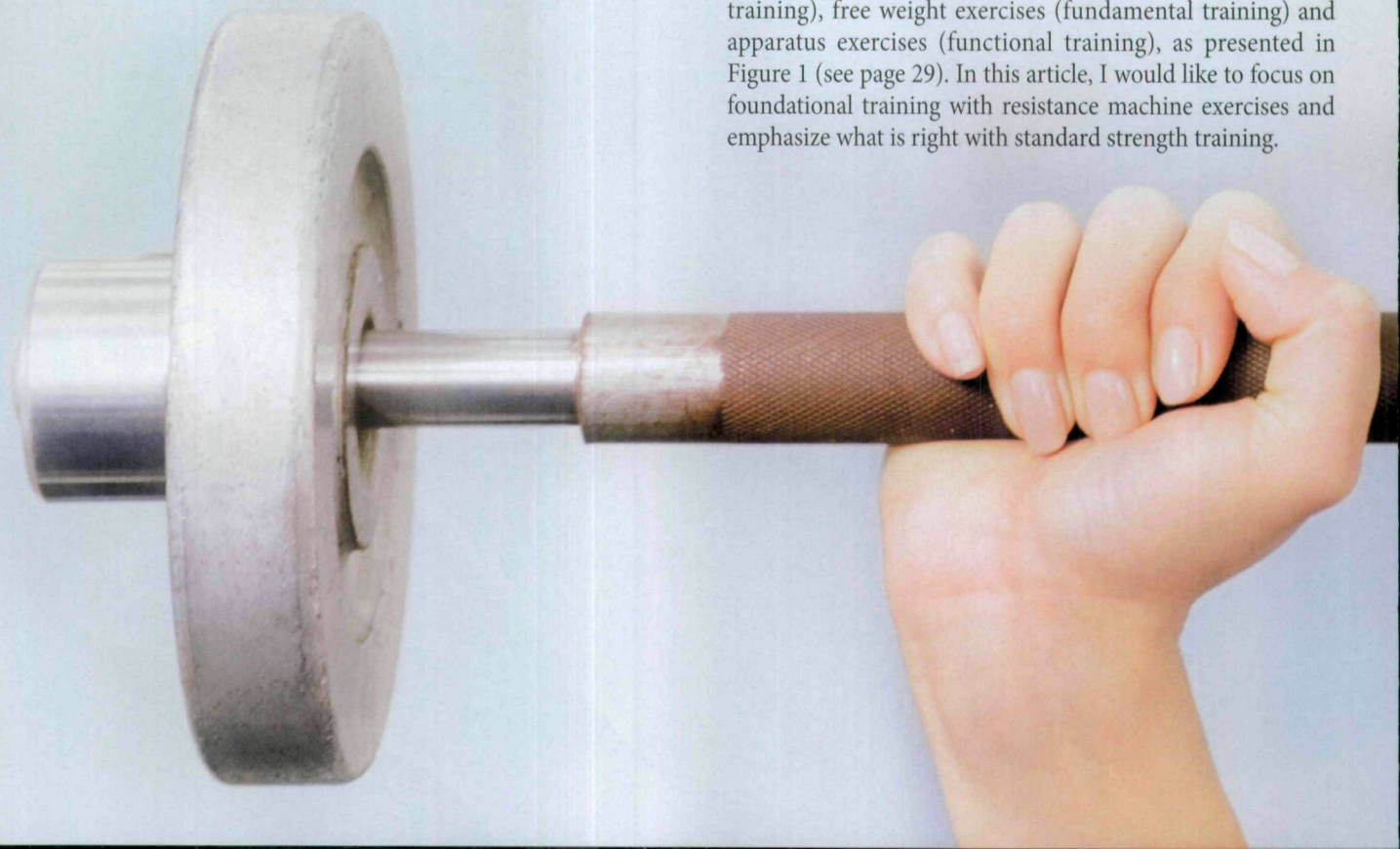
Standard STRENGTH Training

What's right with it?

