



# **Strength Training Children: Research and Recommendations**

**Wayne L. Westcott, Ph.D., C.S.C.S.**

You have undoubtedly heard that strength training is inappropriate for preadolescent boys and girls because it can damage their bone growth plates and retard their musculoskeletal development. Fortunately, this is categorically untrue. There has never been a report of bone growth plate damage in preadolescents involved in strength training programs. In fact, progressive resistance exercise is the best means for enhancing musculoskeletal development in children. For example, in a study by Morris and associates (4), 9 to 10 year old girls who performed 10 months of strength building exercise increased their bone mineral density by 6.2 percent compared to 1.4 percent for non-training control subjects.

You may also have heard that boys and girls cannot gain strength because they lack sufficient levels of testosterone. Although testosterone is helpful, it is not essential for increasing muscle strength. If it were, then women and seniors could not experience the significant strength increases that have been repeatedly reported in the research literature.

More specifically, numerous studies have demonstrated strength exercise is highly effective in youth of all ages. Perhaps the most impressive results were obtained from a twice-a-week, 2-month strength training program conducted by Faigenbaum and associates (1). As shown in Table 1, the 10-year old boys and girls who did five resistance exercises increased their overall muscle strength almost six times as much as a matched group of non-training control subjects (74.3% vs 13.0% strength gain).

Another incorrect assumption is that children's strength gains are only temporary and have no lasting muscular effect. A study by Faigenbaum and colleagues (2) showed a 41 percent increase in chest press strength in 10-year-old boys and girls following two months of strength exercise. After another two months of no strength training these preadolescents regressed only 19 percent, and were still significantly stronger than a control group of their peers (see Figure 1).

Because strength gains have a neuromuscular component, some authorities have concluded that strength training improvements in children are due to motor learning rather than muscle development. However, research by Westcott and colleagues (5) indicated otherwise. As presented in Table 2, the fifth grade boys and girls who strength trained twice-a-week for eight weeks gained significantly more muscle mass (lean weight) than a matched control group.

Many people believe that children should address their muscular fitness with bodyweight exercises rather than use resistance equipment. Unfortunately, most children have too little strength and too much bodyweight to do standard calisthenics exercises such as chin-ups, bar-dips, push-ups and sit-ups. A major advantage of weight training over bodyweight exercise is that the external resistance can be adjusted to the child's current muscular ability and progressively increased as strength improves. For example, a child who cannot perform a chin-up must necessarily use an excessively heavy resistance (bodyweight) in attempting to do this exercise. However, this child can train the same muscles (latissimus dorsi, biceps) safely and effectively by selecting a weightload that can be performed for 15 controlled repetitions on the lat pulldown machine.

Although some people suggest that youth perceive strength training as boring and unenjoyable, this has not been our experience. During the past several years the attendance rate in our youth strength training classes has consistently exceeded 90 percent, indicating that the children really like doing this physical activity.

## **Program Design**

We have found that a relatively brief and basic program of strength exercise enhances the participants' approach tendencies and maintains their training motivation. All of our recent studies have involved one set of 10 weightstack exercises, performed one or two days per week.

We use weightloads that can be performed for 13 to 15 repetitions, as this protocol has proven more productive than training with heavier resistance for fewer repetitions. As shown in Table 3, preadolescents who did 13 to 15 repetitions with moderate weightloads gained significantly more muscle strength and endurance than their peers who performed 6 to 8 repetitions with heavier weightloads (3).

We require our strength program participants to use correct exercise technique and proper body positioning. Although children tend to move in an abrupt manner, we emphasize slow movement speed and full movement range. Generally speaking, our boys and girls take about 3 to 4 seconds for each repetition and 45 to 60 seconds for each exercise set.

The benefits attained from a simple and sensible youth strength training program are really quite remarkable. We recently completed a 10-week study with 26 female figure skaters between 8 and 13 years of age. Due to their extensive skating schedule, we had them strength train only 1 or 2 days per week. All of the participants performed 1 set of 13 to 15 repetitions on the following weightstack machines:

- |                   |                            |
|-------------------|----------------------------|
| 1. leg press      | 6. weight-assisted bar-dip |
| 2. bench press    | 7. weight-assisted chin-up |
| 3. incline press  | 8. low back extension      |
| 4. shoulder press | 9. abdominal curl          |
| 5. seated row     | 10. rotary torso           |

As presented in Table 4, the young skaters increased their leg strength by 99%, their upper body strength by 39%, their hamstring flexibility by 6%, their vertical jump by 13%, and their lean weight by 2.5 lbs. In addition to the significant physical improvements, all of the participants reported positive attitudes towards strength training and committed to continue the exercise program.

