

STRENGTH TRAINING FOR MUSCLE BUILDING

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INTRODUCTION

Strength training is an essential component of exercise programs for increasing muscular strength and size. Other terms that are used to refer to the use of weights or some form of resistance in order to increase muscle strength and size are “resistance training” and “weight training”. Strength training increases muscular strength, muscular endurance and muscle size. The increase in muscle size, which is due to an increase in amount of contractile proteins in the muscle fibers, is termed “muscle hypertrophy” (1).

In designing a strength training program, especially for increasing muscle mass, there are many variables to consider including the person’s level of experience with strength training, the type of training equipment to use, the frequency or number of days per week to workout, the type, number and order of exercises, the number of sets per exercise, the number of repetitions for each set, the weight or resistance to be used for each set and the amount of time between each set and exercise (1, 2). Although there is a very large amount of research examining training program design and muscular strength, much less research has specifically examined program design and muscle hypertrophy. However, some aspects of optimal program design for muscle strength are important for increasing muscle size also. Since there are many ways in which programs can be designed, this paper will discuss general training program design.

GENERAL RESISTANCE TRAINING GUIDELINES

Strength training is often referred to as progressive resistance exercise (PRE), since progression with regard to the weight or resistance used and to some degree the number exercises, and sets is important for promoting increases in muscle size and strength (3). The following guidelines apply to strength training programs regardless of the individual’s level of experience. Both concentric and eccentric muscle actions should be included. During an eccentric muscle action, muscle lengthening occurs while force is developed. Typically, an eccentric action is performed in lowering the resistance or returning the resistance to its original position. A concentric muscle action occurs when the muscle develops force and shortens. Both single- and multiple-joint exercises should be included as part of a well designed program. In general, multiple-joint exercises and those involving a larger number of muscles or a greater muscle mass should be performed before single-joint exercises or those involving a smaller number of muscles and less muscle mass (1). Finally, variation is an essential component of strength training programs. Periodization utilizes planned variation with regard to the exercises performed, the number of sets and repetitions completed, and the resistance used (4). In the classic or



linear model of periodization, planned variation occurs at regular intervals (1). Using an undulating or nonlinear periodization model, variation occurs on a daily or workout-to-workout basis.

TRAINING GUIDELINES FOR NOVICE LIFTERS.

Individuals who have never engaged in strength training will be referred to as novice lifters. Novice lifters should be introduced to free weights, such as barbells and dumbbells, as well as machines (1). Initially, machines may be especially useful for individuals who show reluctance to using free weights. Novice lifters should strength train 2 to 3 times each week (1, 3). Approximately 8 to 10 exercises should be selected so that all the major muscle groups of the body are used. For muscle hypertrophy, multiple sets of each exercise should be completed; therefore, each workout should consist of 2 to 3 sets of each exercise (1, 4). The number of repetitions should be between 5 and 12 for each set and should be varied on a regular basis (1, 6). There are two commonly used methods of selecting the weight or resistance to be used for each exercise. The weight selected can be based on a percentage of the amount of weight that the individual can lift one time for a given exercise. This is referred to as the one repetition-maximum (1-RM). This method is rather tedious since the 1-RM strength of the individual must be determined or estimated for each exercise on a regular basis. Using this method, the weight selected should be at least 60% of the 1-RM up to approximately 85% of 1-RM (1, 3). A second and often more practical method is to determine the amount of weight that can be lifted the desired number of times by trial-and-error. When the desired number of repetitions can be completed for a given set or exercise, additional weight should be used the next time the exercise is performed. In choosing the weight to be used, it is important to remember that sets involving maximal, voluntary muscle contractions should be performed. Another way to describe this is as sets to failure or near failure. Rest periods should be approximately 1 to 2 minutes between sets and 1 to 3 minutes between exercises.

Novice lifters should experience rather rapid increases in muscular strength and should progressively increase the amount of weight being used for each exercise. The initial increases in muscular strength, which typically occur over the first 6 to 10 weeks of strength training, are largely due to adaptations in the nervous system (7, 8, 9). Although these types of adaptations continue as long as one continues to strength train, longer term gains in muscular strength are the result of muscle hypertrophy.

TRAINING GUIDELINES FOR MORE EXPERIENCED LIFTERS.



As individuals become more familiar with strength training, more advanced program designs can be used. Also, the rate at which strength gains are achieved slows considerably as increases in strength are due primarily to muscle hypertrophy. More experienced lifters may want to incorporate additional free weight exercises into their workout program and perform more complex exercises. For example, many novice lifters may avoid the squat exercise, but more experienced lifters who want to increase leg muscle size will find the squat to be a very effective exercise. Often more experienced lifters add more exercises to their training program. In order to complete an entire workout within a reasonable time period, exercises and muscle groups are often split to different days of the week. Therefore, the number of times per week and individual works out may vary from 2 to 6 days per week. An important consideration is that significant gains in muscle strength and size can be achieved by exercising the muscle or muscle group two times each week if an adequate number of sets are performed that involves the muscle(s) (3, 10). An adequate number of sets can be performed by completing more sets per exercise or adding exercises. Each workout should consist of multiple sets (2 to 5) (1, 5) of each exercise, with approximately 8 sets per muscle group (10). The number of repetitions should be between 3 and 12 for each set (1, 3) and should be varied on a regular basis using either a classic or undulating periodization model. The weight selected should be 70 to 90% of the 1-RM or a resistance that requires a maximal effort for one or more sets (1, 3). When the desired number of repetitions can be completed for a given set,, additional weight should be used the next time the exercise is performed. In choosing the weight to be used, it is important to remember that sets involving maximal, voluntary muscle contractions should be performed. Rest periods should be related to the goals specific to each strength training session. In general, rest periods should be approximately 1 to 3 minutes between sets and exercises.

