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Strength Training for Different Populations

Amy Ashmore, PhD

Learner Outcomes

- Identify contemporary research findings for developing strength training sessions and programs for different populations.
- Design strength training programs specifically for the obese population.
- Design strength training programs specifically for the healthy adult.
- Design strength training programs specifically for the athlete.
- Incorporate current recovery and flexibility training guidelines into strength programming for different populations.

Course Outline

- Strength programming variables.
- Strength training for persons with obesity.
- Strength training for healthy adults.
- Strength training for athletes.
- Flexibility training guidelines.

Programming Variables

Programming Variables

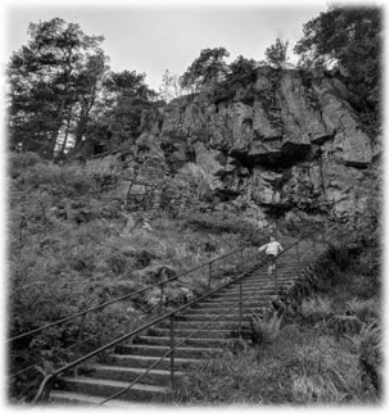
1. Mode (type of training).
2. Frequency (recurrence of sessions; recovery lengths).
3. Duration (length of program, each session total, and session components).

Programming Variables

4. Volume (how much; sets and reps; distance and time).
5. Intensity (how hard; heart rate; MFGC or output).

Mode (type of training)

1. Cardiovascular.
2. Strength.
3. Flexibility.



Frequency (how often)

- Days per week.
- Within days (one or more sessions/day).
- Accounts for rest days (and even hours for more than 1/day sessions).

Duration (time)

- Entire program (weeks to months to a year).
- Each session.
- Each session component (i.e., cardiovascular, strength, flexibility).

Volume (amount)

Strength

- Sets.
- Repetitions.

Volume (amount)

Cardiovascular

- Distance.
- Time.

Intensity (how hard)

Strength

- External weight.
- Body weight.

Speed/velocity (of muscle contraction or on a cardio machine).

Strength Training

Strength Training

- External weight
  - Dumbbells/barbells
  - Machines
  - Bands
  - Medicine balls
  - Kettlebells
  - Ropes
- Body weight
  - Gravity
  - Plyometric drills

Key Concepts

Muscle Strength Defined

Muscle strength is defined as how much force a muscle can produce.

Muscle Strength

- It is typically measured by 1 repetition maximum (1RM).
- However, this is not always a safe and viable test and sub-maximal measurements have their place in the field.

Muscle Strength

In the field and in performance, outcomes are more important than absolute strength. To ensure validity of the program and progression,

- Use reliable and consistent measurements of strength.
- Demonstrate an improvement in strength.
- Correspond to a functional, fitness or athletic goal.

Strength Development

- Neural factors
- Hypertrophy (mass)

Neural Factors

Early on in exercise training muscle strength gains are due to neural factors.

Why?

Neural control of muscle strength

With practice/repetition the brain gets better at –

1. Sending signals to muscles, and
2. Recruiting the target muscle fibers for the desired movement.

Neural control of muscle strength

- During the 1st three weeks of training most strength gains are due to learning.
- Neural factors largely explain strength gains in children (pre-puberty) and elderly – both also due to lower levels of testosterone.

Strength Training Programs for Persons with Obesity

Getting Started

- Limitations, Safety, and Feasibility.
- Warm-ups.
- Neural changes.
- Suggested programming.
- Suggested strength exercises.

Limitations

Extra mass can affect:

- Impact forces on joints.
- Joint range of motion (ROM).
- Ability to fit in machines.
- Ability to get up from the floor
- Ability to stand from a seated position.
- Full ROM to bend over or fully complete an exercise.
- Move around the gym quickly and easily.

Loading Joints

"When people who suffer from obesity walk on a treadmill at a set pace the vertical (downward) loading on the knees is greater than for healthy weight people (Pamukoff et al. 2016). This increased load on the joints contributes to knee degeneration or breakdown over time."

Equipment Suggestions

Most major treadmill brands manufactured today tolerate weights up to 400 pounds easily. Elliptical trainers should be similar.

