Controversies in Strength Training Guidelines and Recommendations

Robert A. Robergs, Ph.D., FASEP, EPC

Exercise Physiology Laboratories, Exercise Science Program, University of New Mexico

Background

- Of all of the disciplines/topics in Exercise Science, strength training clearly has the smallest empirical base of research support.

- Concerns over research-supported practice were raised in responses to the ACSM Position Stand.


- Identification of deficient research areas can stimulate needed research, and refine current strength training recommendations.

Strength Training Controversies

1. Machines vs. Free Weights
• Is one of either machines or free weights superior for strength, power or endurance?
• No.

2. Short vs. Long Repetition Durations
• Are contractions that are < 1-2 s more effective than longer duration contractions in stimulating strength gains?
• No.
3. Number of Repetitions

• Are 5-6 repetitions to failure/set superior for strength gains than sets with more repetitions?

• No. *Data suggest that gains are similar for 3 to 20 repetitions.*

4. Number of Sets – Untrained Subjects

• Are strength gains larger when untrained subjects perform multiple sets?

• *Insufficient evidence! Most research reveals that 1 set is sufficient for optimal strength gains.*

5. Number of Sets – Resistance-Trained Subjects

• Do trained subjects need more sets?

• *No. Most research reveals that 1 set is sufficient for optimal strength gains, even for trained subjects.*
6. Rest Interval Between Sets
• Does increasing rest between sets improve strength training adaptations?
• *Insufficient evidence!*

7. Exaggerating the Eccentric Component
• Is there an added benefit to training when only doing the eccentric component of a muscle action?
• *No!*

8. Number of sessions/week
• Is an increased frequency of training above 3/week beneficial for improved strength gains?
• *Although a seemingly logical recommendation, there is no research support for this belief, not even for highly trained athletes!*

9. Split Routines
• Does the use of split routines to increase training volume increase strength gains?
• *Although a popular practice, there is no research support for split routines, not even for highly trained athletes!*

Dr. Robert A. Robergs, Ph.D., FASEP, EPC
10. Periodization in Training
• Do greater strength gains result from application of periodization principles in a long-term training program?
• No research evidence!

11. High Repetitions and Muscular Endurance
• Does muscular endurance increase more when performing training with high repetitions?
• No research evidence!

12. Explosive Multiple Set Lifting
• Does muscular power increase more when performing rapid or explosive contractions over multiple sets?
• No research evidence!
13. Hypertrophy

• Is muscle hypertrophy increased more with high resistance and volume training?

• No research evidence!

Recommended Research Topics In Resistance Exercise and Training

• Machines vs. Free Weights
• Number of repetitions/set
• Number of sets/session
• Velocity of muscle contractions
• Explosive contractions for muscular power
• Optimal recovery between sets
Hypertrophy vs. Hyperplasia?????

Hypertrophy probably occurs in serious body builders, but we cannot detect it in humans.

Hyperplasia

myosin-ATPase stain
preincubation pH=4.6

Slow-twitch fiber
Fast-twitch fiber

Fast-twitch oxidative fiber
Recent Research From UNM

What is the decrement in strength as RM Increases?
Can we more accurately predict 1RM strength from multiple RM tests?

70 subjects (34 men, 36 women)
1, 5, 10 and 20 RM Testing for Chest Press and Leg Press
We graphed strength decrement across RM values
We calculated 1 RM from 5, 10 and 20 RM tests
Estimating Multiple RM Load

- a: LP Strength (kg) vs. Repetition Number
- b: CP Strength (kg) vs. Repetition Number
Estimating Multiple RM Load

- %LP, % 1 RM = 78.17 * e^{-0.0569 \cdot \text{reps}} + 26.41
- %CP, % 1 RM = 55.51 * e^{-0.0723 \cdot \text{reps}} + 48.47

1 RM Prediction from 5 RM

Measured vs. Predicted 1 RM for LP and CP.
Conclusions

- Leg Press
  - 5 RM = 85.91% 1RM
  - 10 RM = 70.1% 1RM
  - 20 RM = 51.6% 1RM
- Chest Press
  - 5 RM = 87.45% 1RM
  - 10 RM = 75.65% 1RM
  - 20 RM = 61.61% 1RM
- Multiple regression to predict 1 RM most accurate from 5 RM test
  
  Leg Press 1 RM (kg) = (1.09703 x 5 RM kg) + 14.2546
  Chest Press 1 RM (kg) = (1.1307 x 5 RM kg) + 0.6998

Recent Research From UNM

Can we more accurately estimate energy expenditure during strength training?

If so, what is this energy expenditure for a given load and distance the load is lifted?

43 male subjects (23 for chest press, 20 for parallel squat)

In Press: Journal Strength and Conditioning Research. 2006
Problem

Expired gas analysis indirect calorimetry
Accounted for body weight in load lifted
Measured vertical distance the load was lifted
Computed power and work
Used load and distance in multiple regression to predict VO₂
Steady State VO\(_2\) measured for multiple intensities
Linear Regression used to extrapolate VO\(_2\) to heavy loads
VO\(_2\) converted to Kcals/min
Compared Kcals to previously published data.

Sample Data
Linear Regression

VO₂ (mL/kg/min)

Power (Watts)

Bench Press

VO₂ (L/min)

Power (W)

R² = 0.7262
Conclusions

- Chest Press $VO_2 = 0.132 + (0.031 \times \text{kg load}) + (0.01 \times \text{cm lifted})$
- Parallel Squat $VO_2 = -1.421 + (0.022 \times \text{kg load}) + (0.035 \times \text{cm lifted})$
- $K\text{cals} = VO_2 \text{ L/min} \times 5.05 \text{ Kcals/L} \times \text{distance cm} \times \text{repetitions}$
- Energy expenditure 2 to 3 times higher than prior research!
- Supports observations and logic for high energy demands of resistance exercise.

Thank you

rrobergs@unm.edu
www.unm.edu/~rrobergs