BY WAYNE L. WESTCOTT, PhD, CSCS

These days, I hear a lot of people promoting functional training, sport-specific exercise and work hardening programs. While I have no problem with these training procedures when properly instructed to appropriate populations, I wish that fitness professionals would come to a consensus of opinion on a standard strength training protocol for beginning exercisers.

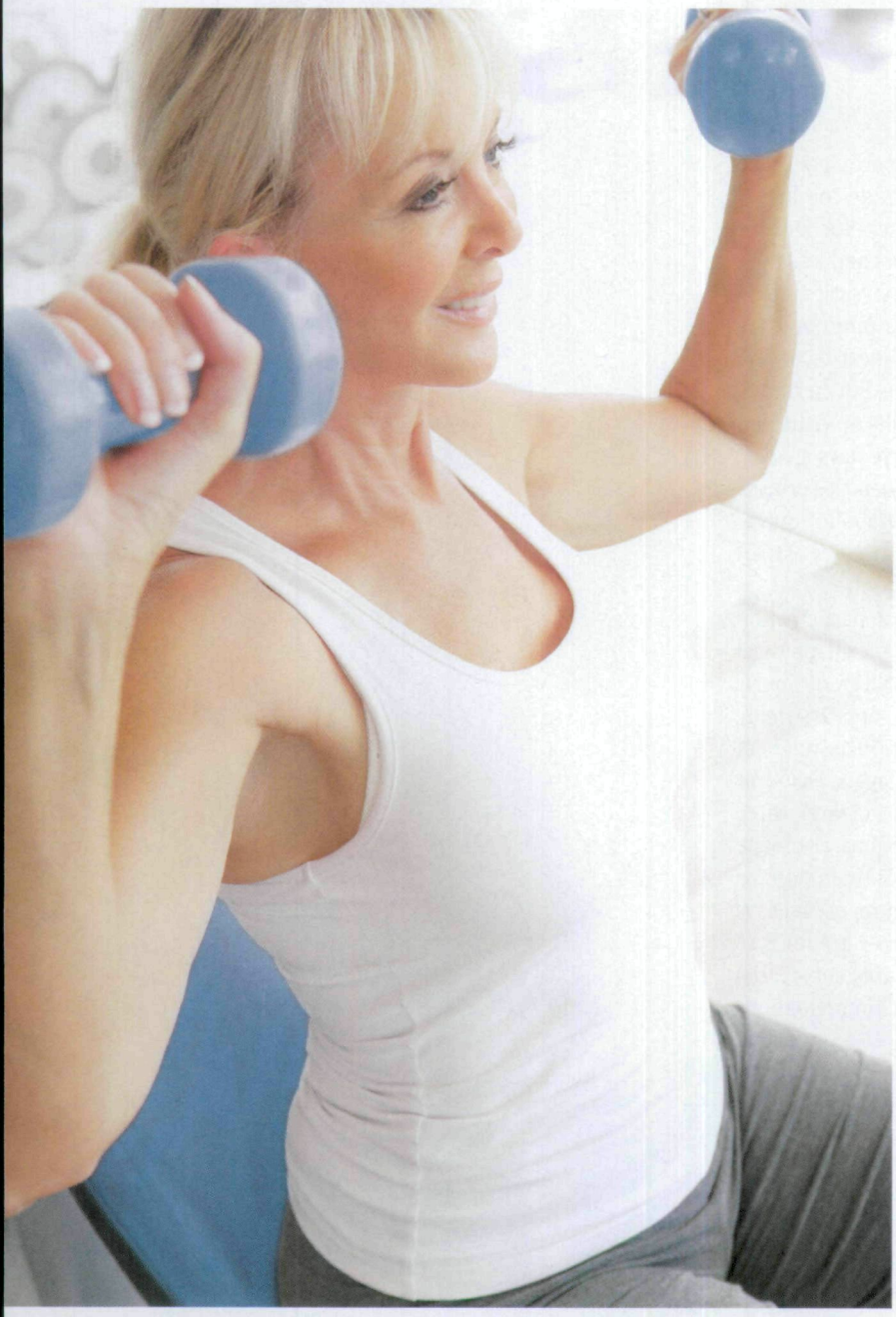
My preferred approach is a progressive three-level program that includes resistance machine exercises (foundational training), free weight exercises (fundamental training) and apparatus exercises (functional training), as presented in Figure 1 (see page 29). In this article, I would like to focus on foundational training with resistance machine exercises and emphasize what is right with standard strength training.



