Preserving shoulder health in wheelchair users: The role of wheelchair propulsion induced fatigue and capacity

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Objectives

Fatigue

1. To examine how wheelchair propulsion-induced fatigue effects neuromuscular activation and propulsion biomechanics
2. To determine persons susceptible to fatigue

Methods

Quasi-experimental study
Pre-test post-test design

<table>
<thead>
<tr>
<th>Study population</th>
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<tbody>
<tr>
<td>34 wheelchair users</td>
<td>No pain that limits ability to propel</td>
</tr>
<tr>
<td>SCI at T2 or below</td>
<td>No history of upper limb fractures/dislocations causing symptoms</td>
</tr>
<tr>
<td>18 % females</td>
<td></td>
</tr>
<tr>
<td>51 ± 10 years of age</td>
<td></td>
</tr>
<tr>
<td>28 ± 12 years since injury</td>
<td></td>
</tr>
</tbody>
</table>
Methods

0

1h

2h

3h

4h

Ultrasound Exam

Preparation

Max test

Rest (12’)

Max test

Max test

Fatigue protocol

25 W

45 W

PASIPD questionnaire

25 W

45 W

Ultrasound Exam

Remove equipment

Clean-up

Introduction
Participant characteristics
Range of Motion
Methods: Dependent variables

2h

3h

4h

Fatigue protocol
**Methods: Dependent variables**

**2h**
- Max test
- Rest (12’)

**3h**
- Fatigue protocol

**4h**

**Anaerobic work capacity:**
15-m sprint

**MVC**

**EMG:**
- RMS and MPF
- EMG%MVC

**Resultant force**

**Push angle**

**Statistical analysis:** One way repeated measures ANOVAs, statistical parametric mapping (SPM), and two sample t-tests ($\alpha = 0.05$)
Results and discussion

→ 47% of the sample was identified as being susceptible to fatigue

* denotes significant difference (α = 0.05).
Results and discussion

78° -> 76°
Results and discussion

Complete lesion

Age at injury

Anaerobic capacity

MET = EMG% / MVC

Max push strength

Pushangle

Frmax
Limitations

❖ Fatigue protocol remains artificial and does not represent real-life situations

❖ No measures of aerobic capacity or the wheelchair and its setup
Conclusions and future perspectives

Fatiguing wheelchair propulsion → Compensation → Shoulder Health
- Increased muscular activation
- Shorter push angle

Predictor variables of susceptibility to fatigue
- Lesion characteristics and capacity

Interventions to improve resistance to fatigue and preserve shoulder health
- Wheelchair training, neuromuscular activation, aerobic capacity
- Focus on persons susceptible to fatigue

NEXT

Tendon appearance
Glenohumeral contact force
Training strategies: HIIT?
Acknowledgements

Dr. Ursina Arnet
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Prof. Dr. Ann Cools

Thank you for your attention!
Extra slides
Recruitment procedure

Persons in SwiSCI database contacted for the SwiSCI Survey 2017
  $n = 2379$

Persons contacted for the current study as they fulfilled part of the inclusion criteria available through the SwiSCI database
  $n = 551$

Refused consent
  $n = 102$

Signed consent but excluded
  $n = 20$

Non response
  $n = 379$

Eligible for all criteria and signed consent
  $n = 53$

Included in the current study
  $n = 50$
Table 1: Subject characteristics and capacity measures for entire sample and by group (non-fatigued vs fatigued).

<table>
<thead>
<tr>
<th></th>
<th>Total (n=34)</th>
<th>Non fatigued (n=18)</th>
<th>Fatigued (n=16)</th>
<th>p</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (% male)</td>
<td>82</td>
<td>78</td>
<td>88</td>
<td>0.458</td>
<td></td>
</tr>
<tr>
<td>Cause injury (% traumatic)</td>
<td>91</td>
<td>94</td>
<td>88</td>
<td>0.476</td>
<td></td>
</tr>
<tr>
<td>Completeness (% incomplete)</td>
<td>79</td>
<td>94</td>
<td>63</td>
<td>0.021</td>
<td>0.021</td>
</tr>
<tr>
<td>Lesion level (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.823</td>
<td></td>
</tr>
<tr>
<td>T2-T6</td>
<td>41</td>
<td>44</td>
<td>38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T7-T12</td>
<td>38</td>
<td>33</td>
<td>44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1-L2</td>
<td>21</td>
<td>22</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>50.8 ± 9.7</td>
<td>50.6 ± 11.1</td>
<td>50.9 ± 8.3</td>
<td>0.924</td>
<td>[-7.24;6.59]</td>
</tr>
<tr>
<td>Height (m)</td>
<td>173.4 ± 7.7</td>
<td>171.7 ± 6.8</td>
<td>175.4 ± 8.5</td>
<td>0.172</td>
<td>[-8.97;1.67]</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>72.8 ± 13.0</td>
<td>69.0 ± 14.1</td>
<td>77.1 ± 9.2</td>
<td>0.059</td>
<td>[-16.54;0.32]</td>
</tr>
<tr>
<td>Weight Wheelchair (Kg)</td>
<td>14.5 ± 2.1</td>
<td>14.1 ± 2.3</td>
<td>15.0 ± 1.6 (n=14)</td>
<td>0.215</td>
<td>[-2.40; 0.56]</td>
</tr>
<tr>
<td>Time since injury (years)</td>
<td>27.8 ± 12.0</td>
<td>32.2 ± 12.6</td>
<td>22.9 ± 9.3</td>
<td>0.021</td>
<td>[1.49;17.16]</td>
</tr>
<tr>
<td>Age at injury (years)</td>
<td>22.9 ± 10.4</td>
<td>18.4 ± 8.4</td>
<td>28.0 ± 10.4</td>
<td>0.005</td>
<td>[-16.21;-3.09]</td>
</tr>
<tr>
<td>Total laps</td>
<td>29.6 ± 3.0</td>
<td>29.8 ± 4.7</td>
<td></td>
<td>0.898</td>
<td>[-2.90;2.55]</td>
</tr>
<tr>
<td>Maximum push strength (N)</td>
<td>183.7 ± 47.7</td>
<td>224.8 ± 42.8</td>
<td>224.8 ± 42.8</td>
<td>0.015</td>
<td>[-73.63;-8.63]</td>
</tr>
<tr>
<td>Anaerobic work capacity (W)</td>
<td>76.0 ± 23.8</td>
<td>101.6 ± 29.2</td>
<td></td>
<td>0.008</td>
<td>[-44.04;-7.04]</td>
</tr>
<tr>
<td>Activity levels (MET)</td>
<td>21.7 ± 11.6</td>
<td>18.2 ± 16.6</td>
<td></td>
<td>0.476</td>
<td>[-6.41;13.43]</td>
</tr>
</tbody>
</table>

NOTE. p-values (α = 0.05) and 95% confidence interval (95% CI) represent comparison of non-fatigued and fatigued group.