> *</td>
<td>0.05 (0.03)</td>
</tr>
</tbody>
</table>

* p<0.05

### Diurnal sedentary time curves

The graph shows the diurnal pattern of sedentary time over 1 month, 6 months, and 12 months. The sedentary time decreases as the day progresses, with a notable increase in sedentary time during the evening hours. The patterns indicate a consistent trend across different time periods, with slight variations in the magnitude of sedentary time.
Functional ability

6-minute walk distance

![Graph showing 6-minute walk distance over time.](image)

Functional independence

![Graph showing functional independence over time.](image)

Linear mixed model results

- **Model 1 (age, sex, stroke severity)**
  - No longitudinal changes (1, 6, 12 months) in sedentary behaviour
  - Median bout length decreased with age (0.02 S.D., p<0.05)
  - Median bout length decreased more over time with higher NIHSS scores (-0.25 S.D. per 1-point score change, p<0.05)

- **Model 2: (+ NEADL)**
  - No longitudinal changes in sedentary behaviour
  - Higher NEADL score was associated with less sedentary behaviour (p<0.01)
  - Men spent less time being sedentary than women (-0.37 S.D., p<0.05)

- **Model 3 (+ 6-min walk)**
  - No longitudinal changes in sedentary behaviour
Conclusions

- Stroke survivors are highly sedentary and remain so a year after stroke, independently of their functional ability
  
  Most patients lived at home and reported high levels of functional independence!

- Sedentary time is greater and less fragmented compared to healthy older adults

- Higher stroke severity and less functional independence associated cross-sectionally with more sedentary behaviour

Discussion

- Weaknesses
  - Reactivity (BUT: on average 5 recording days)
  - No control group
  - Drop-out – but no obvious selection bias
  - ‘Mild’ sample: minor neurological deficits, all living at home

- Strengths
  - Largest sample to date, longer follow-up
  - Complete picture of amount and pattern of sedentary behaviour
  - Taking into account functional ability
Discussion

- Sedentary lifestyle in people with stroke despite adequate functional ability
  - Target behavioural changes in addition to physical function
  - Developing interventions to reduce sedentary behaviour

- Clear distinction between assessing changes in:
  1. what a person can do (functional outcomes - 6-min walk)
  2. what they say they can do (self report measures - NEADL)
  3. what they do do (objectively measured - body worn sensor)

- Determinants: Fatigue? Anxiety? Depression? Apathy?

Thank you!

Edinburgh & Lothian Health Foundation
Study patients and their families
Service User Group (study design)

Staff of Royal Infirmary of Edinburgh
Staff of Western General Hospital
Staff of outpatient clinics

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