MUSCLE SIZE AND SPECIFIC FORCE ALONG THE LENGTH OF THE QUADRICEPS IN OLDER AND YOUNG INDIVIDUALS

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Introduction

• **Sarcopenia:** decrease in muscle size with age

• **Dynapenia:** decrease in muscle strength and power with age (Clark and Manini 2012)
  
  – **Likely causes of Dynapenia:** (Clark and Manini 2012)
    - Decreased muscle size
    - Neural system impairments
      - Ability to fully activate muscle
      - Fewer motor neurons

• **Specific torque:** strength per unit of cross sectional area (CSA)
  
  – Describes the quality of the muscle as a whole (Trappe et al. 2001)
Relevance

• Muscle strength is needed to control or initiate muscle movement (Jaiyesimi and Jegede 2005)

• Low levels of strength put an individual at greater risk of functional limitation and injury (Clark and Manini 2012)

• Hypertrophy patterns show a greater increase in the middle of the muscle compared to the proximal and distal ends (Tracy et al 1999)
Purpose

To compare muscle size of the quadriceps throughout the length of the thigh and specific torque in older and young individuals.
Hypotheses

1. Young subjects will have the largest CSA in the middle of the muscle and they will have a larger quadriceps CSA compared to older subjects.

2. There will not be differences in CSA among young and older subjects at the ends of the muscle.

3. Young subjects will have greater specific torque compared to older subjects.
## Descriptive Statistics of Subjects

<table>
<thead>
<tr>
<th>Group</th>
<th>Old (N = 22)</th>
<th>Young (N = 18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>76.3 ± 8.2 *</td>
<td>19.9 ± 1.3</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>168.3 ± 10.4</td>
<td>169.5 ± 9.5</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>72.4 ± 14.5</td>
<td>67.2 ± 10.2</td>
</tr>
<tr>
<td>BMI (kg•m⁻²)</td>
<td>25.4 ± 3.2 *</td>
<td>23.3 ± 2.5</td>
</tr>
</tbody>
</table>
Isometric Torque

- HUMAC Norm Dynamometer
- Right leg
- 60° knee angle
- Knee extension
- 3-5 contractions with 1 min rest between
Muscle Cross-Sectional Area (CSA)

- Magnetic Resonance Imaging (MRI)
  - 30 min supine rest for fluid equilibration

- CSA of the quadriceps was measured using Image J software
  - Rectus femoris and vasti muscles were traced manually and repeated twice
  - Intra-rater reliability: <2% difference between analyses
  - Inter-rater reliability: ICC = 0.9 between investigators

- ST of the Quadriceps = Torque (Nm) / CSA (cm²)
Section Selection

- MRI slices were dividing into Proximal, Mid, and Distal regions
  - First 3 slices
  - Middle 3 slices
  - End 3 slices
- Average of the three slices were used for CSA in each section
Statistics

• Repeated Measures Analysis of Variance (ANOVA)
  – Compare length of quadriceps (Proximal, Mid, Distal) between young and older subjects

• One-way ANOVA
  – Compare ST between young and older subjects

• Significance was followed up with T-tests and Bonferroni corrections

• IBM SPSS 21.0

• P < 0.05
RF CSA in Young and Old

![Graph showing CSA RF differences between young and old groups at proximal, mid, and distal sections.]

- **Proximal**: 56% Difference
- **Mid**: 49% Difference
- **Distal**: 43% Difference

*Significant difference indicated by asterisk (*)
Vasti CSA in Young and Old

- Proximal: 33% Difference
- Mid: 32% Difference
- Distal: 19% Difference

CSA Vasti (cm²)
QF CSA in Young and Old

![Graph showing CSA QF (cm²) for Young and Old groups at Proximal, Mid, and Distal sections with 34% and 24% differences marked.](attachment:graph.png)
Specific Torque in Young and Old

![Bar graph showing specific torque comparison between young and old individuals. The graph indicates a significant difference (*) between the two groups.](image)
Conclusion

• Young subjects have larger CSA in all areas of the muscle compared to older subjects

• Sites of atrophy are not limited to just the middle of the muscle in older subjects

• Older subjects have significantly lower ST values compared to young subjects
Limitations

• This is a cross sectional study

• Could not account for intramuscular fat
Application

• Determining where declines in CSA are most prevalent along the muscle allow for proper training or rehabilitation interventions to be implemented

• Develop exercise programs that target the full length of the quadriceps
Assisted Full Range Squat
Acknowledgements

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