Maximizing Adaptations to Resistance Training Programs for Females – Performance & Physique Considerations

Bill Campbell, PhD, CSCS, FISSN
bcampbell@usf.edu

Overview

• Perspectives
• Overview of Health Benefits
• Strength and Lean Body Mass Adaptations
• Recent Findings – Protein and Lean Body Mass
• Conclusions
Perspectives –
Performance & Physique

Things to Consider

• Trained vs. Untrained Participants
• Age of Females
  — College-aged, Middle-aged, Older
• Inclusion or Exclusion of Dietary Control
  — Protein Intake
• Monitoring of Other Daily Activities
  — Concurrent aerobic training
• Mode/Type of Resistance Training
  — Circuit resistance training vs. Traditional resistance training

Things to Consider

• Program Design
  — Linear periodization, DUP, WUP, etc.
• Length of Program
• The Use of Dietary Supplements
• The Contamination of Males
• Measures of Strength
• Measures of Body Composition
  — HW, DXA, Skinfolds, Ultrasound, BodPod, BIA, etc.
Reasons for Resistance Training

Musculoskeletal Health

- Strategies for preventing osteoporosis:
  - Maximizing peak bone mass early in life
  - Slowing the rate of age-related bone loss

MAXIMAL STRENGTH TRAINING IMPROVES BONE MINERAL DENSITY AND NEUROMUSCULAR PERFORMANCE IN YOUNG ADULT WOMEN

May P. Moran,1 Tricia Colahan,1 Elizabeth Aas,1 Jan Hess,1,2 Arthur R. Shapiro1,2 and Uma Stewart1,2
Department of Cancer Research and Molecular Medicine and 2Radiology and Medical Imaging, University of
California, San Diego, California, and Department of Physical Medicine and Rehabilitation, 2Radiology,
and 2Rehabilitation, Scripps Clinic and Research Foundation, La Jolla, California.

Abstract

Muscle, bone, and nerve function, and neuromuscular performance in young women are affected by maximal strength training. Stud

ty highlights the importance of strength training in young women, and the benefits of incorporating strength training into their routine.

Introduction

Strategies for preventing osteoporosis include maximizing peak bone mass early in life and slowing the rate of age-related bone loss.
Young women are a high-risk group for osteoporosis, and strength training is effective in improving bone mineral density and preventing

Maximal strength training may improve bone mineral density in young women.
Study Overview

• Investigated the effects of lower body RT on:
  – Bone-related parameters
  – Rate of force development
  – 1RM
• 12-week training program
  – 3x/week (36 total sessions)
  – 4 works sets of 3-5 reps
    • (85-90% 1RM)

Bone Parameters

• BMD in the lumbar spine and hip.
• Bone formation marker – P1NP
  – Type 1 collagen aminoterminal propeptide
• Bone resorption marker – CTX
  – Type 1 collagen C breakdown
Health Benefits

• Regardless of the motivation to resistance train, there are tangible health benefits to the activity, especially in relation to bone health.

Questions

• What type of gains can we expect from a group of middle-aged females (~41 years old) that have not resistance trained for the past year?
  – Also, what are the time course changes for:
    • Maximal strength
    • Muscle thickness (skeletal muscle hypertrophy)

The Program

<table>
<thead>
<tr>
<th>Exercises</th>
<th>Sets</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee Extension</td>
<td>3 (or 1)</td>
<td>8-12RM to fatigue</td>
</tr>
<tr>
<td>Knee Flexion</td>
<td>3 (or 1)</td>
<td>8-12RM to fatigue</td>
</tr>
<tr>
<td>Chest Press</td>
<td>3 (or 1)</td>
<td>8-12RM to fatigue</td>
</tr>
<tr>
<td>Seated Row</td>
<td>3 (or 1)</td>
<td>8-12RM to fatigue</td>
</tr>
<tr>
<td>Curls (elbow flexion)</td>
<td>3 (or 1)</td>
<td>8-12RM to fatigue</td>
</tr>
<tr>
<td>Triceps Extensions</td>
<td>3 (or 1)</td>
<td>8-12RM to fatigue</td>
</tr>
</tbody>
</table>

3 days/week for 12 weeks (total of 36 workouts)
Strength Gains

Increased chest press strength by 29% and 38% after 8 & 12 weeks.

Increased knee ext. strength by 21% and 23% after 8 & 12 weeks.

