

Strength development in adolescents in physical education classes

Abstract

Objective: The objective of this study was to gain muscle strength in all its variables in adolescents after a strength training program in physical education classes for a period of 12 weeks - a strength training program in physical education classes at a State School of Ponta Pora (Brazil) was applied.

Materials and methods: The instruments used were measured and Brazil Project Sport tests except for hand grip strength tests, medicine ball ball, abdominal strength, jump distance and adjusted pre and post intervention bar. The subjects were 15 girls and 15 boys, totalling the amount of 30 students for statistical analysis was applied to the T-student parametric test considering 95% significance level.

Results: The results showed statistically significant differences in all tests applied after the intervention of strength training in school.

Conclusion: Thus, it was observed that the students developed the strength in all its variables demonstrating that physical education is responsible for providing comprehensive education, also with purpose and concern of developing the physical fitness of adolescents in school age through pedagogically oriented physical activities.

Keywords: muscle strength, resistance training, school physical education

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Introduction

In the 1980 the Academy Pediatrics¹ and National Strength Conditioning Association,² said the strength training in children was not feasible, because did not have the amount of hormones (testosterone, growth hormone, etc.) necessary for the development of muscle hypertrophy, one of the determining factors for increased strength.

However, in recent years the controversy was no longer on hormonal parameters, because the scientific community certify that the development of strength, both in children and adults is possible, since the first weeks of training their development occurs by neural adaptation, regardless of whether the practitioner is a child, adolescent or adult.³

After all these discussions, states that there is no doubt that strength training programs for children are effective and safe when properly prescribed and supervised, and providing benefits such as increased muscle strength; increased muscular endurance capacity; decreased risk of injuries during the practice of sports and recreational activities; increased performance capability of sports and recreational activities; increased self-esteem.

This strength training idea in youth is already reinforced by the medical community, and for exactly the same institutions mentioned above² in stating that children and young people, when subjected to an appropriate training program and a competent supervision, can increase muscle strength without a significant risk of injury. With these statements presented, it is possible to point out that due to the benefits that strength training brings to children and adolescents, it is essential that at some point in Physical Education, this motor capacity is developed.⁴

Physical Education is responsible for providing comprehensive education, also with purpose and concern of developing the physical fitness of adolescents in school age through pedagogically oriented physical activities. Currently, children and adolescents, according

to the National Curriculum Parameters (NCPs), are becoming increasingly sedentary, caused often by not presenting stimuli according to their interests.

On the other hand, school requirements, imposing various academic disciplines learning by requiring student's hours of physical inactivity in some suitable character to its physical structure, determine other reasons that probably lead teens to have little time and space for regular practice physical exercise.⁵

Thus, according to the NCPs (1998), Physical Education cannot fail to address how some of his main themes, concern fitness related to the performance and fitness related to health. Thus, the aim of this study was to gain muscle strength in all its variables in adolescents after a strength training intervention in physical education classes.

Materials and methods

The data collection was carried out in a State School of Ponta Pora-MS (Brazil). The subjects consisted of 15 girls and 15 boys, totalling 30 students of both sexes, aged 14 to 16 years. All participants attending the 9th grade of elementary school.

The instruments were measured and testing of Project Sport Brazil. These instruments were chosen for facilitating the use in large populations such as school, being instruments simple to use and low cost, that measure the maximum strength variables, quick strength and endurance strength for physical strength capacity in school physical education classes. Students, the consent form was delivered and clarified which led to parents sign authorizing the participation of the child in the research. After authorization being collected, was explained to the students and parents work as the development of research, only participated in the survey students who had signed the free and informed consent.

To measure the strength variables of upper limb, a hand-held dynamometer was used to measure the maximum force of hand pressure; launch the ball medicine ball 4kg, where the student was in

the sitting position, with outstretched and legs together, holding the medicine ball to his chest with the elbows bent and then performed the launch, for the measurement of explosive strength, with a ribbon metric fixed to the ground in horizontal position perpendicular to the wall to assist in numerical collection; suspension in the modified bar to evaluate the expression of the resistance force (the supine position with the legs extended, the student is suspended and remains as much time as possible); the adapted abdominal was used to evaluate the expression trunk resistance force, the student who was ready for testing, is positioned lying on the ground (supine position) with knees bent at an angle of 90 degrees, arms crossed with the palm of the hand on the shoulder, where he counted the total number of repetitions (at which the elbow touches the quadriceps) 1min to exercise. Finally, we used the long jump to measure the explosive power of the lower limbs, where it was placed a tape measure horizontally to facilitate the collection of measures, the student performed the jump with feet together, starting from the "standing" position.

To keep test reliability, every year except the abdominal and the modified bar, students performed the data collection procedure for three consecutive times, which was added the three values and divided by three to get a general average (Table 1).

Table 1 Strength tests for gauging

Hand grip strength	Maximum strength of hand grip
Throwing medicineball	Explosive force of superior members
Modified bar	Strength endurance upper limbs
Abdominal modified	Maximum strength and resistance abdominal
Long jump	Explosive force of lower limbs

Training program

Strength training program was 12 weeks and went through three phases: the introduction phase or learning phase; Progression stage where there adjustment of repetitions and sets the functional phase and increasing the intensity or phase.

The introduction phase was held in the first week, where it was characterized by an improvement of the movements, all the students included in the TF program were instructed to perform the movement with interventions if need be. It is noteworthy that in a brief conversation with the teacher, it was found that the students have performed strength training, but did not have a frequency nor a predetermined constant, they practiced about 2 times a month and have had a reasonable domain execution movement, therefore, the initiation period had no time so extensive.