NUTRITIONAL CONSIDERATIONS

Individual should set realistic goals for the amount of weight gain per week or month. In setting goals, several key points should be considered. The desired weight gain is muscle not fat, and the more rapidly an individual attempts to increase body weight, the more likely that a greater proportion of the weight gained will be fat rather than muscle. The rate at which an individual can gain weight will be affected by several factors, including their level of strength training experience and genetics. Novice lifters with a rather low amount of muscle mass may be able to gain weight more rapidly than more advanced lifters or those with a greater muscle mass. Muscle hypertrophy is more likely to occur at a greater rate in individuals with a greater proportion of fast twitch muscle fibers (11, 12). As individuals increase their muscle mass and approach their genetic limits, it becomes more



difficult to increase muscle mass. Although some texts suggest that a weight gain of one to two pounds per week is possible, a more reasonable goal for a lifter in order to reduce fat weight gain would be $\frac{1}{2}$ to one pound per week initially and $\frac{1}{2}$ to one pound per month for an advanced lifter with a high degree of muscularity.

In order to increase muscle size, the lifter has to increase the amount of muscle protein in their muscle cells. This process requires adequate calories and protein in the individual's diet. In order to gain one pound of muscle, an increased calorie balance of approximately 3,500 calories is needed. For example, if an individual's goal is to gain $\frac{1}{2}$ pound per week, then an additional caloric intake of 1,750 per week, or 250 calories per day, above the person's typical calorie consumption is needed. Also if an individual has not been exercising prior to beginning a strength training program, then additional calories are needed to replace those expended during the workout. Depending on the amount of exercises, sets and repetitions completed, the energy expended during a workout might be approximately 200 to 300 calories. Finally, it is generally recognized that the protein needs of individuals attempting to increase muscle mass are increased (13, 14, 15). A reasonable recommendation is to obtain 1.4 to 1.8 grams of protein per kilogram of body weight or approximately 0.65 to 0.80 grams per pound of body weight each day.

An important consideration is the timing of meal or food consumption relative to the workout session. Recent research demonstrates that consumption of protein and carbohydrates shortly following a workout increases protein synthesis and reduces protein breakdown (16, 17, 18), thus increasing the potential for gaining muscle mass. Individuals may ask whether protein or other nutritional supplements are necessary. Although these types of supplements are not absolutely necessary, they may provide a convenient way of obtaining additional calories and protein especially during the post-workout period.

PROGRAM DESIGN FOR NOVICE LIFTERS:

Type of training equipment:	Free Weights and Machines
Frequency:	2 to 3 days per week
Number and order of exercises:	8 to 10 exercises; Larger muscle mass and more complex exercises first and smaller muscle mass, simpler exercises later.
Number of sets per exercise:	2 to 3
Repetitions for each set:	5 to 12; should be varied on a regular basis



Weight to be used for each set: 65 to 85% of 1-repetition maximum; one or more sets that involve maximal effort should be performed.

Rest periods: 1 to 2 minutes between sets; 1 to 3 minutes between exercises.

PROGRAM DESIGN FOR MORE ADVANCED LIFTERS:

Type of training equipment: Free weights and machines; increasing emphasis on free weights.

Frequency: 2 times per week per muscle group;
2 to 6 days per week; split routines often performed.

Number and order of exercises: 8 to 10 exercises; Larger muscle mass and more complex exercises first and smaller muscle mass, simpler exercises later.

Number of sets per exercise: 2 to 5; may differ for various exercises.

Repetitions for each set: 3 to 12; should be varied on a regular basis.

Weight to be used for each set: 70 to 90% of 1-repetition maximum; one or more sets incorporating maximal effort must be performed.

Rest periods: 1 to 3 minutes between sets depending upon goals of the workout; 1 to 3 minutes between exercises.

SAMPLE EXERCISES FOR NOVICE LIFTERS:

Bench Press (free weights)
Leg extensions (machine)
Pull downs (machine)
Military Press (free weights)
Leg Extensions (machine)
Rowing Exercise (machine)
Triceps Pushdown (machine)
Arms curls (free weights)
Abdominal crunches

SAMPLE EXERCISES FOR MORE EXPERIENCE LIFTERS SHOWING A TWO-DAY SPLIT:



Monday and Thursday

Bench press (free weights)
Inclined press with dumbbells (free weights)
Pull downs to back (machine)
Behind the neck press (free weights)
Rowing Exercise (machine)
Triceps Pushdown (machine)
Arms curls (free weights)

Tuesday and Friday

Leg Press (machine)
Leg extensions (machine)
Leg curls (machine)
Calf raises (free weights or machine)
Abdominal crunches

Individuals should contact a National Strength and Conditioning Association (NSCA) Certified Strength and Conditioning Specialist (CSCS) or Certified Personal Trainer (NSCA-CPT).



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