DEVELOPING A LIFELONG RESISTANCE TRAINING PROGRAM

by Len R. Kravitz, PhD

Apply It!

1. The health benefits of resistance training clearly suggest that resistance training is vital for overall health and should be included in the design of training programs for youth, adults, and older persons.
2. The concept of an individualized resistance training program for all persons indicates that current exercise guidelines provide scientific direction to practitioners, but true optimal success will only be achieved through individualized assessment and consideration of a person's health status and goals.

Key words: Resistance Training, Weight Training, Exercise, Health

We are a species made to move. Physical activity is a part of our daily lives. Looking retrospectively, Harvard evolutionary biologist Dr. Daniel Lieberman (1) states humans have evolved and adapted for a wide range of diverse physical activities, such as long-distance running and walking in the heat, carrying, digging, and throwing objects. Yet we now face a unique challenge as fitness professionals and educators. The urbanization and industrial shifts in Western society, along with our remarkable technological advances, have helped to create chair-based environments where we sit for the greater part of our waking day (2). Excessive sitting lifestyles have inspired a new science of sedentary behavior to better understand the deleterious effects and to develop strategies to thwart the perils of "sitting disease" (2). However, we currently have the most compelling of research studies that denote regular participation in aerobic exercise and resistance training is health promoting and successful in disease management and prevention for people of all ages. What's more, in a recent 2018 systematic review and meta-analysis (a statistical approach to combine the results from multiple studies) that analyzed data from 2 million women and men, the researchers concluded, "Higher levels of upper- and lower-body muscular strength are associated with a lower risk of mortality in adult populations at any age, regardless of age and follow-up period" (3). In addition, youth exercise programs that enhance muscular strength and fundamental movement skill performance early in life will build the foundation for an active lifestyle later in life (4). Therefore, the aim of this paper is twofold: 1) to substantiate the evidence-based health benefits of resistance training and 2) to provide a structure and basis for developing a lifelong resistance training program.

Humans have evolved and adapted for a wide range of unique physical activities, such as long-distance running and walking in the heat, carrying, digging, and throwing projectiles.

WHAT ARE THE HEALTH BENEFITS OF RESISTANCE TRAINING?

Resistance training is a method of conditioning where individuals work against a broad range of resistive loads (*e.g.*, body weight, weight machines, free weights, elastic bands, and medicine balls) to enhance fitness level, health, and/or sports performance (4). In a very well-documented review (5), Dr. Wayne L. Westcott, who directs exercise programs and the fitness research at Quincy College, has summarized the fact-based health benefits of resistance training. Westcott submits solid evidence that shows regular, progressively challenging resistance training can improve bone density, percent body fat, resting metabolism, muscle mass, glycemic control, blood pressure, blood lipids, physical function, and mental health. Relatedly, Borde et al. (6) report that recent studies support an emerging hypothesis that lifelong resistance training may be an important nonpharmaceutical intervention to slow and even counteract the age-related loss of neuromuscular function. Furthermore, resistance training is particularly important in the fifth and sixth decade of life

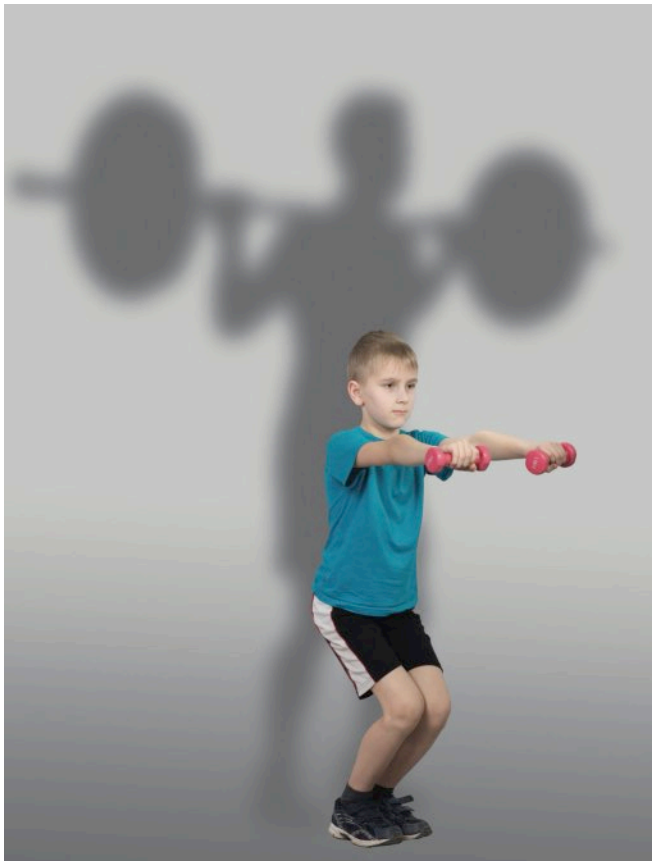
to control and help reverse the age-associated losses of muscle size (7). Three vital benefits of resistance training that warrant further discussion in this paper are the improvements in bone density, body fat, and glycemic control.