Let's begin with the present state of exercise participation in the United States. According to a recent research study conducted by the National Institutes of Health and the Centers for Disease Control and Prevention,[1] less than 10% of teenagers and less than 5% of adults attain the minimum recommended physical activity levels. Data from almost 5,000 study participants monitored by accelerometers revealed that only 8.0% of 12- to 19-year-olds were moderately active for 60 minutes on five days a week. Furthermore, only 3.5% of adults 20 to 59 years and 2.4% of adults 60 years and older were moderately active for 30 minutes on five days a week. These are not encouraging findings, especially when the criteria for moderate level activity was only 3.0 METs (Metabolic equivalent of task, or walking about 2.5 mph), and the 30 minutes of total daily activity could be accumulated in 10-minute bouts.

Considering the extremely low level of exercise participation among youth, adults and older adults, the most recent physical activity recommendations from the American College of Sports Medicine and the American Heart Association[2] appear highly appropriate. The new exercise guidelines call for 30 minutes of moderate intensity activity (e.g., walking) five days a week, *or* 20 minutes of vigorous intensity activity (e.g., jogging) three days a week. The updated exercise recommendations also state that "every adult should perform activities that maintain or increase muscular strength and endurance a minimum of two days each week." The specific strength training guidelines are for 8 to 10 exercises performed with a resistance that causes substantial muscle fatigue within 8 to 12 repetitions. These recommendations are completely consistent with those presented in *ACSM's Guidelines for Exercise Testing and Prescription*, 8th Edition.[3]

Although both resistance machines and free weights are recommended for strength exercisers of all ages, it is probably prudent to employ machine exercises with beginning participants and special populations. For example, the Aerobics and Fitness



Association of America[4] advocates basic resistance machine exercises for beginning clients, the American College of Sports Medicine[5] recommends machine strength training for elderly individuals, and the President's Council on Physical Fitness and Sports[6] advises resistance machine exercises for obese youth and adolescents. The advantages of resistance machines for previously untrained individuals include supportive structure for greater stability, fixed movement patterns for correct biomechanics, and variable resistance for better matching of resistance forces to muscle forces throughout the exercise movements. Consider the following research studies that support standard resistance machine exercises for older adults, middle-aged adults, younger adults, and youth who are starting a strength training program.

Strength Training for Older Adults

John Knox Village, a lifecare retirement community in Orange City, Fla., requested a strength training study with 19 of their elderly residents.[7] These nearly 90-year-old men and women were physically weak and used wheelchairs for transportation. The challenge was to make them strong enough to walk again. Due to their limited physical ability, we selected five resistance machines to cumulatively address most of their major muscle groups (leg press, triceps press, seated row, low back extension, neck extension).

Because the participants had low entry levels of strength, stamina and energy, and typically suffered from lower back, upper back and neck discomfort, we had them train two days a week (Mondays and Fridays), with 1 set of each exercise, using a resistance that they could lift between 8 and 12 repetitions (approximately 70 to 80% of maximum). Whenever they could complete 12 repetitions, we increased the exercise resistance by about 5%. This basic and brief training protocol was well received and well tolerated by these elderly participants, who experienced no exercise-related injuries and expressed high levels of satisfaction with the strength training program.