Equipment Solution

Recumbent trainers - SCIFIT has a line of recumbent trainers that allow users up to 650 pounds to enter via swivel chair and sit comfortably.

Neural Changes with Obesity

"Research shows us that people who are obese have less white matter or neural pathways connecting the different parts of the brain (gray matter) than normal weight people (Ronan L et al 2016). Fewer neural pathways and connections mean that people who suffer from obesity might have a tougher time remembering new information (Gupta et al 2015)."

Suggested Programming

2 – 2 – 10 – 20 Model

- 2 exercise for the upper and lower body each, along with 2 exercises for the core muscles.
- 2 sets of each exercise.
- 10 - 20 repetitions of each exercise.

Note: most persons struggling with weight loss and new to fitness will workout 2-3 times/week making this a feasible total body workout model.

Simplified Programming

- Focus.
  - Lower intensity, higher volume a good start place.
  - Repetition aides motor learning.
- Neural Priming.
- Adherence.
  - Process Goals.
  - Examples.

Exercise Psychology

Process goals/Micro goals/Sessions goals:

- Short term, workout session based goals that can be reached right now.
- They help to improve self-efficacy.
- They help to improve short and long-term adherence.
- In contrast to vague, hard-to-reach goals like “I want to lose weight and tone up”.

Examples of Process Goals

"Complete 10 reps of wall squats."

OR

"Complete10 minutes on the treadmill at 3.5 speed."

Exercise Selection

"Select exercises based on challenges due to extra mass, mobility issues, standing limits, use of interchangeable free weights, bands, and body weight resistance, ease of execution (single joint exercises in particular), and the ability to alter mechanics and range of motion easily."

Suggested LB Exercises

- Static lunge
- Seated knee extensions (on a bench or chair)
- Bench or chair squat (aka sit to stand)
- Wall squat
- Traditional squat
- Step up and down (ADV)
- Quadruped Bird Dog (core)
- Standing crunches with or without cable or band (core)
- Standing lateral flexion
- Standing one leg balance (can use wall or other aid)
- Standing partial ROM back flexion (Romanian Deadlift)
- Standing cable rotation or cable chop (core)

Suggested UB Exercises

- Biceps curls
- Standing cable or dumbbell row
- Shoulder flexion/extension
- Shoulder abduction/adduction
- Seated overhead press with dumbbells
- Seated or standing triceps overhead extension
- Standing one arm or two arm press

Adding Variety

- Change exercise mechanics slightly.
  - Vary arm position during a squat.
  - Try wall squats with a physioball behind the lower back.
  - Try hammer curls versus standard biceps curls.
- Vary the order of exercises.
  - Start with isolation exercises to focus on a particular muscle weakness or muscle group.
  - Start with core exercises.

Strategic Timing

Change the timing of an exercise.

- Hold a **peak contraction** - stop at the mid-point of any exercise and squeeze the target muscle for a few seconds.
- Count four to eight counts on each phase (up/down, prep/power).
- Practice slow, controlled movements synchronizing breathing techniques to exercises.

Tip and Tricks

- If mechanics get off:
  - *Stop, return to the start position, and begin again.*
- If the client is having difficulties executing a movement try this:
  - *Place your hand on the working muscle and press gently.*

Tip and Tricks

- If the client gets tired, try one or both of these easy fixes:
  - *Use **rest break sets** (stop, rest, and finish when ready) until your client can complete at least 10 reps or*
  - *Finish the set with a lower weight (**drop sets**).*

Strength Training for Healthy Adults

Defining healthy adults

For our purposes, healthy adults are any person over 18 in good health and not limited to a specific exercise program due to health or mobility concerns.

Research

Active aging

"New research (Franchi, 2019) has revealed that plyometric training significantly reduces the risk of age-related muscle loss, termed sarcopenia, and relieves some of the associated negative effects of sarcopenia like loss of muscle tone, strength, and function."

Purpose

The goal of the study was to examine the effects of a six-week plyometric training program on knee extensor (quadriceps) muscle size and strength.

The Equipment

The exercise equipment used in the study was a customized machine similar to a leg press.

- The exerciser used his legs to bounce his body weight off a trampoline.
- The machine is similar to a leg press in the use of hip and knee flexion and extension and similar muscles.
- It differs in that the user is positioned incline to the trampoline (seated upright and coming down on top of the trampoline rather than a decline leg press where the sled comes down on the exerciser or a machine leg press where the exerciser extends his legs directly out in front of him).

