Resistance Training and Cardiovascular Exercise in Obese Youth: Which is Better?

Len Kravitz, Ph.D.

According to the U.S. Department of Health and Human Services (DDHS), children and teens should be physically active for at least 60 minutes on most, if not all days of the week. This recommendation adds that the 60 minutes may be attained in 'smaller chunks' of time throughout the day. However, Troiano et al. (2008) report that only 8% of youth ages 12 to 19 years of age are attaining the recommended 60 minutes per day of exercise. Alas, a sedentary lifestyle as a youth may also lead to a similar lifestyle as an adult. Besides doing sports, games and cardiovascular activities, a number of personal trainers are now designing resistance training programs for preadolescence youth and teenagers (in an attempt to get more children doing exercise). In spite of the contention that strength training is risky for young weight trainers, the safety and effectiveness of youth strength training is now well documented (Washington, 2001). Nevertheless, the metabolic effects of resistance training and aerobic exercise in obese youth are very limited. Two recent studies led by van der Heijden (2009, 2010) present new data in this area.

Resistance Training Study in Obese Youth (van der Heijden et al., 2010)

Subjects

Six sedentary male and six sedentary female obese (BMI greater than 35 kg/m^2; %body fat >40%; age 15.5 yrs) youth volunteered for this study. The youth had been obese for >5 years and self-reported less than 45 minutes of light-to-moderate activity during the course of the week. None of the youth was on any medications nor did any of them have any first-degree relatives (i.e., parents and siblings) with diabetes.

Resistance Training Program

The youth completed a 12-week program of resistance exercise on two days of the week (one day of rest between workouts). Each session lasted about one hour, which included a 10-minute warm-up, 40 minutes of weight training and a 10-minute cool-down. The program followed a periodized training design with the youth initially completing ~50% of their 3-repetition maximum (3RM) with 2-3 sets of 8 to 12 repetitions for most exercises (see Table 1 for exercises). The program gradually increased in intensity with the youth completing ~80%-85% of their 3RM with sets of 15 to 20 repetitions during weeks 9 to 12. A trained exercise physiologist supervised all workouts and the subjects did not complete any other physical activity during the week.

Table 1. Resistance Exercises

Muscle Group	***Exercise***
Quadriceps	Leg extensions, static lunges, squats
Hamstrings	Dead lifts, leg curls
Calves	Heel raises
Chest	Chest flies, chest press, push-ups
Back	Seated row, overhead press
Triceps	Triceps extensions with hand-held weights
Biceps	Curls with hand-held weights
Gluteals	Bridges on physioball
Abdominals	Curl-ups

Variables Measured and Results

For succinctness, the variables measured and results have been combined. The youth males and females completed 96% of the 24 workouts during this 12-week training program. All subjects showed a significant increase in upper body strength (biceps, triceps and pectorals) as well as lower body strength (quadriceps and hamstrings). There was a slight increase in body weight due to the increase in muscle mass, but no change in percent fat or in visceral fat was

observed. Insulin concentrations (i.e., a marker for pre-diabetes) were slightly lower (positive adaptation, yet not significantly decreased). There was no change in fasting glucose, but the youth were producing less glucose, which is a beneficial adaptation for pre-diabetes risk reduction. There was no significant change in LDL-cholesterol (i.e., the unhealthy cholesterol), HDL-cholesterol (i.e., the good cholesterol) or blood fats (triglycerides). As well, no significant change was seen with leptin (regulating hormone of energy intake and energy expenditure), adiponectin (hormone that regulates glucose and fatty acid breakdown) and hs-CRP (inflammatory protein marker for cardiovascular disease). In summary, the major findings of this study were that resistance training increased strength, lean body mass and improved insulin sensitivity (which is a preventative adaptation for the development of pre-diabetes)

Cardiovascular Training Study in Obese Youth (van der Heijden, 2009)

Twenty-nine post-puberty youth (17 male {10 lean/7 obese} and 12 female {4 lean/8 obese} as determined by % body fat) who were lean and/or obese for the last 5 years volunteered for this study. As with the resistance training study, subjects reported less than 45 minutes of light-to-moderate activity during the course of the week. None of the youth was on any medications nor did any of them have any first-degree relatives (i.e., parents and siblings) with diabetes.

Cardiovascular Training Program

The subjects completed 12 weeks of cardiovascular exercise. Each subject self-selected a treadmill, elliptical or cycle ergometer for his/her mode of exercise. All subjects completed four 30-minute cardiovascular workouts during the week (two supervised and two on their own) at 70% of their aerobic capacity. A VO_2 peak was determined at the beginning of the

study for proper design of each subject's workout intensity. Subjects wore heart-rate monitors in an attempt to make sure they were exercising at an intensity to raise their heart rate >140 beats/minute during every 30-minute workout, which included warm-up and cool-down periods.

Variables Measured and Results

For conciseness of the obese and lean subject date collected, several of the main variables measured and results detected are presented in Table 2.

Table 2. Results of 12-Week Cardiovascular Study in Lean and Obese Post-Pubescent Youth

Parameter	**Lean Youth**	**Obese**
Compliance to Workouts	87%	89%
VO_2 peak	16% increase	12% increase
Body weight	1% increase	No change
% body fat	No change	3% decrease
Lean muscle mass	3% increase	2% increase
Glucose production	No change	No change
Insulin concentration	8% decrease	14% decrease
LDL-cholesterol	3.5% decrease	3.5% decrease
HDL-cholesterol	No change	5% increase

As with the resistance training study in obese youth, no significant changes in adiponectin, leptin and hs-CRP were shown. However, the major finding of this study was the significant improvement in cardiovascular fitness and insulin sensitivity.

