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Young Weightlifters' Performance Across Time

Ronald Byrd, Chris Baker, Kyle Pierce & Jenny Brady - Louisiana State University, Shreveport, USA

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Introduction

Strength training and weightlifting for children remain controversial issues despite mounting evidence regarding potential benefits versus risks. There are two paramount issues: (1) are these activities safe for children? (2) Are these activities worthwhile in terms of benefits or should they be delayed until well after puberty and the escalation of circulating hormones known to facilitate hypertrophy and strength gain?

Safety

With respect to the first issue, the American Academy of Pediatrics (1983) produced a position statement that has had serious negative impact for almost two decades. The paper concluded that weightlifting has a high injury rate and should be avoided by preadolescents. Sewall and Micheli (1986) concur with the American Academy of Pediatrics, recommending that any resistive training for preadolescents should be controlled and slow and that weightlifting competition should not take place until after skeletal maturity is achieved. In contrast, Micheli (1988) admitted later that

there is little scientific evidence regarding injury potential of preadolescents in resistive training and that "…potential for growth plate injury may actually be less in the prepubescent than in the pubescent, however, because the growth plate is actually much stronger and more resistant to sheer stress in younger children than in adolescents." A second position paper by the American Academy of Pediatrics (1990) recommended, "Unless good data become available that demonstrate safety, children and adolescents should avoid the practice of weight lifting, power lifting, and body building…" (p. 802). The lack of data is the issue; the alarmist negative response by well-meaning physicians and scientists has done an immeasurable disservice to the sport of weightlifting. In a recent paper presenting information regarding injuries to children resulting from weightlifting, Pierce, Byrd, and Stone (1999) reported no days of training lost from injuries incurred in weightlifting over a period of a year's competition and training by 70 children ranging in age from 7 to 16 years. It was concluded that weightlifting is safer than is generally believed if training and competition are appropriate for this age group and are well supervised. Another related study by this group of researchers is in progress, in which there is an ongoing compilation of all physical problems, even minor aches and pains, at the same weightlifting center. Clearly, this is an issue that could best be resolved by scientific study. Anecdotal reports and conjecture regarding injury potential continue to limit early participation and possibly eventual potential. On the other hand, if the sport proves under scientific scrutiny to be dangerous, participation should be deferred until some yet to be determined later stage of maturity.

Efficacy

The second issue, that resistive training is pretty much a waste of time prior to puberty, was also addressed by the American Academy of Pediatrics (1983). They stated that an insufficiency of androgens dictates that neither girls nor prepubertal boys will increase muscle mass with resistive training and will have little or no gain in strength. Further, they state that after menarche females might gain some strength with resistive training, but will not increase muscle mass at any age without use of steroids. These positions, unfortunately, remain as too frequent beliefs in the U.S.A. almost two

decades later. The second position paper by this group (American Academy of Pediatrics, 1990) capitulated somewhat, recommending that strength training could be permitted for children if conducted by well-trained adults.

Vrijens' (1978) study in which it was found that prepubescent children failed to gain strength from resistive training is frequently cited by naysayers. However, Sewall and Micheli (1986) reported strength gains in preadolescents, but did not assess sex differences. Pfeiffer and Francis (1986) looked at prepubescent, pubescent, and postpubescent males and found a lack of consistent differences in strength gains related to level of maturity. Faigenbaum, Westcott, Micheli, Outerbridge, Long, LaRosa-Loud, and Zaichkowsky (1996) found in a study of 7-12-year old boys and girls, Tanner Stages 1 and 2, large and significant increases in strength from resistive training, with no injuries. There is really no controversy regarding pubescent children; there is ample evidence that older boys and girls both profit in terms of strength gain from resistive training (Sale, 1989). All of the aforementioned studies were relatively short-term programs using isometric, isokinetic, pneumatic, hydraulic, machine weights, or free weights in resistive training. An American College of Sports Medicine position paper supports weight training under proper conditions, but emphasizes the difference between weightlifting and weight training, stating that children should not train with maximal weights (Faigenbaum & Micheli, 1998). "Maximal weights" was not defined, but one would imply that weightlifting should be avoided by this population. A thorough literature review and position paper developed for the National Strength and Conditioning Association by Faigenbaum, Kraemer, Cahill et al. (1996) encourages resistive training for children, given proper programs and supervision by well-trained professionals but no mention is made of weightlifting. A recent paper presented data on young weightlifters (mean age 15.1 years; SD=1.1), commenting on the generally good technique and comparing elements of biomechanics to elite adult weightlifters (Byrd, Brady, & Pierce, 2000). However, because data regarding efficacy of training for weightlifting competition is lacking for children, the purpose of this paper is to address that particular deficit.