Methods

- 14 young men with an average age of 25 were compared to nine older men with an average age of 70.
- Each person trained three times per week; however, the training volume differed between the age groups:
  - The young group did four sets of 30 repetitions each for the first four weeks, followed by five sets of 30 repetitions for the final two weeks.
  - The older did three sets of 30 repetitions for the first four weeks, followed by four sets of 30 repetitions for the final two weeks.

Note: the training volumes differed because the older subjects showed fatigue in the pilot study with the younger group higher volume program.

Results

Plyometric training resulted in:

1. Increased muscle mass in both young and older men.
2. Increased muscle strength in both young and older men.

Conclusion

- The results of the study are not surprising (especially in young people) because muscle mass and strength are due to improved performance of type II muscle fibers and plyometric training is known to target them.
- Sarcopenia is a direct result of a loss of type II fibers so any increase in their cross-sectional area is significant.

Application

- Plyometric training can positively impact sarcopenia.
- However, the problem is applying the research with the general public in a traditional fitness setting where the research equipment is not available and safety is paramount.

Training Suggestions

To get started, try these strategies first:

- Strengthen the muscles that originate in the hips like the gluteals, quadriceps, hamstrings, and hip abductors.
  - These are the largest muscles in the body.
  - They are used in traditional lower body plyometric drills and play a significant role in balance that is required for plyometrics.
- Strengthen the core muscles.

Establishing readiness

1. For **lower-body speed**, exercisers should be able to complete 5 repetitions of the back squat at 60% or more of his or her body weight in 5 seconds or less.
2. For **upper-body speed**, exercisers should be able to complete 5 repetitions of the bench press at 60% or more of his or her body weight in 5 seconds or less.

Lower Body Plyometrics

Once lower body strength has been developed, readiness has been established, and balance is not an issue, start with a small range of motion:

1. Jump squat.
2. Jump and reach drills.

Upper Body Plyometrics

Lower body plyometric drills require strength and balance and produce a lot of impact forces. For those reasons, they may not be a good place to start, but a compromise is to use low-intensity upper body plyometric exercises like:

1. Kneeling ball pass.
2. Medicine ball chest pass training.

Choosing Resistance

Follow these two general rules to determine the weight of the medicine ball:

1. The ball must be heavy enough to slow the exercise but not so heavy to reduce the range of motion.
2. The ball must NOT be so heavy that it makes it difficult for the client to comfortably control the ball for at least 5 repetitions.

Sample Routine

Exercise	Sets	Reps	Between-set rest break
Medicine ball chest pass training*	3**	15	30 seconds to two minutes

Progression

A simple progression strategy is:

after two weeks, add a 4th set of 15 repetitions.

Concurrent Training

What is Concurrent Training?

Concurrent Training is doing multiple modes of exercise in one session to achieve fitness goals.

It is effective for general fitness; however, it is NOT recommended for athletes or advanced exercisers with muscle performance goals.

Concurrent Workout

- Warm-up/cardiovascular training. 5 – 20 minutes.
- Strength training. 15 – 35 minutes.
- Flexibility training. 5 – 10 minutes.

Programming

- Choose **one to two lower body** exercises.
- Choose **one to two upper body** exercises.
- Choose **one to two core** exercises.
- Where appropriate, select at least **one plyometric** exercise.
- Do **two – three sets** of each exercise
- For each set complete **10 – 18 repetitions**.

Plyometrics Supersets

Traditional exercise ⟺ plyometric exercise

Sample Plyometric Superset Workout

Exercise	Reps	Sets	Resistance	Rest Between Sets
Back Squat	**15**	**2 – 4**	**TBD**	**30 – 60 seconds**
Jump Squat	10	2 - 4	Bodyweight Only	30 – 60 seconds
Back Squat	**15**	**2 - 4**	**TBD**	**30 – 60 seconds**
Jump Squat	10	2 - 4	Bodyweight Only	30 – 60 seconds
Back Squat	**15**	**2 - 4**	**TBD**	**30 – 60 seconds**
Jump Squat	10	2 - 4	Bodyweight Only	30 – 60 seconds

Strength Training for Athletes

CONTINUED

Measuring Strength

Calculating 1RM and predicted 1RM -

"Understanding 1-RM and Predicted 1-RM Assessments"

CONTINUED

Resource citation

https://www.acefitness.org/fitness-certifications/resource-center/exam-preparation-blog/2894/understanding-1-rm-and-predicted-1-rm-assessments.