Body Composition Changes

- No changes in FFM or % Bodyfat over the course of the study in females.
  - Gain of 1.5 pounds of muscle
Muscle Thickness (Hypertrophy)

• Upper Body:
  – Biceps: 12% increase at 8-weeks
  – Triceps: 8% increase at 6-weeks (same at 8-weeks)
  – Chest: 13% increase at 6-weeks (19% at 8-weeks)

• Lower Body:
  – Quadriceps (50%): No sig. increase over the course of study (7%)
  – Hamstrings (50%): No sig. increase over the course of study (7%)
  • Note: Gradual increases were observed, but were not significant
Strength Gains

<table>
<thead>
<tr>
<th></th>
<th>Chest Press</th>
<th>Leg Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td>77 pounds (23%)</td>
<td>88 pounds (23%)</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td>50 pounds (38%)</td>
<td>48 pounds (23%)</td>
</tr>
</tbody>
</table>

Males experienced significantly greater mean absolute changes in upper and lower body strength. However, when expressed as a relative % of increase, the males and females were not significantly different.

Body Composition

- No significant differences in FFM or % body fat
  - Males gained 3.5 pounds of FFM (2.6%)
  - Females gained 1.5 pounds of FFM (1.7%)

Muscle Thickness (Hypertrophy)

<table>
<thead>
<tr>
<th></th>
<th>Upper Body</th>
<th>Lower Body</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td>12-21%</td>
<td>7-9%</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td>10-31%</td>
<td>7-8%</td>
</tr>
</tbody>
</table>
Muscle hypertrophy in men and women

For upper arm, no differences between males (16%) and females (23%).

No muscle hypertrophy occurred in the thigh.
Body Composition Changes

- No changes in Fat-Free Weight or Fat Weight over the course of the study for the males or females.

![Graph showing body composition changes]

Strength

- Absolute changes by the males were significantly greater as compared to the females.
- However, relative increases were not significantly different between the males and females.

![Image of a muscular person]

Evidence
Programming Superiority

Weekly Undulating Periodization

vs.

Block Periodization
Weekly Undulating vs. Block Periodization

• Who was in the study?
  – 17 females (~24 years) with resistance training and back squat experience

• What did they do?
  – Randomly assigned to a block periodization or weekly undulating periodization group
  – Resistance trained 3 days/week for 10-weeks
    • Total of 30 workouts

Weekly Undulating vs. Block Periodization

• What was measured?
  – Maximal Strength
    • Squat
    • Bench Press
    • Deadlift
  – Body Composition
    • Lean Body Mass
    • Fat Mass
    • Estimated Arm Muscle Area
    • Estimated Total Thigh Muscle Cross-Sectional Area

Table 1. Exercises for both BP and WUD training programs.

<table>
<thead>
<tr>
<th>Day</th>
<th>Exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>Squat</td>
</tr>
<tr>
<td></td>
<td>Counter movement jump</td>
</tr>
<tr>
<td></td>
<td>Bench press</td>
</tr>
<tr>
<td></td>
<td>Military press</td>
</tr>
<tr>
<td></td>
<td>Leg curl</td>
</tr>
<tr>
<td>Wednesday</td>
<td>Deadlift</td>
</tr>
<tr>
<td></td>
<td>Seated row</td>
</tr>
<tr>
<td></td>
<td>Lat machine</td>
</tr>
<tr>
<td></td>
<td>Preacher curl</td>
</tr>
<tr>
<td>Friday</td>
<td>Squat deadlift</td>
</tr>
<tr>
<td></td>
<td>Leg extension</td>
</tr>
<tr>
<td></td>
<td>Inclined bench press</td>
</tr>
<tr>
<td></td>
<td>High pull</td>
</tr>
<tr>
<td></td>
<td>Barbell rows</td>
</tr>
</tbody>
</table>

BP = block periodization; WUD = weekly undulating.
Results – Muscular Strength

- Weekly Undulating Periodization training resulted in a significant difference in maximal squat strength.
- No significant differences between training programs in maximal strength for the bench press and deadlift.

<table>
<thead>
<tr>
<th></th>
<th>Weekly Undulating</th>
<th>Block Periodization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Squat 1RM</td>
<td>12%</td>
<td>26%*</td>
</tr>
<tr>
<td>Bench Press 1RM</td>
<td>1.5%</td>
<td>5.7%</td>
</tr>
<tr>
<td>Deadlift 1RM</td>
<td>21%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Results – Body Composition

- No significant differences between training programs in lean body mass and arm muscle area.
- Estimated total thigh muscle cross-sectional area was significantly greater in the Weekly Undulating Periodization group as compared to the Block group.
  - Increase of 5.8% vs. 1.3%
Conclusions

• "Previous studies comparing Block Periodization to Undulating models in male subjects have reported greater gains in strength and power after the block model."

New Protein Research

References