The increase and/or preservation of bone mass is paramount, particularly to women as they age. Women are at higher risk because their bone loss quickens after the onset of menopause. During menopause, the loss of bone mass may lead to osteoporosis. According to the World Health Organization (8), the lifetime risk for osteoporotic fractures in women is at least 30%, and possibly closer to 40%. In men, the risk is only 13% (8). In their systematic review, Gómez-Cabello et al. (9), researchers from universities in Spain, state that resistance training is a powerful stimulus to maintain and improve bone mass during the ageing process.

In his research review, Westcott (5) cites several studies that show resistance training programs lead to a decrease in fat weight and an increase in muscle mass. In another review, Strasser and Schobersberger (10), from the Institute for Sports Medicine in Tirol, Austria, highlight that resistance training programs have been shown to be effective in reducing visceral fat. Visceral fat obesity is highly associated with the development of hypertension, high blood lipids, type 2 diabetes, and cardiovascular disease (10). The researchers draw attention to studies that show muscle mass is inversely associated with all-cause (*i.e.*, harmful diseases) mortality and the prevalence of metabolic syndrome. Thus, an important case is made, and perhaps needs more attention in the consumer media, for the evidence relating to the positive impact of resistance training in reducing major cardiovascular disease risk factors.

In regard to the effects of resistance training to improve glycemic control, the American Diabetes Association (ADA) Standards of Medical Care in Diabetes — 2018 reports that there is supportive evidence from well-conducted cohort studies that persons with diabetes should engage in resistance exercise 2 to 3 sessions per week on nonconsecutive days (11). In addition, the ADA report highlights that higher levels of exercise intensity are associated with greater improvements in A1c (*i.e.*, A1c or HbA1c is the form of hemoglobin measured to identify the 3-month average of blood glucose concentration). Ishiguro et al. (12), from the Department of Hematology, Endocrinology, and Metabolism from Niigata University in Japan, provide other useful suggestions from their systematic review and meta-analysis. Their research revealed that there is a much better outcome with A1c reduction in type 2 diabetes mellitus patients when patients did resistance training programs consisting of 21 or more sets per session of training. For example, in a program of 7 different upper- and lower-body exercises, 3 sets of 7 exercises would be 21 total sets. In another major finding from the review, the researchers indicate that resistance training has a better glycemic control effect when it is introduced in people who have had type 2 diabetes for 6 years or less. A third important finding of this research reveals that resistance training has a more pronounced effect in persons whose body mass index (BMI) is from 22.3 to 38.8 kg/m^2, which are BMI classifications of normal to obese, respectively.

Higher levels of exercise intensity are associated with greater improvements in A1c.



The findings discussed in the previous paragraphs present impressive evidence why resistance training is vital for overall health. In the next sections, a plan for a lifelong resistance training program is discussed for youth and adults.

LIFELONG RESISTANCE TRAINING STARTS WITH YOUTH

The term "youth" is a broadly defined term that encompasses children and adolescents (13). Children, also defined as preadolescents, refers to girls (up to age 11) and boys (up to age 13) who have not developed secondary sex characteristics. Adolescence depicts a period of time between childhood and adulthood. For instance, adolescence for girls is approximately between 12 and 18 years and for boys it is between 14 and 18 years (13).

There is now worldwide acceptance by scientists that resistance training in youth will lead to significant improvements of muscular strength, muscular endurance, power production, running velocity, change-of-direction speed, and motor skills

and functional performance if the training is under the supervision and guidance of a qualified fitness instructor (4,13,14). In addition, resistance training in children has been shown to helpfully alter body composition, reduce fat, and improve insulin sensitivity in adolescents who are overweight (4). Interestingly, data now show that youth with low muscular fitness are at increased risk of maintaining a low muscular fitness level into adulthood (15). Supportively, in boys and girls, resistance training may also lead to a positive attitude by increasing self-esteem and confidence levels. However, for all of these convincing results to be realized and achieved for participation in resistance training, Lloyd et al. (4) state that for children to succeed, they must be able to demonstrate that they are emotionally mature enough to follow directions.