Hypertrophy

- Increase in muscle mass (size).
- It is a reflection of muscle fiber growth
  - Hyperplasia (increase in the number of fibers) *not* a factor in humans.
- Measured by cross-sectional area of a muscle.

Testosterone

- Levels naturally fluctuate throughout the day.
  - Highest in the morning – around 8 am.
  - Begin to level off between 4 and 6 pm, decreasing after that.

Testosterone

Levels can be manipulated by resistance training.

How?

Testosterone

Multi-joint exercises like squats and deadlifts are known to release high amounts of testosterone into the bloodstream that facilitate muscle growth, strength, and power development.

Human Growth Hormone (HGH)

- Like testosterone, HGH is released into the bloodstream during multi-joint exercises such as squats and deadlifts.
- Eccentric or lengthening muscle contractions cause more HGH release than concentric or shortening contractions (Crewther, 2006).

Programming for Strength

- Types of resistance exercise
  - Use multi-joint exercises.
  - Complimentary use of single-joint exercises.

Multi-joint exercises

- Also known as compound exercises.
- Total body exercises.
- Use two or more joints and many muscles.
- Popular for functional training, athletic training, and general fitness.

Multi-joint exercises

Multi-joint exercises do have limitations:

1. They are limited by motor coordination.
2. They are limited by the exerciser's previous experience.
3. They can lack muscle focus if the mechanics are not correct.

Single-joint exercises

- Also known as isolation exercises.
- Focus on one muscle group.
- Popular for building muscle mass and inducing positive body composition changes.
- Also have a known supporting role.

Weakest link

- Multi-joint exercises use a lot of muscles.
- The biggest and strongest will take over.
- However, if a small muscle is too weak it can limit the exercise.
- Isolation exercises are used to remedy this.

Research

Multi-joint vs single-joint

- Paoli and colleagues (2015) compared the effects of equal-volume (amount of training per session and week) single-joint and multi-joint resistance training on:
  - muscle strength.
  - body composition.
- In 36 trained men.

Two exercise groups

- Multi-joint exercises.
- Single-joint exercises.

Multi-joint exercises

- Bench press
- Deadlift
- Squat
- Leg press
- Shoulder press
- Lat pulldown
- Seated row

Single-joint exercises

- Dumbbell fly
- Knee extension
- Knee flexion
- Pec deck
- Biceps curl
- Incline dumbbell fly
- Abdominal curl
- Lateral raise
- Pull-over
- Rear deltoid fly
- Cable elbow extension
- Calf raise

Results

- Both multi-joint and single-joint exercises decreased body fat and increased muscle mass.
- No difference between them.
- Shows that single-joint exercises can improve body composition and play a supporting role for multi-joint exercises.

Results

- The improvements in the multi-joint exercise group were higher than the single-joint exercise group for:
  - muscle strength.
  - maximal oxygen uptake.

Conclusions

- Single-joint exercises have a role in resistance training programs to improve body composition.
- Good fit for general fitness goals.

Conclusions

- Multi-joint exercises are the better choice for muscle strength improvements.
- Multi-joint exercises are better suited to improve all elements of performance including muscle endurance, strength, and power.
- Best suited for athletes.

Study citation

Paoli A, Gentil P, Moro T, Marcolin G, Bianco A. (2015). Resistance Training with Single vs. Multi-joint Exercises at Equal Total Load Volume: Effects on Body Composition, Cardiorespiratory Fitness, and Muscle Strength. *Frontiers in Physiology*. Dec 22; 8:1105.

Strength training programming

- Bilateral or unilateral exercises.
- Upper or lower body exercises.
- Agonist-antagonist exercises.