Theory to Practice Recommendations

In a position statement by the American Academy of Pediatrics (Washington et al., 2001), it has been determined that resistance training programs in preadolescents and adolescents (See Figure 1. for guidelines) do not adversely affect linear growth patterns or have any long-term detrimental effect on cardiovascular health. Therefore, for overall health, cardiovascular fitness, muscular strength and prevention of obesity, diabetes and cardiovascular disease in youth, these two studies reviewed in this column suggest that personal trainers would best serve youth populations if they incorporate cardiovascular exercise and resistance training interventions in their exercise program designs.

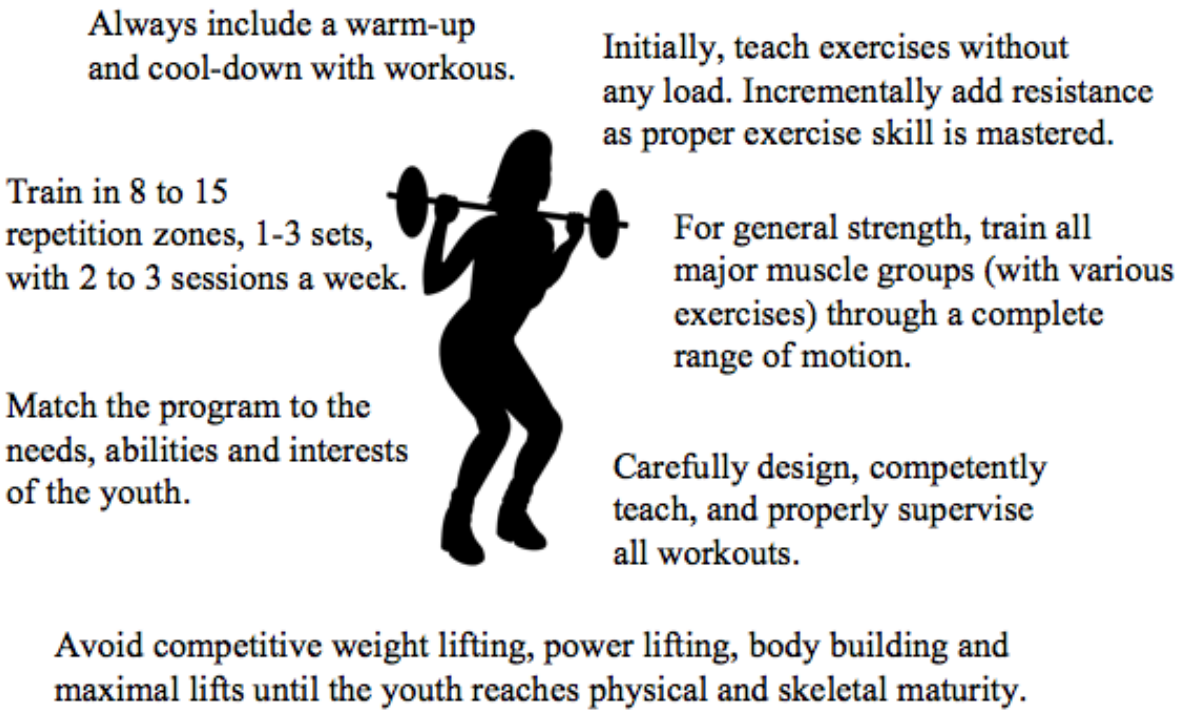

Figure 1. Strength Training Guidelines for Youth
Sources: Washington et al. (2001). Faigenbaum (2010).
Note: The American Academy of Pediatrics (Washington, 2001) states that a medical evaluation may be needed for some youth prior to initiating a resistance training program to identify any possible risk factors for injury and/or to provide guidance for goals of the weight training.

References:

DHHS, (2008). How much physical activity should your family get? U.S. Department of Health & Human Services.
http://www.nhlbi.nih.gov/health/public/heart/obesity/wecan/get-active/physical-activity-guidelines.htm
Accessed November 15, 2010

Faigenbaum, A.D. (2010). Youth strength training: Potential benefits and concerns.
http://www.strongkid.com/uploads/Benefits_risks.pdf
Accessed November 15, 2010

Troiano R.P., Berrigan, D., Dodd K.W., Masse, L.C., Tilert, T, and McDowell, M. (2008). Physical activity in the United States measured by accelerometer. Medicine & Science in Sports & Exercise, 40(1), 181-188.

van der Heijden, G-J., Toffolo, G., Manesso, E., Sauer, P.J.J., and Sunehag, A.L. (2009). Aerobic exercise increases peripheral and hepatic insulin sensitivity in sedentary adolescents. The Journal of Endocrinology & Metabolism, 94, 4292-4299.

van der Heijden, G-J., Wang, Z.J., Chu, Z., Toffolo, G., Manesso, E., Sauer, P.J.J., and Sunehag, A.L. (2010). Strength exercise improves muscle mass and hepatic insulin sensitivity in obese youth. Medicine & Science in Sports & Exercise, 42(11), 1973-1980.

Washington, R.L., Bernhardt, D.T., Gomez, J. et al. (2001). Strength training by children and adolescents. Pediatrics, 107(6), 1470-1472.

Len Kravitz, PhD, is the program coordinator of exercise science and a researcher at the University of New Mexico, Albuquerque, where he won the Outstanding Teacher of the Year award. He has also received the prestigious Can-Fit-Pro Lifetime Achievement Award and the Aquatic Exercise Association Global Award.