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A very popular way to introduce youth to resistance training is with body weight exercises. Initially teaching children pushups (or wall pushups), squats, lunges, pull-ups, dips, bridges, and inverted rows (from a bar or rings) will help them learn more about the muscular control it takes to move the body. As their interest progresses, begin adding exercises with resistance bands, medicine balls, dowel rods, and light dumbbells. All resistance exercises should be performed with appropriate progressions in training using proper technique. For a sustained and hopefully the start of a lifelong resistance training program, develop a program that is challenging and always changing. The updated position paper on youth resistance training from the National Strength and Conditioning Association (14) provides several helpful general resistance training guidelines, which are summarized.

In boys and girls, resistance training may also lead to a positive attitude by increasing self-esteem and confidence levels.

1. Ensure a safe exercise environment that is free of hazards.
2. Begin training sessions with a 5- to 10-minute dynamic warm-up.
3. Start the training with relatively light loads; the focus should be on learning the exercises with proper form and performing the exercises with a moderate velocity. As the youth progresses, incorporating different velocities of movement, such as plyometric exercises, may be introduced.
4. Develop the resistance program with the goal of attaining symmetrical muscular development with satisfactory muscular strength balance around the movable joints.
5. Perform 1 to 3 sets of 6 to 15 repetitions 2 to 3 times per week (nonconsecutive days). With power development, 1 to 3 sets of 3 to 6 repetitions can be employed.
6. A gradual progression (5% to 10% increase) for each participant should be based on his or her ability, needs, and goals.
7. Always include a cool-down consisting of light-intensity calisthenics and static stretching.

For lifelong maintenance of resistance training, education on healthy lifestyles is encouraged including discussions on sleep, hydration, and the importance of rest and sleep. Although many youths may choose to start resistance training for purposes of enhancing sport performance, fitness pros should always remind them of the health-related benefits they are also attaining. For the improvement of youth muscular strength, which Borde et al. (6) encourage as a lifelong goal, the National Strength and Conditioning Association recommendations for novice, intermediate, and advanced levels of youth resistance training programs are synthesized in Table 1. Moreover, Table 2 provides movement competencies for implementing youth resistance training programs.

LIFELONG RESISTANCE TRAINING WITH ADULTS

As with youth, one of the meaningful keys for adults to succeed with a lifelong, effective resistance training program is to ensure that it is developed and supervised by a qualified professional. Educate participants that a program that gradually progresses will help confirm the many documented health benefits associated with resistance training. Because many adults will be transitioning from a sedentary lifestyle to their first introduction to resistance training, perhaps a circuit weight training (CWT) program would

TABLE 1: NSCA Recommendations for Progression in Youth Strength Training

Variable	Advance Level	Intermediate Level	Novice Level
Frequency (d/wk)	3–4	2–3	2–3
Muscle action	CON and ECC	CON and ECC	CON and ECC
Exercise choice	MJ and SJ	MJ and SJ	MJ and SJ
Volume	≥3 sets × 6–10 reps	2–3 sets × 8–12 reps	1–2 sets × 10–15 reps
Intensity	70%–85% 1RM	60%–80% 1RM	50%–70% 1RM
Rest intervals (min)	2–3	1–2	1
Movement speed	Moderate	Moderate	Moderate

CON, concentric; ECC, eccentric; MJ, multijoint; SJ, single joint; 1RM, 1 repetition maximum; rep, repetition Adapted from (14).

be most appropriate to introduce. Circuit weight training is a sequence of 6 to 12 (or more) resistance exercises performed in a rotational order with light-to-moderate intensity loads (40% to 60% one-repetition maximum) using limited to no rest between exercises (16). This type of training has been implemented in programs involving healthy younger and older adults, as well as in programs involving clinical populations such as people with hypertension, diabetes mellitus, and heart disease. Moreover, CWT programs are time-efficient programs that have been shown to improve muscular strength and endurance, flexibility, body composition, and health-related enhancements such as resting blood pressure, hemoglobin A1c, and aerobic capacity (16). Common exercise selections for CWT, as well as traditional resistance training, include exercises for the chest (*e.g.*, bench press, decline dumbbell bench press), shoulder (*e.g.*, standing dumbbell side lateral, seated shoulder press), upper/middle back (*e.g.*, latissimus

TABLE 2: Movement Competencies for Youth Resistance Training

It is important to remember that youth are not small adults. Design resistance training programs to match the movement competencies of the youth. Successful youth resistance training programs include appropriate program design, instruction on proper lifting techniques, sensible methods of progression, and adequate recovery between sessions. Start the resistance training with basic exercises and gradually progress to more complex exercises as the youth's competence and confidence improve. Here are some applied suggestions and movement competencies for developing a youth resistance training program.