Routine for Bilateral Lower-Body Exercises

Exercise	Reps	Resistance	Between-set rest break
Back squat	6-10	65-85% 1RM	30 seconds-4 minutes
Seated knee extension	6-10	65-85% 1RM	30 seconds-4 minutes
Back squat	6-10	65-85% 1RM	30 seconds-4 minutes
Seated knee extension	6-10	65-85% 1RM	30 seconds-4 minutes
Back squat	6-10	65-85% 1RM	30 seconds-4 minutes
Seated knee extension	6-10	65-85% 1RM	30 seconds-4 minutes

Routine for Lower-Body Exercises With Upper-Body Exercises

Exercise	Reps	Resistance	Between-set rest break
Back squat	6-10	65-85% 1RM	30 seconds-4 minutes
Lateral dumbbell raise	6-10	65-85% 1RM	30 seconds-4 minutes
Back squat	6-10	65-85% 1RM	30 seconds-4 minutes
Lateral dumbbell raise	6-10	65-85% 1RM	30 seconds-4 minutes
Back squat	6-10	65-85% 1RM	30 seconds-4 minutes
Lateral dumbbell raise	6-10	65-85% 1RM	30 seconds-4 minutes

Routine for Agonist–Antagonist Exercises

Exercise	Reps	Resistance	Between-set rest break
Hip abduction	6-10	65-85% 1RM	30 seconds-1 minute
Hip adduction	6-10	65-85% 1RM	30 seconds-1 minute
Hip abduction	6-10	65-85% 1RM	30 seconds-1 minute
Hip adduction	6-10	65-85% 1RM	30 seconds-1 minute
Hip abduction	6-10	65-85% 1RM	30 seconds-1 minute
Hip adduction	6-10	65-85% 1RM	30 seconds-1 minute

Paired Training Method

Paired Training Method

- Uses biomechanically-similar paired exercises.
- Two exercises:
  - Similar or same joint action.
  - Similar or same muscle action.

(Ashmore, 2019)

Why?

Play on volume –

- Because one of the biggest dilemmas facing athletics is overtraining.
- Pairing biomechanically similar exercises allows us to stress maximally the target muscles while varying mechanics enough to change how we work muscles.

Paired Routine for Upper Body Exercises

Exercise	Reps	Resistance	Between sets rest breaks
Bench Press	4 - 6	65 – 85% of 1RM	30 seconds up to four minutes
Push-up	4 – 6	Body weight	30 seconds up to four minutes
Bench Press	4 - 6	65 – 85% of 1RM	30 seconds up to four minutes
Push-up	4 – 6	Body weight	30 seconds up to four minutes
Bench Press	4 - 6	65 – 85% of 1RM	30 seconds up to four minutes
Push-up	4 – 6	Body weight	30 seconds up to four minutes

Exercise Mechanics

The first thing people typically change in a workout is the exercise itself, like a squat or deadlift for example, or they change the mechanics of an exercise from a front lunge to a side lunge for example.

Exercise Mechanics

- Determine how a muscle is used for a particular exercise.
- Varies with different exercises for the same muscle or muscle group.
  - Compare a squat with a seated leg press.

Example

- Push-ups

VS

- Plyometric push-ups

Mixed-intensity training

Mixed-intensity training

Vary the loads (intensity) used during a session and even during a set.

The Study

Ozaki H, Kubota A, Natsume T, Loenneke JP, Abe T, Machida S, Naito H. (2018). Effects of drop sets with resistance training on increases in muscle CSA, strength, and endurance: a pilot study. *Journal of Sports Sciences*. Mar; 36(6):691-696.

https://www.ncbi.nlm.nih.gov/pubmed/28532248

Methods

Three different training load groups:

- Three high-intensity (80% 1RM) sets.
- Three low-intensity (30% 1RM) sets.
- A single high-load set (80%) with an additional drop set without recovery progressively reducing weight to 30% 1 RM (mixed-intensity training) – this is the mixed-intensity set.

Volume

It is important to note that the training volume was about 2/3rds of the three set high and low-intensity in the mixed-intensity set.

*Mixed-intensity set – which was 80% initially with a drop-set was lower volume training.

Conclusion

Lower volume mixed-intensity training can simultaneously increase muscle hypertrophy, strength, and endurance when compared to traditional three set high-intensity or low-intensity training models.

Application

Mixed-intensity training saves time when compared to the traditional three sets training programs and still yields significant muscle improvement benefits.

