

## The effect of athletic training on strength in prepubertal children aged 6-9 years

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### Abstract

The problem of practicing a sport during childhood is a largely commented topic, being closely related to the physical development, physiological and emotional balance of the human body during the growth period. The obesity rate increased with over 20% in prepubertal children, which inevitably led to a decrease in their motor performance in strength, speed and endurance efforts, hence the imperative to train strength in children. Starting from this idea, our study aimed at investigating whether a 10-month training program involving athletic means could improve strength in prepubertal children aged 6-9 years. There were 50 investigated subjects aged 6-9 years, of whom 20 subjects were part of the experimental group. The athletics lessons took place three times per week and lasted 80 minutes. Strength was assessed by two motor tests: standing long jump and sit-ups from lying on the back within 30 seconds. After the statistical processing of the obtained results in the two motor tests, we can conclude that, at this age, it is possible to intervene on the improvement of both the lower-limb explosive strength and the abdominal muscle strength.

**Keywords:** strength, athletic training, prepubertal children

### Rezumat

Problema practicării unui sport la vârsta copilăriei este un subiect multiplu comentat, fiind strâns legat de dezvoltarea fizică, de echilibrul fiziologic și afectiv al organismului uman aflat în perioada de creștere. Rata creșterii obezității trece de 20% la copiii antepubertari, ceea ce implică, inevitabil, și scăderea performanței motrice în eforturile de forță, viteză și rezistență, de aici imperativul de a se antrena forța copiilor. Pornind de la această idee, prin studiul desfășurat, ne-am propus să investigăm dacă un program de pregătire cu o durată de 10 luni, care implică mijloace atletice, poate ameliora forța la copiii antepubertari de 6-9 ani. Au fost investigați 50 de subiecți cu vârsta cuprinsă între 6-9 ani, dintre care 20 de subiecți au fost componenți ai lotului experimental. Lecțiile de atletism au avut o frecvență de trei ori pe săptămână, cu o durată de 80 de minute. Evaluarea forței s-a realizat prin două probe motrice: săritura în lungime de pe loc și ridicări de trunchi din culcat dorsal în 30 de secunde. Rezultatele obținute la cele două probe motrice prelucrate statistic ne îndreptătesc să concluzionăm că, la această vârstă, se poate interveni în ameliorarea forței explozive la nivelul trenului inferior, precum și a forței musculaturii abdominale.

**Cuvinte cheie:** forță, antrenament athletic, copii antepubertari

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## Introduction

Athletic sports activities at the prepubertal age represent a set of educational actions with psychological, medical, social and ethical implications, their main objective being to improve the child's biomotor potential, with the functional integration of this potential in the personality structure.

In children training should foster the enhancement of psychomotor qualities and physiological indices through correct action, without neglecting the age-related particularities. According to Gallahue and Ozmun [1], the initial stage of most fundamental motor behaviors would correspond to the age of 2-3 years, the intermediate stage being placed between 4-5 years, and the final stage, between 6-7 years. It is worth noting that the age is not the only factor determining the occurrence and acquisition of motor behaviors, and that the child's motor experience also plays an essential role.

Hence the importance of early training under the guidance of a caring and well-informed teacher, whose priorities are both the acquisition of fundamental motor behaviors (through various games and challenges) and the improvement of children's motor potential. Thus, some authors have long supported the idea that, in prepubertal children, it is not possible to record an increase in muscle strength through training due to testosterone deficiency. In their opinion, it would be useless to strengthen the muscles before puberty. For example, the study conducted by Vrijens [2] shows an increase in trunk muscle strength in prepubertal children after 8 weeks of training.

The study achieved by Diekmann and Letzelter [3] reveals that the strength-speed couple can be improved starting in primary school; thus, after 12 weeks of training with two sessions of 30-35 minutes per week, clear superior performances were recorded by those in the study group compared to those in the control group.

More recent studies report an increase in maximal strength in prepubertal children when the load used allowed them to perform up to 10 repetitions.

The literature indicates an increase in explosive strength, indirectly assessed through the results achieved in the vertical jump after a 14-week strength training program. A 10% increase rate was noted in prepubertal children aged 6-11 years [2] and 15% in those aged 11-13 years, after 12 months of training [2].

The study conducted by Katic, Males and Miletić [4] shows an improvement in the variables of aerobic endurance (3-min run), flexibility (forward bow), explosive strength (ball throwing and 20-m run), keeping balance (bench standing), static strength

(bent arm hang) and repetitive strength (sit-ups) in 7-year-old girls in the study group.

Moreover, the study conducted by Faigenbaum et al. [5] indicates an increase in strength in children aged 5-12 years after an 8-week training program. The research conducted by Detteret et al. [6] highlights that a 3-year physical activity intervention program in prepubertal children improves muscular strength.

Keiner M et al. [7] demonstrated that long term bodybuilding is recommended from the earliest age and adolescence.

More recent studies have shown that, at the prepubertal age, the gain in strength is achieved through an improvement in both the excitation-contraction coupling and the transmission of strength to the bone segments, not by increasing muscle mass, which occurs after the puberty period.

## Materials and methods

### Research purpose

The aim of the research was to investigate the impact of a 10-month athletic training program on muscle strength in prepubertal children.

### Hypothesis

By using athletic means, it is possible to positively intervene on the strength improvement in prepubertal children aged 6-9 years through an appropriate program adapted to their age particularities.