Methods

Subjects: The eleven subjects (3 female, 8 male) had trained at the Olympic Weightlifting Development Center in Shreveport Louisiana for a minimum of 22 months (mean=28.8; SD+4.4). At the outset, the first competition, there were no significant differences between the sexes (Table 1). All subjects have been successful in subsequent competition, having medalled at one or more national or international events.

Table I . Biometric and performance data at first competition: Means ± SD.

	Age (yrs)	Weight (kg)	Snatch (kg)	Clean & jerk (kg)	Total (kg)
Girls	13.7±1.2	68.9±26.8	30.0±10.0	41.7±10.4	71.7±20.2
Boys	12.5±1.6	46.1±9.7	25.6±6.9	34.7±8.2	60.3±15.0

Training: Technique was the first priority, with the children using wooden sticks in lieu of a bar during initial learning stages. During this period, they worked repetitively on snatches and cleans to a full squat, not only to learn the skill, but

to work on flexibility as well. Jerks were taught from the outset as well, using wooden sticks. Once the overhead squat was mastered, the snatch from the upper thigh (start position of second pull) was taught. The next step was to use a 5 or 7.5kg bar with 1.5kg wooden plates during this exercise. Progression to the snatch and clean from the knee and finally from the ground completed the first sequence of drills on technique.

No strength work was done until there was clear understanding and progress in technique. At that point, general strength exercises such as full squats with weights held overhead, upright rows, shrugs, and presses were performed, all with light weights. Back and front squats were then added and weights were gradually added to the most important lift, the pull from the thigh. All of was accomplished with the plan of having the child lift in a local event after about two to three months of training.

Following the first competition, if technique proved adequate standard concepts of training and periodization were applied, using the model of Stone and O'Bryant (1987) as a frame of reference for percentage of maximum, repetitions, and sets (Table 2).

Table 2 . Training variations in intensity, sets, and repetitions.

	Preparation phase	Competition phase
General strength exercises	3 sets of 10 reps @ 60-75%	5 sets of 5 reps @ 65-80%
Lifts and pulls	5 sets of 5 reps @ 65-80%	5 sets of 3 reps @ 75-90%

There continued to be an emphasis on lifts from the thigh (~75%) and knee (~25%), focusing on the second pull. The only lifts from the floor were singles and clusters of singles (up to 3) just prior to competitions. All lifts were into a full squat from the outset; no power cleans or power snatches were used. Within this broad framework, individualization of training was carried out as dictated by level of skill mastery, size, strength, and other elements of fitness such as speed, balance, agility, power, and ability to endure.

Results & Discussion

As would be expected, body weight and all performance measures increased significantly over time. In the context of age, that these children are lifting in excess of body weight in both the snatch and the clean and jerk would suggest that this sport is appropriate for children, particularly in view of the fact that no significant injuries related to weightlifting occurred to any of these athletes during this period. The increased variability in performance measures on the final measures is worth mentioning.

Table 3 . Means and standard deviations for body weight and performance measures.

	Wt*	Snatch*	C&J*	Total*	Rel sn**	Rel C&J**	Rel total**
Initial	52.2 ±19.8	26.8 ±7.6	36.6 ±8.9	63.4 ±16.3	.54 ±.14	.74 ±.18	1.28 ±.31
Final	66.3 ±16.2	68.4 ±16.3	83.0 ±21.0	151.4 ±37.2	1.05 ±.18	1.28 ±.23	2.33 ±.41

*Values in kg; all initial to final comparisons were significantly different at alpha=.05

**Values in kg lifted per kg body weight; all comparisons were different at alpha=.05

With higher levels of training and competition, external factors begin to operate, separating those more focused from others. For example, one of the less motivated female subjects experienced a performance plateau after only one year, obviously related to quality of training. Of the eight boys, five participated in football. Two of these did continue regular weightlifting training during football season, but three did only maintenance work and as a result their weightlifting performances were compromised somewhat.