Work-rest Ratios

Work-rest periods

Research on recovery periods shows that shorter rest intervals within sets, termed intra-set rest periods, are better for muscle strength improvement than longer 120 second traditional between-set rest periods (Oliver, 2013).

Intra-set rest periods

- Range from ten to 60 seconds.
- They can occur every few reps (cluster set training) or with each rep (RRT).
- Allow for minimal muscle recovery during the set.

Intra-set rest periods

- The intent of an intra-set rest period is to provide the exerciser with the opportunity to finish the target set and number of repetitions.
  - with the original weight versus reducing the weight and/or the number of repetitions.

Intra-set rest periods

- The goal is to coax the muscle to produce greater force within a shorter time period.
- This should result in greater strength improvements.

Redistributed rest training (RRT)

RRT is defined by equal rest between **each repetition** within a set.

Study

Compared the efficacy redistributed rest training to cluster sets on measures of muscle velocity and strength output in squats (Tufano 2017).

Methods

The three different training groups are shown here and on next slide:

- Group #1: Athletes did four cluster sets (CS4) that included 30 seconds of rest after the 4th, 8th, 16th, 20th, 28th, and 32nd exercise repetition in addition to 120 seconds of rest after the 12th and 24th repetitions.

Methods

- Group #2: For these athletes, the total 420 seconds of rest given to the CS4 group was redistributed to include nine sets of four repetitions each with 52.5 seconds of rest after every fourth repetition (RR4).
- Group #3: The final group used a unique protocol where the total 420 seconds of rest was evenly distributed after each of the 36 single repetitions resulting in 12 seconds of rest after each repetition (RR1).

Results

#1: With redistributed rest over each repetition (RR1) mean and peak muscle velocity along with mean and peak muscle strength remained the same; however, they all decreased every four repetitions during cluster and RR4 training.

#2: Peak muscle force was maintained during redistributed rest over each repetition (RR1), but was less for cluster and RR4 for subsequent repetitions.

Conclusion

These data indicate that when total rest time is redistributed over each repetition, mechanics and speed of each exercise repetition is more constant improving muscle strength performance results.

Study citation

Tufano, James & Conlon, Jenny & Nimphius, Sophia & Brown, Lee & Petkovic, Alex & Frick, Justin & Haff, Guy. (2017). Effects of Cluster Sets and Rest-Redistribution on Mechanical Responses to Back Squats in Trained Men. Journal of Human Kinetics. 58. 35-43.

Sample Workout: RRT

Exercise	Reps	Resistance	Intra-set rest breaks after each repetition
Modified Romanian Deadlift	Up to 36	80% or above of 1RM	10 - 60 seconds
Back squat	Up to 36	80% or above of 1 RM	10 - 60 seconds

Intermittent Rest

Rest two days per week on non-consecutive days to stay on a 24-hour cycle (Ashmore, 2019).

Recovery period upper limits

Length of recovery periods should not exceed **96 hours**. After 96 hours detraining occurs.

Effects of Cardiovascular Endurance Training on Strength Development

"Strength gains are negatively impacted by high-intensity cardiovascular training."

Doma and Deakin, 2013; Jones et al 2017

Why?

- Muscles get confused at a molecular level.
- Confusion is the molecular explanation for why cardiovascular endurance training inhibits muscle strength gains.

Muscle Confusion Defined

- Muscles get confused when multiple modes of work are performed during the same training session
  - or even day if not enough time allowed between (6-24 hours; no less than 3).
- The mechanisms of strength gains get canceled out by cardiovascular work.

Muscle Contractility

- Muscle contractility is a structural or morphological change that impacts muscle's ability to elicit the desired effects during strength training.
- Prolonged endurance training interferes with a muscle's ability to contract during strength training.

Muscle Contractility, cont'd

- Doing cardiovascular endurance training before strength training adversely impacts MFGC (the ability of a muscle to produce force).
- Decreases the likelihood of positive muscle growth, strength, and power outcomes.

Delayed-Onset Muscle Soreness (DOMS)

- DOMS cause a series of events, including microscopic damage to muscle fibers that prevent strength and power gains.
- Prolonged muscle work associated with DOMS causes substrate depletion and increased protein breakdown, both of which hinder strength and power gains.