### **Youth Strength Training Recommendations**

1. Select 6 to 12 basic exercises for the major muscle groups.
2. Perform 1 or 2 sets of each exercise.
3. Select a resistance that permits 10 to 15 repetitions.
4. Increase the resistance by 1 to 3 pounds whenever 15 repetitions are completed with proper form.
5. Use slow movement speed and full movement range.
6. Train 1, 2, or 3 non-consecutive days per week.

7. Train under close supervision by qualified adult instructors.
8. Train on properly-sized resistance equipment.
9. Train in spacious, uncluttered and well-ventilated exercise facilities.
10. Keep careful records of all strength workouts.

## **Summary**

Strength training is an important physical activity that can be performed safely and successfully by essentially all boys and girls, assuming no medical contraindications. Strength training promotes balanced musculoskeletal development during the critical growth years, including stronger and more injury resistance muscles, bones, tendons, ligaments and joint structures. Simplicity and supervision are the key factors for efficient, effective and enjoyable youth strength training programs that encourage youth to participate on a regular and continuing basis.

Table 1. Changes in muscle strength for exercisers and controls after eight-week training period (23 subjects, mean age 10 years).

10 RM Strength (in kilograms)	EXERCISE GROUP (N = 14)			CONTROL GROUP (N = 9)		
	Pre	Post	% Change	Pre	Post	% Change
Leg Extension	12.9	21.3	64.5*	12.1	13.8	14.1
Leg Curl	10.4	18.5	77.6*	12.0	13.6	13.2
Chest Press	15.2	25.0	64.1*	13.4	15.0	12.5
Overhead Press	7.2	14.1	87.0*	7.8	8.8	13.1
Biceps Curl	4.7	8.3	78.1*	4.8	5.3	12.2
<b>Mean % Change</b>			<b>74.3</b>			<b>13.0</b>

\*Significant two-way interaction > (p 0.01).

Table 2. Changes in body composition for exercisers and controls after eight-week training period (42 subjects, mean age 11 years).

Group	% Fat Change	Lean Weight Change (lbs)	Fat Weight Change (lbs)
Exercise	- 2.7*	+ 2.5*	- 3.0*
Control	- 1.9*	+ 1.5	- 1.4*

\*Significant change ( p<0.01).

Table 3. Effects of youth strength training with higher repetitions and lower weightloads vs. lower repetitions and higher weightloads (43 subjects, mean age 8 years).

<b>VARIABLE</b>	<b>CONTROL GROUP (NO TRAINING)</b>	<b>LOW REP GROUP (6-8 REPS)</b>	<b>HIGH REP GROUP (13-15 REPS)</b>
<b>Leg Extension</b> Strength	+ 13.6%	+ 31.0%	+ 40.9%
<b>Chest Press</b> Strength	+ 4.2%	+ 5.3%	+ 16.3%
<b>Leg Extension</b> Endurance	+ 3.7 reps	+ 8.7 reps	+ 13.1 reps
<b>Chest Press</b> Endurance	+ 1.7 reps	+ 3.1 reps	+ 5.2 reps

Table 4. Changes in selected fitness parameters for youth figure skaters following 10 weeks of basic strength training (26 subjects, mean age 10 years).

<b>Fitness Parameter</b>	<b>Pre</b>	<b>Post</b>	<b>Change</b>	<b>% Change</b>
Leg Strength	47.4 lbs	94.5 lbs	47.1 lbs	+ 99%
Upper Body Strength	32.8 lbs	45.7 lbs	12.9 lbs	+ 39%
Hamstring Flexibility	18.7 in	19.8 in	1.1 in	+ 6%
Vertical Jump	10.2 in	11.5 in	1.3 in	+ 13%
Lean Weight	80.2 lbs	82.7 lbs	2.5 lbs	+ 3%

## References

1. Faigenbaum, A., Zaichkowsky, L., Westcott, W., Micheli, L., and Fehlandt, A. 1993. The effects of a twice-a-week strength training program on children. *Pediatric Exercise Science*, 5: 339-346.
2. Faigenbaum, A., Westcott, W., Micheli, L., Outerbridge, A., Long, C., LaRosa Loud, R., Zaichkowsky, L. 1996. The effects of strength training and detraining on children. *Journal of Strength and Conditioning Research*, 10 (2): 109-114.
3. Faigenbaum, A., Westcott, W., LaRosa Loud, R., Long, C. 1999. The effects of different resistance training protocols on muscular strength and endurance development in children. *Pediatrics*, 104 (1): 1-7.
4. Morris, F., Naughton, G., Gibbs, J., Carlson, J., and Wark, J. 1997. Prospective ten-month exercise intervention in premenarcheal girls: positive effects on bone and lean mass. *Journal of Bone and Mineral Research*, 12 (9): 1453-1462.
5. Westcott, W., Tolken, J., and Wessner, B. 1995. School-based conditioning programs for physically unfit children. *Strength and Conditioning*, 17: 5-9.