Following 14 weeks of regular resistance exercise, these trainees made significant improvements in body composition, muscle strength, joint flexibility and functional abilities (capacity for performing daily living activities). As presented in Table 1, they increased lean (muscle) weight by 3.8 pounds, decreased fat weight by 2.9 pounds, increased lower body strength by 81%, increased upper body strength by 39%, increased hip flexibility by 53%, increased shoulder flexibility by 9% and improved functional independence by 14%. Equally important, essentially all of the program participants reported less physical discomfort (lower back pain, upper back pain, neck pain); all but one trainee (a double leg amputee) spent less time in wheelchairs; one woman no longer needed to use a wheelchair; and another woman left the assisted living facility to reside again with her husband in an independent living apartment. Clearly, this basic resistance machine exercise program produced impressive physiological improvements that resulted in greater physical function and higher life quality for these elderly participants.

Strength Training for Middle-Aged Adults

At the South Shore YMCA in Quincy, Mass., we conducted an eight-year study with middle-aged adults who enrolled in a beginning exercise program.[8] The 10-week program provided small class training sessions with about 25 minutes of strength exercise (10 resistance machines) and about 25 minutes of aerobic activity (treadmill and

TABLE 1. FOURTEEN-WEEK IMPROVEMENTS IN PHYSIOLOGICAL AND FUNCTIONAL FACTORS FOR OLDER ADULT STRENGTH TRAINING PARTICIPANTS (N=19).

FACTOR	PRE-TRAINING	POST-TRAINING	IMPROVEMENT
Lean Weight	100.5 lbs	104.3 lbs	+3.8 lbs *
Fat Weight	29.7 lbs	26.8 lbs	-2.9 lbs *
Leg Press Strength	58.1 lbs	105.3 lbs	+81.2% *
Triceps Press Strength	37.9 lbs	52.6 lbs	+38.8% *
Hip Flexibility	29.0 deg	44.3 deg	+52.8% *
Shoulder Flexibility	100.0 deg	109.4 deg	+9.4% *
**FIM Score	77.5 points	88.5 points	+14.2% *

*Statistically significant ($p<0.05$). **Functional Independent Measure

TABLE 2. TEN-WEEK IMPROVEMENTS IN PHYSIOLOGICAL FACTORS FOR MIDDLE-AGED ADULT STRENGTH TRAINING PARTICIPANTS (N=1644).

FACTOR	PRE-TRAINING	POST-TRAINING	IMPROVEMENT
Lean Weight	127.9 lbs	131.0 lbs	+3.1 lbs *
Fat Weight	51.3 lbs	47.6 lbs	-3.7 lbs *
Systolic Blood Pressure	128.3 mmHg	124.5 mmHg	-3.8 mmHg *
Triceps Press Strength	77.0 mmHg	75.2 mmHg	-1.8 mmHg *

*Statistically significant ($p<0.05$).

TABLE 3. TWELVE-WEEK IMPROVEMENTS IN PHYSIOLOGICAL FACTORS FOR YOUNGER ADULT STRENGTH TRAINING PARTICIPANTS (N=57).

FACTOR	PRE-TRAINING	POST-TRAINING	IMPROVEMENT
1.5-Mile Run	1055.7 secs	1020.4 secs	-35.3 secs *
Waist Circumference	38.7 in	37.4 in	-1.3 in *
Push-Ups	29.3 reps	36.4 reps	+7.1 reps *
Abdominal Crunches	30.2 reps	36.0 reps	+5.8 reps *

*Statistically significant ($p<0.05$).

TABLE 4. EIGHT-WEEK IMPROVEMENTS IN MUSCLE STRENGTH PERFORMANCE FOR YOUTH STRENGTH TRAINING PARTICIPANTS (N=14).

