Muscle Physiology and Function

- Largest tissue of the human body
- Responsible for the vast majority of energy use
- Primary site of glucose disposal, fat use and protein stores
- Major site of hormone action (insulin)
Remarkable Capacity for Adult Regeneration

Declines with Age

Muller et al, 1994
### An Ageing Nation

**Figure 1: From pyramid to coffin**

Changing age structure of the Australian population, 1925-2045

<table>
<thead>
<tr>
<th>Year</th>
<th>Males 0-14</th>
<th>Males 15-24</th>
<th>Males 25-34</th>
<th>Males 35-44</th>
<th>Males 45-54</th>
<th>Males 55-64</th>
<th>Males 65-74</th>
<th>Males 75-84</th>
<th>Males 85+</th>
</tr>
</thead>
<tbody>
<tr>
<td>1925</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>2000</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>2045</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
</tr>
</tbody>
</table>

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Image of a sign with the text: "Elderly people"
Smaller, fattier and stiffer
Muscle Structure

Bone

Muscle fiber

Blood vessel

Tendon

Muscle

Partridge T et al, 2005
Muscle - Protein Balance

Synthesis

MUSCLE MASS

Hormones
Exercise
Nutrition

Muscle growth

Breakdown

Malnutrition
Inactivity
Insulin resistance

Muscle loss

Muscle Loss in Elderly

Loss of lean leg mass (g)

Young Control
25 Days

3 times more muscle loss
1/3 the time

Elderly
13 Dart

2% total lean leg mass
9% total lean leg mass

Paddon-Jones et al. 2004
Frontera et al. 2007
Hormones

Exercise Activation of Protein Synthesis

Strength Gains in Nonagenarians

Fiatarone et al JAMA 1990;263:3029
Just 7 grams – of essentials ONLY


Diminished response in elderly

## Protein Source

<table>
<thead>
<tr>
<th>Protein Source</th>
<th>Leucine (%)</th>
<th>BCAA (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whey protein isolate</td>
<td>14</td>
<td>26</td>
</tr>
<tr>
<td>Milk protein</td>
<td>10</td>
<td>21</td>
</tr>
<tr>
<td>Egg protein</td>
<td>8.5</td>
<td>20</td>
</tr>
<tr>
<td>Muscle protein</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>Soy protein isolate</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>Wheat protein</td>
<td>7</td>
<td>15</td>
</tr>
</tbody>
</table>

Superiority of Whey


Compared to other protein sources

More evidence of superiority – the signals

http://cellbio.utmb.edu/cellbio/rer4.jpg

Whey V Soy – Older men

2-way repeated measures ANOVA
Interaction p=0.0003
Time p<0.0001
Group p<0.0050

Bars with different scripts significantly differ from each other p<0.05
How much?


Exercise and whey supplementation for athletes

Exercise and Whey Protein in Older People

Acknowledgements