1. A boundless number of exercises can be used to develop muscular fitness provided that the exercises are appropriate for a child's fitness level, body size, and exercise performance technique experience.
2. Free weights (barbells and dumbbells), elastic bands, medicine balls, and body mass exercises have been shown to be safe and effective for children.
3. Child- and adult-size machines should be selected if they are appropriate to the youth's body size and muscular development.
4. Incorporate multijoint exercises (*e.g.*, squat and bench press) and single-joint exercises (*e.g.*, leg extension and biceps curl) in the program design.
5. Perform the concentric and eccentric phases of the lift with control.
6. Advanced exercises, such as Olympic-style lifts (*e.g.*, snatch, clean, and jerk), are fine to incorporate in a program design; make sure the young participants learn these lifts with light loads (*e.g.*, wooden dowels or unloaded barbells).
7. Plyometric exercises (*e.g.,* body mass jumping exercises on yielding surfaces and medicine ball throws) can be safe and effective for developing speed of movement and muscle power in children, provided appropriate training guidelines are followed.
8. Start plyometric exercise training (≤ 10 repetitions of an exercise) with less-intense drills (*i.e.*, double-leg jumps) and gradually progress to more advanced drills (*i.e.*, single-leg hops).
9. Incorporate balance exercises in the resistance training program design, because balance and coordination are not fully developed in youth.
10. Incorporate progressive strengthening exercises for the hips, abdomen, and lower back in the youth training program as part of a preventative, injury prevention health strategy.

Adapted from (13)

dorsi pulldown, seated pulley row, upright row), core (*e.g.*, plank hold, physioball crunch, and physioball back extension), biceps (*e.g.*, standing barbell curl, alternating incline dumbbell curl), triceps (*e.g.*, decline triceps extensions, overhead rope triceps extensions), thigh/hip/gluteals (*e.g.*, leg press, lunges, standing leg curls, leg extensions), and calves (*e.g.*, seated and standing calf raises). Start with one circuit and gradually progress up to four circuits, resting 1 to 3 minutes after the completion of each circuit.

To maximize a lifelong resistance training program for adults, an individualized program design approach is encouraged. In *ACSM's Guidelines for Exercise Testing and Prescription* (17), it is suggested that an optimal resistance training program acutely manipulates the following variables: 1) intensity (*i.e.*, loading); 2) volume, which is the number of sets and repetitions; 3) exercises selected; 4) order of the exercises; 5) rest intervals between sets; 6) velocity of contraction; and 7) frequency of exercise.

For a lifelong resistance training program, progressive overload, specificity, and variation of training should be addressed (18). With progressive overload, the key is to advance gradually, increasing the task on the body's musculoskeletal system. Resistance training is most effective for improving long-term muscular fitness and health when the human body is regularly challenged to exert a force to meet a higher physiological demand (18). Specificity refers to several key training points, including the velocity of the movement, the muscle groups trained, the range of motion of the exercise, the intensity and volume of the training, and the energy system involved with the exercises (18). Dr. William Kraemer et al. (18) underscore that the most successful resistance training programs individualize all of these specificity variables

to each person's fitness level and training goals. For lifelong progression in resistance training, variation, or a systematic alternation of the program, is needed. If a person applies the same stressor on the muscular fitness system of the body, this may result in an undesirable plateau in health benefits because the body has adapted to the same repetitive training stimulus. With resistance training, variation can easily be implemented by regularly changing the exercises, performing the exercises in a different sequence, and performing the movements at different tempos. Table 3 summarizes the resistance training guidelines from ACSM (17), and Table 4 is a generic resistance training program design template that you can individualize for all healthly and clinical populations of boys and girls and men and women.

TABLE 3: Resistance Exercise Recommendations for Adults

Variable	Evidence-Based Recommendation
Frequency	Major muscle groups should be trained 2–3 d/wk with a 48-h rest between sessions for muscle groups
Intensity (strength)	40%–50% of 1RM or very light-to-light intensity for beginning older persons and for beginning sedentary persons 60%–70% of 1RM or moderate-to-vigorous intensity for novice to intermediate adult exercisers >80% of 1RM or vigorous-to-very vigorous intensity for experienced weight lifters
Intensity (endurance)	<50% of 1RM or light-to-moderate intensity
Intensity (power)	20%–50% of 1RM in older adults
Repetitions	10–15 repetitions to improve strength in beginning, middle-aged, and older persons 8–12 repetitions to improve strength and power in most adults 10–15 repetitions is effective for improved strength in middle-aged and older persons starting a resistance training program 15–25 repetitions to improve muscular endurance in most adults
Sets	Single set training for novice and older adults 2–4 sets are recommended for strength and power of most adults <2 sets for muscular endurance
Rest	2–3 min of rest between multiple set training >48 h between sessions for any individual muscle group

Adapted from (17).