### Subjects and location

The research was conducted over a 10-month period and included 50 subjects of both genders aged between 6-9 years, of whom 20 subjects were included in the study group. The subjects in the study group, besides taking part in the 2 physical education classes provided in the school curriculum, also attended the athletic training classes, which took place on the "Viitorul" stadium three times a week, each class lasting 80 minutes.

The control group included 30 randomly selected subjects, participants in the physical education classes.

Before the beginning of the study, the subjects were verbally informed about the testing particularities and the types of assessment used. All subjects agreed to the way the study was conducted.

### Research methods

The research used primary data summarized in a database and processed using a computer program. After data acquisition the performed measurements were processed statistically and mathematically.

The motor tests used were: standing long jump (SLL), sit-ups from lying on the back with bent knees (ABD).

The statistical parameters assessed were: arithmetic means, standard deviation, standard

mean error. Anova parametric test, Post Hoc parametric tests (Turkey HSD, Scheffe, Games-Howell, Student) were used. The data were presented in both the tabular and graphical forms.

**Results and statistical analysis**

**Table I.** Calculated statistical parameters–Intergroup comparisons (SLL)

Test	Mean	Median	Standard deviation	95% Mean confidence interval		Minimum	Maximum	Coefficient of variation
				minimum	maximum			
Experiment	157.75	157.50	10.42	153.18	162.32	142.00	182.00	6.61%
Control	134.93	134.50	16.25	129.12	140.75	105.00	180.00	12.04%

**Table II.** Multiple comparisons (SLL)

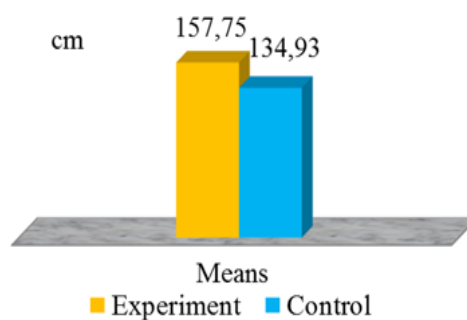
Test	Testing		Mean difference (I-II)	Standard error	P
	I	II			
Dunnett T3	Experiment	Control *	22.817	3.77	0.00
	Control	Experiment*	-22.817	3.77	0.00
Games-Howell	Experiment	Control *	22.817	3.77	0.00
	Control	Experiment*	-22.817	3.77	0.00

\* significant differences

According to the Games-Howell tests, there are statistically significant differences between the results achieved by the study group and those from the control group, the value of the significance threshold being  $p < 0.05$ . The effect size (0.60) indicates large to very large differences between groups. For the experiment group, the mean is 22.82cm higher than for the control group, the means being 157.75cm for the study group and 134.93cm for the control group. The mean value for

the subjects in the study group is included in the confidence interval (153.18-162.32) in 95% of cases. The data have a homogeneous distribution in all groups.

The research hypothesis according to which there are significant differences between groups at the time of testing is accepted. The graphical representation of the mean values is shown in Figure 1.



**Figure 1.** Mean values recorded by the two groups for the standing long jump

**Table III.** Statistical parameters – Intergroup comparisons (ABD)

Tests	Mean	Median	Standard deviation	95% Mean confidence interval		Minimum	Maximum	Coefficient of variation
				minimum	maximum			
Experiment	27.20	27.00	3.76	25.55	28.85	21.00	35.00	13.84%
Control	20.43	20.00	4.29	18.90	21.97	11.00	31.00	20.99%

**Table IV.** Multiple comparisons (ABD)

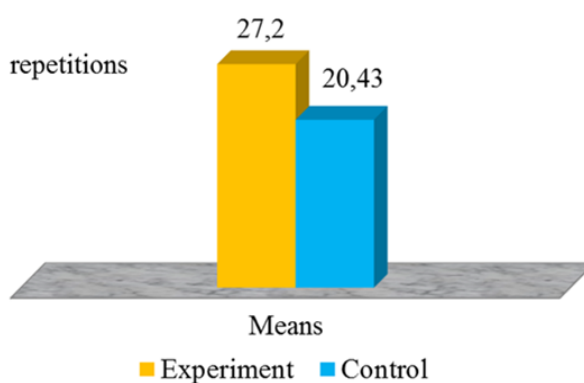
Test	Testing		Mean difference (I-II)	Standard error	P
	I	II			
Tukey HSD	Experiment	Control *	6.767	1.15	0.00
	Control	Experiment*	-6.767	1.15	0.00
Scheffe	Experiment	Control *	6.767	1.15	0.00
	Control	Experiment*	-6.767	1.15	0.00

\* significant differences

According to Tukey HSD, there are significant differences between the results of the two groups, the value of the significance threshold being  $p < 0.05$ . The effect size (0.60) indicates large to very large differences between the groups. For the study group, the mean value is with 6,77 repetitions higher than that for the control group (27.20 repetitions for the study group and 20.43 repetitions for the control group). The mean value for the study group subjects

is included in the confidence interval (25.55-28.85) in 95% of cases. The data have a relatively homogeneous distribution in the experiment group and the control group.

The research hypothesis according to which there are significant differences between the two groups at the time of testing was validated. The graphical representation of the mean values is shown in Figure 2.



**Figure 2.** Mean values recorded by the two groups for the sit-ups from lying on the back (ABD) within 30 seconds

**Conclusions**

The superior results of study group for the SLL and ABD lead us to the conclusion that, at this age, it is possible to intervene in the improvement of both

the lower-limb explosive strength and endurance strength. Strength training should not be excluded at the prepubertal age, the muscle toning itself playing an important role in the prevention of

certain trauma.

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