Testosterone Levels

- Combined strength and cardiovascular training can decrease testosterone levels.
- Testosterone is essential to muscle development and growth.
- Therefore, decreases muscle growth, strength, and power gains.

Cortisol and Blood Lactate Levels

- Doing endurance training before strength training increases blood lactate and cortisol levels.
- However, both need to be **lowered** for muscle growth, strength, and power gains.
- Therefore, endurance training works against muscle growth, strength, and power gains via cortisol and blood lactate channels.

Jogging's Dilemma

The problem

Cardiovascular endurance training reduces the likelihood of muscle growth, strength, and power improvements, creating a serious dilemma for athletic performance training and to serious fitness enthusiasts.

Impacts strength

- Prolonged endurance work like jogging can impede strength gains.
- It is accepted that **endurance training, jogging specifically, reduces the quality of strength training** sessions.

Cardiovascular Endurance
Programming for Strength

Programming Goal

- Primary goal is to maximize muscle strength.
  - Include endurance/cardiovascular training.
  - Avoid muscle confusion.

Programming Variables

- Type or mode of endurance exercise (i.e., jogging or cycling).
- Length of recovery time (rest cycles).
- *Frequency of sessions.

Programming Variables, cont'd

- Intensity of cardiovascular training.
- Volume (duration) of cardiovascular training.

Mode

- Cycling is recommended.
- Running/jogging decreases strength more than cycling.

Duration

Limit cardiovascular endurance training sessions where strength gains are the primary training goal to 20 – 30 minutes max.

Recovery length

Muscles need to rest for **at least 48 hours** after high-intensity exercise (greater than 85% maximum capacity) to return to baseline strength levels.

Note: rest can be an active recovery that includes cardiovascular activity at a lower intensity.

Frequency

- Schedule cardiovascular endurance and strength training on alternate days.
- Limit cardiovascular endurance training to three or fewer times per week.

Intensity

- Direct relationship between intensity of cardiovascular endurance exercise and strength decrements.
- For best results, low to moderate cardiovascular endurance work is recommended.

Sample Cardiovascular Workout

Day	Exercise mode	Intensity	Duration
Monday	Off		
Tuesday	Cycling	40-75%	20-30 minutes
Wednesday	Off		
Thursday	Cycling	40-75%	20-30 minutes
Friday	Off		
Saturday	Cycling	40-75%	20-30 minutes
Sunday	Off		

Summary

- Limit cardiovascular endurance training to three or fewer times per week.
- Use cycling versus running as the cardiovascular exercise.

Summary

- Use low-intensity cardiovascular endurance sessions.
- Keep cardiovascular exercise sessions to between 20 and 30 minutes.

Flexibility Programming

Muscle Stretch

A strength development stimulus.

Benefits

- Promotes joint range of motion (ROM).
- A lengthened muscle can generate greater force than a shorter one.
- The ability of a muscle to lengthen is a factor to strength development.
  - Optimal length is a joint angle around 110 degrees.

General Fitness

After a workout,

- Select one to two **static** stretches for the major muscle groups.
- Do **one to two sets** of each stretch.
- Hold each stretch for **20 – 60 seconds** each.

Athletes

Flexibility training, if not programmed correctly, can lead to muscle performance decrements.

Athletes

- The general rule is to avoid static stretches and go with dynamic stretching prior to performance.
- If you choose to do dynamic stretches prior to performance, provide a buffer of at least **five minutes** for muscles to recover.
- Stretch all major muscle groups post training.
- Focus on areas of particular use and/or need.

Flexibility programming references

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Wrap-up

Key messages

- Neural changes associated with obesity affect motor learning and thus strength programming.
- New research suggests plyometric training for active aging.
- Concurrent training is recommended for healthy adults with general fitness goals.

Key Messages

For athletes:

Research suggests:

- Using mixed-intensity training.
- Keeping volume moderate.
- Using moderate loads.
  - Include high-intensity loads where applicable.
- Manipulate rest periods within sets versus between.

Key messages

For athletes:

- Carefully integrate cardiovascular endurance training in alignment with strength goals.
- Carefully integrate flexibility work.

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Thank you!
~ Dr. Amy