In only one measure, kg gain in lift total across time, was a significant sex difference found; clearly, the small sample size limited statistical power and one should consider sex comparisons with that in mind. Gains for boys (Figure 1) and for girls (Figure 2) in totals lifted in competition were plotted across months of training. While data from both sets of data could be used to generate prediction equations, they would be of little value in terms of generalizing to other populations because of variability in training. The variation in compliance to training, differences in exercises, volumes, intensities, and other elements of training complicate expectations, having the potential to produce different rates of gain in performance.

Lift total gain over time

Figure 1

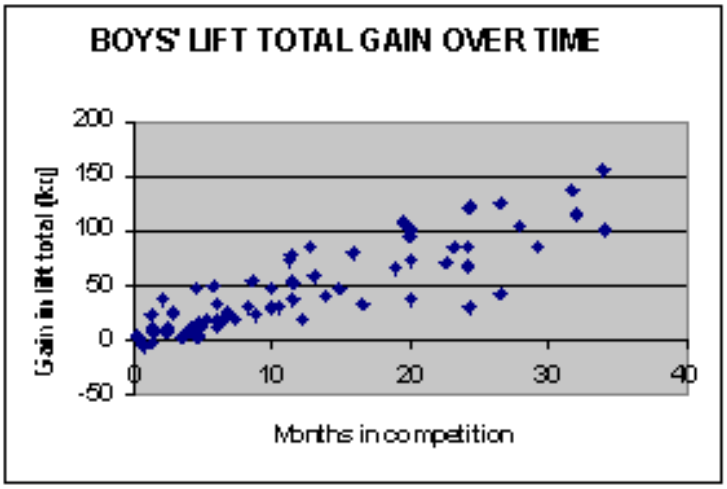
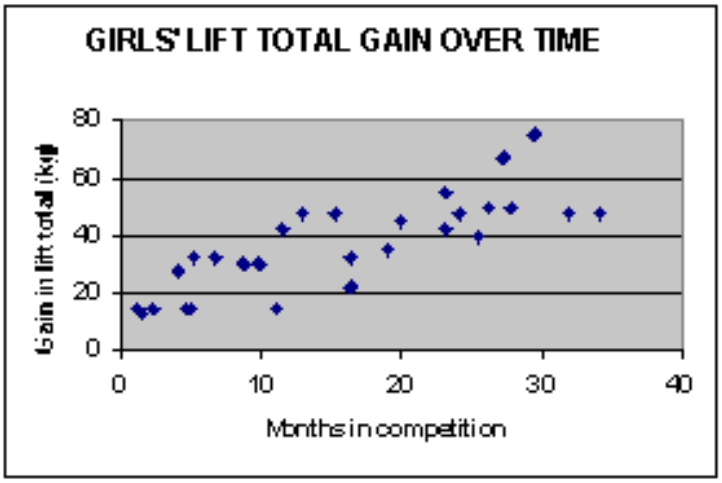


Figure 2



A cursory comparison of Figures 1 and 2 reveals that each represents a linear relationship. However, it is apparent that boys' gains in absolute values are greater than those of girls. For example, boys' total lift increased by approximately 75kg after two years while it appears that girls' improvement was by about 50kg at that time. While the girls' mean gain (54±18kg) was less than that of boys (100±33kg), their mean relative total lift was 2.0 kg/kg body weight, calling into question the early position paper by the American Academy of Pediatrics (1983) that girls through resistive training would experience little or no increase in strength. Present data support the androgen-related difference in response, but reveal at the same time quite remarkable performance gains by these three female subjects.

The youngest subject, a male, merits special consideration. He began training at 9 years of age and had been competing for 26.5 months. Over that period, his body weight increased from 34.7 to 42kg. His snatch, clean & jerk, and totals were 15, 25, and 40 at his first competition and at the most recent event had increased to 37.5, 45, and 82.5. Even though we are not including level of sexual maturation in our data, we find that to be a remarkable performance by an 11-year-old, probably evidence in support of the efficacy of weightlifting for prepubertal boys or pubertal boys.

Conclusion

The purpose of this paper was to address the deficit in knowledge regarding efficacy of training for weightlifting by children. There can remain no doubt regarding whether boys and girls can participate successfully in this sport. While there was a sex difference in degree of improvement in lift total, both girls and boys made remarkable progress in competition performance. Thus, lack of efficacy, one of the old arguments against children's participation in resistive training, is laid to rest. Another, safety concerns, is receiving increasing attention and should be vigorously pursued. We wish to emphasize that results in this particular study must be viewed in light of the conservative and scientific approach to training and competition with these children. In no way do we suggest that resistive training or weightlifting are appropriate for children under any other conditions.

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