MEET YOUR RISE RESEARCH TEAM

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OUR TIME TODAY

- Introductions (5 min)
- Our Approach to the Research Question (15 min)
- Results & Findings (15 min)
- Future Studies & Considerations (10 min)
- Q&A (5 min)
RESEARCH QUESTION
YOU ASKED RISE …

… to determine the biomechanical and physiological effects of using the SmartCam machines on maximum muscle output force (i.e. strength) at various elbow angles.
OUR HYPOTHESES

Using a SmartCam machine will result in:
1) Higher rates of perceived exertion following a workout
2) Significantly more force development at the ends of the range of motion
RECRUITMENT

RISE recruited 21 healthy adults that met the following criteria:

• Between the ages of 18 and 60
• Free from neurological, cardiovascular and musculoskeletal disorders
• Familiar with weight machines and use them regularly (at least once per week)
• Willing to participate in six test sessions under the supervision of RISE over a two week time period
Subjects were randomly placed into one of three groups. Each group’s subjects followed the same five-set protocol three times per week for two weeks.

**Control**

Complete a 5x8 set of bicep curls using plate-loaded (non-adjusted resistance curve) protocol

**Evolution (Selectorized)**

Complete bicep curls using the Evolution arm curl machine in the configuration order “2,” “4,” “1,” “5,” “3”

**Plate-loaded**

Complete bicep curls using the plate-loaded machine in the configuration order “2,” “4,” “1,” “5,” “3”
## Testing Protocol

### Baseline Testing

Collected the maximum isometric force output on a bicep curl for five elbow angles (30°, 45°, 90°, 135°, 180°)

### Intervention

- The sets of repetitions stayed consistent at 100% of the single arm 1-rep maximum measured on the first day
- Following each test session, subjects were asked to provide their rate of perceived exertion (RPE) on a scale from 1-10

### Impact Testing

- The maximum force output at varying elbow angles was collected again and compared, within subject, to the pre-intervention data
MEASUREMENT: RATED PERCEIVED EXERTION

How hard is the activity?

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Nothing at all</td>
</tr>
<tr>
<td>0.5</td>
<td>Just noticeable</td>
</tr>
<tr>
<td>1</td>
<td>Very light</td>
</tr>
<tr>
<td>2</td>
<td>Light</td>
</tr>
<tr>
<td>3</td>
<td>Moderate</td>
</tr>
<tr>
<td>4</td>
<td>Somewhat heavy</td>
</tr>
<tr>
<td>5</td>
<td>Heavy</td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Very heavy</td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Very, very heavy</td>
</tr>
<tr>
<td>**</td>
<td>Maximal</td>
</tr>
</tbody>
</table>

Subjects were asked for their RPE after each session.
MEASUREMENT: FORCE OUTPUT

• Subjects performed a bicep curl with a handle connected to a load cell, which was fixed to the ground.
• The position of the handle was adjusted to measure the maximum force at 5 angles.
• Repeated-measures ANOVA statistical analysis was performed with a significance level of 0.05.
# PROTOCOL LIMITATIONS

In an effort to reduce cost to Prime Fitness and increase the speed-to-market for study findings, certain research protocol aspects were deemed out of scope.

<table>
<thead>
<tr>
<th>Out-of-scope tactic</th>
<th>Corresponding Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Submit the experimental protocol to an Institutional Review Board (IRB)</td>
<td>• Collected informed consent and collected “blind data”</td>
</tr>
<tr>
<td>• Completely isolate muscles during baseline and post-intervention testing</td>
<td>• A strict, repetitive measurement protocol increased accuracy</td>
</tr>
<tr>
<td>• Investigate muscle recruitment or activation</td>
<td>• Identified areas for future collaboration</td>
</tr>
</tbody>
</table>
ANALYSIS & FINDINGS
SUBJECT DEMOGRAPHICS

Sex

- Males: 67%
- Females: 33%

Averages

- Male:
  - Age: 25
  - Weight: 164 lb.
  - Height: 5’10"

- Female:
  - Age: 28
  - Weight: 119 lb.
  - Height: 5’5"
RPE – SMARTER, NOT HARDER

How hard is the activity?

0  Nothing at all
0.5  Just noticeable
1  Very light
2  Light
3  Moderate
4  Somewhat heavy
5  Heavy
6
7  Very heavy
8
9
10  Very, very heavy
**  Maximal

<table>
<thead>
<tr>
<th>Group</th>
<th>Average RPE</th>
<th>P-value vs. Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>7.2</td>
<td>-</td>
</tr>
<tr>
<td>Plate-loaded</td>
<td>6.2</td>
<td>0.06</td>
</tr>
<tr>
<td>Selectorized</td>
<td>6.4</td>
<td>0.30</td>
</tr>
</tbody>
</table>

- Control group subjects reported “harder” workouts, but demonstrated fewer gains.
- Plate-loaded and Selectorized subjects reported “easier” workouts, but demonstrated larger gains.
POST-INTERVENTION GAINS (POUNDS)

Plate-loaded and Selectorized
- Realized gains at all angles
- Significant increase in average post-intervention gains (4.17 and 2.88lbs, respectively)

Control
- Produced lower average force (-3.33lbs), except at 30 (+3.95lbs)
  - Possibly due to muscle fatigue
POST-INTERVENTION GAINS (%)

**Plate-loaded and Selectorized**
- 16.7% average Plate-loaded gains
- 9.2% average Selectorized gains

**Control**
- -2.6% average Control gains (loss)
COMPARATIVE PERFORMANCE

Gains over Control
• 19.3% average Plate-loaded gains
• 11.8% average Selectorized gains
DID WE ANSWER THE RESEARCH QUESTION?

Plate-loaded and Selectorized groups demonstrated significant improvements in maximal force output at all angles.

<table>
<thead>
<tr>
<th></th>
<th>Plate-loaded</th>
<th>Selectorized</th>
<th>Smartcam Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gains Versus Control</td>
<td>19.3%</td>
<td>11.8%</td>
<td>15.6%</td>
</tr>
<tr>
<td>Gains Versus Baseline</td>
<td>16.7%</td>
<td>9.2%</td>
<td>13.0%</td>
</tr>
</tbody>
</table>

PLATE-LOADED | SELECTORIZED | SMARTCAM AVERAGE
WHAT WOULD WE DO NEXT?
FUTURE RESEARCH

**Hypothesis:** Implementing SmartCam technology results in higher muscle activation compared to typical weightlifting machines.

**Measurement Technique:** Measure motor unit muscle activation via electromyography (EMG) during specific lift concentric and eccentric contractions.

**Business Value:** Greater muscle activation demonstrates improvements in the neural activation sent to the muscles, indicating *users are getting more out of each workout and thus will see higher gains post-intervention.*