LIFELONG RESISTANCE TRAINING PROGRAM

TABLE 4: Template for an Individualized Resistance Training Program Design for All Persons

Variable	Weeks 1–2	Weeks 3–4	Weeks 5–6	Weeks 7–9	Weeks 10–12
Frequency	2× per week	2× per week	2× per week	2× per week	2× per week
Time	As needed	As needed	As needed	As needed	As needed
Type*	S.M./E.R.	S.M./E.R.	S.M./B.W./M.B.	S.M./F.W./K.B.	K.B./F.W./B.W.
Intensity†	40% 1RM	50% 1RM	60% 1RM	70% 1RM	80% 1RM
Repetitions	8–10	8–10	8–10	8–10	8–10
Sets‡	1	1	2	2–3	3
Rest§	60 s	60 s	60 s	90 s	90 s

Progression: Increase repetitions, then weight as tolerated and then sets as time and goals dictate.

*(S.M.) Selectorized machine, (E.R.) elastic resistance, (B.W.) bodyweight, (F.W.) free weight, (K.B.) kettlebells, (M.B.) medicine balls.

†(1-RM) One repetition maximum.

‡As time and tolerance dictate.

§Rest periods between sets may be extended (*i.e.*, 90 seconds) if necessary to allow blood pressure to return to near baseline levels.

Source: Reprinted with permission from (19).

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SPECIAL LIFELONG RESISTANCE TRAINING CONSIDERATIONS WITH OLDER ADULTS

In a systematic scientific review study, Latham et al. (20) recap that progressive resistance training has been shown to meaningfully and significantly increase strength in older adults. It also has an advantageous effect on improving several functional limitations associated with aging. Importantly, for a higher level of movement function, the researchers recommend that resistance training programs need to be combined with other forms of exercise such as balance training. The researchers suggest that practitioners need to always consider any disabilities and health factors for each client in the design of resistance training programs. Latham et al. encourage clinicians to carefully monitor participants for any adverse effects, particularly those who are frail or have been ill recently. In addition, practitioners should also be aware of the special issues of this population, such as barriers to exercise and self-esteem issues that may be a result of a disability and/or disease.

RESISTANCE TRAINING: OBSERVATIONS TOWARD THE FUTURE

Exercise that is enjoyable can improve adoption and adherence to exercise programs. Lieberman (1) submits we need to devise ways to make physical activity more enjoyable in schools, workplaces, and other environments. The dedicated professional practitioners, educators, and researchers in the fitness industry, who have helped resistance training evolve to our present level, need to now champion innovative ways to help people start, progress, and maintain lifelong resistance training for all people. As we progress into this next chapter of lifelong resistance training for all, perhaps we all need to continually affirm this author's philosophical slogan, "with every repetition, we all get stronger and healthier."

VALUABLE VIDEO RESOURCES:

In the following video clips, you will find practical tutorials on how to teach and progress the following exercises.

Squat: see Supplemental Digital Content 1, Video, http://links.lww.com/FIT/A103.

Hip hinge: see Supplemental Digital Content 2, Video, http://links.lww.com/FIT/A104.

Horizontal push: see Supplemental Digital Content 3, Video, http://links.lww.com/FIT/A105.

Horizontal pull: see Supplemental Digital Content 4, Video, http://links.lww.com/FIT/A106.

Vertical press: see Supplemental Digital Content 5, Video, http://links.lww.com/FIT/A107.

Vertical pull: see Supplemental Digital Content 6, Video, http://links.lww.com/FIT/A108.

Carry teach: see Supplemental Digital Content 7, Video, http://links.lww.com/FIT/A109.

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BRIDGING THE GAP

Humans have evolved and adapted for a wide range of unique physical activities. Excessive sitting lifestyles have inspired a new science on sedentary behavior to better understand the deleterious outcomes of too much sitting and ways to thwart it. We now have the most compelling of research studies that indicate regular participation in resistance training is health promoting and successful in disease prevention and management for youth, adults, and older adults. Following established evidence-based guidelines of resistance training provides practitioners with the directions for individualized progressive resistance training guidelines for each person's fitness level, goals, and needs. Periodic variation of a resistance training program is necessary to prevent plateaus in training and to motivate clients to continue forward in their training for lifelong healthy living.