FACTOR	PRE-TRAINING	POST-TRAINING	IMPROVEMENT
Leg Extension	28.4 lbs	46.6 lbs	+64.5% *
Leg Curl	22.9 lbs	42.9 lbs	+77.6% *
Chest Press	33.4 lbs	55.0 lbs	+64.1% *
Overhead Press	16.5 lbs	31.0 lbs	+87.0% *
Arm Curl	10.3 lbs	18.3 lbs	+78.1% *

*Statistically significant ($p<0.05$).

cycle). The strength training protocol was 1 set of each exercise (leg extension, leg curl, double chest press, back pull-over, lateral raise, biceps curl, triceps extension, abdominal curl, low back extension, neck extension/flexion) using a resistance that could be performed for 8 to 12 repetitions (approximately 70 to 80% of maximum). Whenever 12 repetitions could be completed the resistance was increased by about 5%. The research class members (mean age 54 years) expressed a high level of satisfaction with this training protocol, as evidenced by a 92% program completion rate.

On average, the 1,644 men and women who participated in this study increased lean (muscle) weight by 3.1 pounds; decreased fat weight by 3.7 pounds; reduced resting systolic blood pressure by 3.8 mmHg; and reduced resting diastolic blood pressure by 1.8 mmHg (see Table 2). All of these physiological changes were significant statistically and practically with respect to health, fitness and function. In fact, from a performance perspective, a subgroup of 77 recreational golfers who followed the same training protocol increased their club head speed by 6%, leading to longer drives and better golf scores.[9] In general, the basic and brief strength training program seemed well suited for these previously sedentary men and women, resulting in more muscle, less fat, lower resting blood pressure and improved physical performance.

Strength Training for Younger Adults

A study was conducted at Langley Air Force Base, with 83 men and women who did not attain a passing score on the U.S. Air Force physical fitness test battery.[10] The four assessment areas included a 1.5-mile run (50% of total score), an abdominal circumference (30% of total score), 1-minute push-ups (10% of total score) and 1-minute abdominal crunches (10% of total score). The study participants were randomly assigned to one of two exercise programs intended to improve their fitness test scores. Those assigned to the standard Air Force aerobic exercise program were directed to perform approximately 60 minutes of mostly aerobic activity (e.g., running), four to five days a week for a period of 12 weeks. Those assigned to the circuit strength training program were directed to perform approximately 20 minutes of physical activity, three days a week, alternating 1-minute bouts of resistance exercise with 1-minute bouts of stationary cycling. Participants performed 1 set of 15 to 20 repetitions on 10 resistance machines (squat, seated leg curl, leg extension, chest press, seated row, shoulder press, lat pull-down, triceps press, biceps curl, abdominal crunch).

Following 12 weeks of training, the aerobic exercise group failed to achieve significant improvements in any of the assessment areas. However, the circuit strength training group attained significant improvements in all of the assessment areas as presented in Table 3.

Why would such a well designed aerobic exercise program fail to produce faster times in the 1.5 mile run or smaller abdominal circumferences in this training group? Although 60 minutes of mostly aerobic activity performed four to five days a week represents an excellent exercise program for reasonably fit individuals, this relatively long duration and high frequency training protocol is not well suited for unfit individuals, especially those who have low cardiovascular endurance and high body weight. Beginning exercisers in these categories experience much greater success with activities (both strength and endurance) that use external resistance rather than bodyweight. The unfit participants in the circuit strength training program could lower the machine exercise resistance to their individual strength levels, and they could set the bicycle exercise tension to their individual endurance levels. When the exercise resistance and training intensity are appropriate, new participants can successfully perform a basic circuit training program that concurrently improves muscular strength, cardiovascular endurance and body composition.

Strength Training for Youth

Dozens of strength training studies were conducted for preadolescent boys and girls, almost all of which used youth-sized resistance machines and standard exercise protocols. In the classic youth strength training study conducted by my colleague Avery Faigenbaum, 11-year-old boys and girls performed 3 sets of 10 repetitions each for five basic exercises on a child-sized, multistation weight stack machine: leg extension, leg curl, chest press, arm curl, shoulder press.[11] The first set was performed with 50% of their 10 repetition maximum weight load (10RM); the second set was done with 75% of their 10RM weight load; and the third set was executed with the 10RM weight load. When 15 repetitions could be completed with the 10RM weight load, the resistance was raised by about 5%.

After eight weeks of twice weekly training sessions, the preadolescent participants experienced a 74% average gain in muscular strength (see Table 4). This statistically significant strength increase was almost six times greater than the 13% strength gain attained through normal growth processes by the nontraining control group. In addition, the youth who completed the two-month strength training program made significant improvements in their body composition.

Because most boys and girls have little previous strength training experience, the fixed movement patterns and body stability provided by properly sized resistance machines facilitates safe and effective exercise experiences. Clearly, preadolescents can improve their muscle strength and body composition through standard strength training protocols. We have found that young people, whether athletic or not, enjoy the process and product of performing basic and brief bouts of strength exercise, as evidenced by a 95% completion rate over 15 years of continuous youth strength training programs.

The Results

Based on these four research studies, it would seem that standard strength training is a highly effective means for increasing muscle strength, improving body composition, and enhancing a variety of health and fitness factors in older adults, middle-aged adults, younger adults and youth.

As an analogy, a person who has never tasted ice cream can be satisfied for several months by eating just chocolate or vanilla. In the same way, an individual who has never done strength training should respond favorably to a basic program of resistance exercise. Just as one may eventually want to try additional ice cream flavors, when new exercisers attain a higher level of strength fitness,

they may benefit from more advanced resistance training protocols and modalities. In my opinion, beginning exercisers of all ages should start with *foundational strength training* performed on well designed resistance machines that provide proper movement patterns, body support and highly stable performance conditions. I believe the next step should be *fundamental strength training* performed with free weights (dumbbells and barbells) that offer more movement freedom, less body support and moderately stable performance conditions. Exercisers may then progress to *functional strength training* using a variety of resistance equipment and materials (medicine balls, exercise balls, etc.) that further facilitate movement freedom as well as unsupported and unstable performance conditions (see Figure 1).

We have followed this progression for many years and found that starting with standard machine strength training produces excellent results from both a physiological and psychological perspective.[12,13]

Our progression from machine exercises to free weights to functional training has provided relatively high rates of strength development, as well as relatively low rates of physical injury and mental burnout. Likewise our progression from basic and lower volume training protocols to more complex and higher volume training protocols has proven to be practical, productive and well received by our program participants.

If the primary purpose of strength training is to increase muscle strength, beginners are well advised to perform a standard program of resistance exercise in accordance with the American College of Sports Medicine and American Heart Association guidelines published in 2007.[2] Simply stated, new participants should perform 8 to 10 exercises that cumulatively address all of the major muscle groups, using resistance that fatigues the muscles within 8 to 12 repetitions, on two or three nonconsecutive days each week. As our studies clearly indicate, there is a lot that's right with this standard strength training protocol. **AF**

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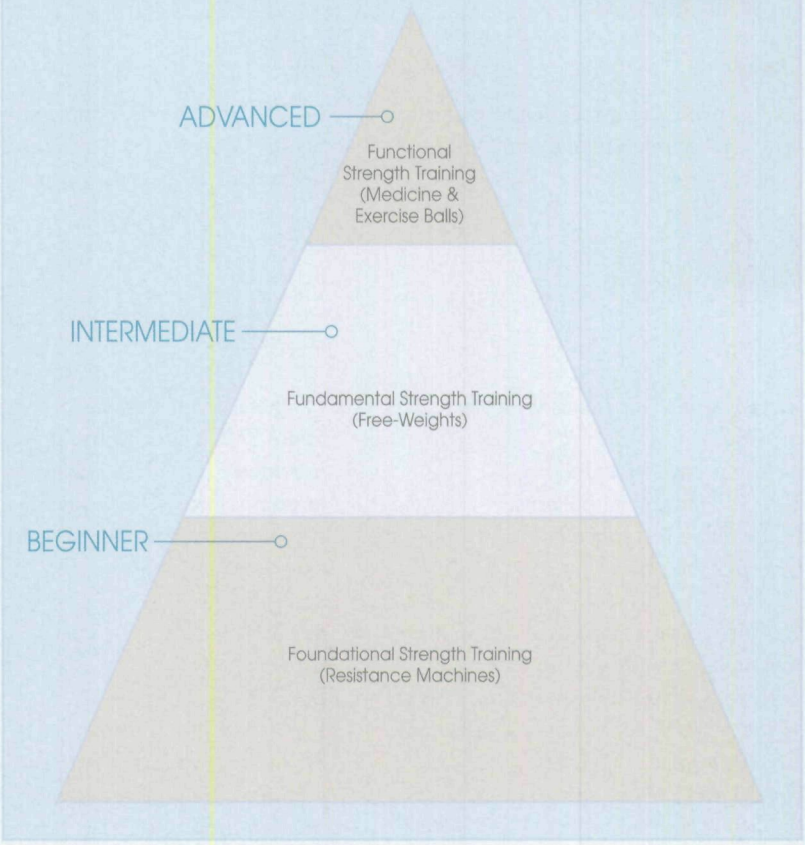
FIGURE 1. RECOMMENDED PROGRESSION OF STRENGTH TRAINING MODALITIES FOR NEW EXERCISERS.



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Standard Strength Training

Code No. 0106

1. According to a recent national study, ____ of American adults attain the minimum recommended physical activity levels.
A. 5%
B. 10%
C. 25%
D. 50%

2. Resistance machines typically provide:
A. supportive structure.
B. fixed movement patterns.
C. variable resistance.
D. all of the above.

3. The elderly residents in the John Knox Village strength training study performed five exercises initially using ___ to ___ of their maximum resistance.
A. 30; 40%
B. 50; 60%
C. 70; 80%
D. 90; 100%

4. Based on the results of the John Knox Village strength training study, elderly individuals may expect to gain ___ to ____ pounds of lean weight after 14 weeks of resistance training.
A. 1; 2
B. 3; 4
C. 5; 6
D. 7; 8

5. What is an explanation for the John Knox Village elderly exercisers' ability to walk more and spend less time in their wheelchairs?
A. More social interaction
B. Increased cardiovascular endurance
C. Improved cognitive function
D. Significant strength gains

6. The adult participants in the South Shore YMCA strength training study performed 10 exercises using ___ to ___ repetitions.
A. 2; 4
B. 6; 10
C. 8; 12
D. 14; 16

7. Based on the results of the South Shore YMCA strength training study, previously sedentary adults may expect to gain ___ to ___ pounds of lean weight after 10 weeks of resistance exercise.
A. 1; 2
B. 3; 4
C. 5; 6
D. 7; 8

8. In the Air Force fitness study, a difference between the two exercise training groups was:
A. program frequency.
B. training duration.
C. exercise mode.
D. none of these.

9. One major advantage of external resistance over bodyweight resistance for overweight exercisers is that it:
A. adapts to the participant's physical abilities.
B. requires the use of specialized technology.
C. provides less support to the client's body structure.
D. necessitates flexibility to maintain balance and coordination.

10. Based on the results of the Air Force fitness study, which fitness component(s) concurrently improve through a circuit strength training program?
A. Muscular strength
B. Cardiovascular endurance
C. Body composition
D. All of the above

11. In the youth strength training study, preadolescent boys and girls who performed eight weeks of resistance exercise increased their overall muscle strength almost _____ times more than their nontraining peers.
A. two
B. four
C. six
D. eight

12. Which statement supports the contention that preadolescent youth find basic and brief sessions of resistance exercise positively reinforcing?
A. 95% completion rate over 15 years
B. 74% average increase in muscle strength
C. Significant improvement in body composition
D. Better athletic performance

13. Individuals new to exercise should begin by performing a _____ strength training program.
A. stable
B. foundational
C. isometric
D. fundamental

14. Starting with a standard strength machine training program produces excellent _____ results.
A. spiritual
B. occupational
C. emotional
D. physiological

15. According to Table 4, youth training participants improved strength by 87% for the _____ exercise.
A. overhead press
B. leg curl
C. chest fly
D. abdominal crunch