After the first week was pre stipulated the amount of exercise and the execution time for each training station. The second week was characterized as progression phase and lasted for one week, where they performed the exercises of each season in a 30s time frame for each station.

The third week was added another exercise series for each training station. It was characterized by increased intensity, where individuals performed the maximum movement in 30 seconds and resting (30s 1min), to perform the same exercise again.

The fourth and final week of training was functional stage where young people already had a reasonable area in executing the movement and good strength, it was added over a series for each station and the time taken for execution. The research subjects performed the movements to muscle fatigue. Some authors Faigenbaum et al.⁶

and Faigenbaum Bardley,⁷ Carvalho (1998) and Scott (2000) show some characteristics to these three phases, which are followed in the planning of this study:

Phase 1-initiation

In the first weeks of this period of adjustment, the students were taught how to correctly perform the exercises, starting with the simplest to the most complex. The aim at this stage is to make the exercises run correctly. The initiation phase consisted of a series of exercises, with as many repetitions as possible in 30 seconds for each exercise, the goal is to facilitate the technique of learning each year. The exercises were performed in two weekly training sessions on consecutive days in physical education classes.

Phase 2-progression

At this stage students have shown a reasonable domain in implementing the program of exercises for all different muscle groups. Then intensified the difficulty of the exercises, adding another series of exercises per session. During this period the student is who determines if will rest interval between stations and between training series. The volume (time) training is four weeks. Two weekly sessions on consecutive days. Each session will consist of two nine exercises series, with eight to 20 repetitions per exercise. The exercises will always be multi-joint.

Phase 3-functional

At this stage, the students started to do three exercises per session series. Two weekly sessions, each session consists of three sets of exercises. The exercises continue in number nine and each year students conducted a number of eight to 20 repetitions.

According to the progress of the young, the volume or intensity of training were increased by the number of repetitions. The rest interval between sets of exercises and exchange stations was up to 1 min.

Statistical analysis

Data analysis was performed using the t test to check student parametric post-intervention statistical difference of the training program at the school. Data were considered significant when showed 95% significance level, value ($p < 0.05$).

Results and discussion

The results of strength tests are shown in the comparative graphic format, highlighting the statistical significance between them. The charts were divided by sex and the overall average of the subjects. Below are the results analyzed (Table 2).

Table 2 Statistical results of strength tests on female sex after 12 weeks of training in physical education classes.

	Before training	After training
Hand grip strength (Kg)	29.8±2.3	32.46±2.1*
Throwing medicineball (m)	2.15±1.1	2.48±1.3*
Modified bar (s)	33.5±2.4	64.33±2.5*
Abdominal modified (repetitions)	27±1.5	30.83±2.8*
Long jump (m)	1.26±0.8	1.4±0.2*

*statistically significant difference between this test (95% significance level $p < 0.05$)

It is observed statistically significant difference ($p < 0.05$) in the hand grip strength tests, medicine ball throw, modified bar, abdominal modified female and jump distance (Table 3) (Table 4).

Table 3 Statistical results of strength tests on male sex after 12 weeks of training in physical education classes

	Before training	After training
Hand grip strength (Kg)	36.5±2.4	4.84±2.1*
Throwing medicineball (m)	2.61±1.2	3.21±1.3*
Modified bar (s)	57.16 ±2.3	76.41±2.5*
Abdominal modified (repetitions)	31.5±1.6	34.83±2.8*
Long jump (m)	1.82 ±0.9	1.90±0.3*

*statistically significant difference between this test (95% significance level $p < 0.05$)

Table 4 General statistical result (male and female) of the strength tests after 12 weeks of training in physical education classes

	Before training	After training
Hand grip strength (Kg)	34.26 ±2.3	38.05 ±2.4*
Throwing medicineball (m)	2.45±1.1	2.96±1.3*
Modified bar (s)	49.27±2.4	72.38±2.6*
Abdominal modified (repetitions)	30±1.7	33.5±2.2*
Long jump (m)	1.63±0.9	1,73±0.3*

*statistically significant difference between this test (95% significance level $p < 0.05$)

When compared to overall average of strength tests both male and female, it is observed that there were statistically significant differences in all tests applied after intervention training in school.

Comparing the values in the variables sex, there is a significant difference of values. Being that in males there was a greater development of strength, according to Ferreira,⁸ this is due to androgenic influence of testosterone in males, and also for the growth spurt that occurs after 14 years, in which the body of males is susceptible to increased strength compared girls.

Wedge (1996) evaluated the maximum force by hand dynamometer in pre-pubertal and pubertal school after 10 weeks of training, we found a statistically significant increase in mean both groups. The results showed that, with a few weeks of training, you can increase the maximum force of young people of both sexes, but the intensity and volume should have the aim of stimulating the neural adaptation.

Note that compared the results before and after strength training, explosive strength variable upper (Throwing the medicine ball) had a significant increase in both sexes. The explosive force of superior members, they also made the use of launch equipment for measurement of explosive strength of upper limbs variable. The biggest statistical index of force development when compared to pre and post training, took place in the modified bar, where female and male subjects had a statistically significant increase. The resistive force of the upper limbs modified test bar, increased after application of a resistance training program for explosive strength in prepubertal school. In contrast, a study of Dumith,⁹ in all tests, the least had an effect was modified bar, adding that the largest number of repetitions was measured in rural schools, claiming the same, that such a feat, It can be influenced by the sample variability. Another study of school Gaucho north and west of Santa Catarina, of Glaner,¹⁰ it was found that rural boys have physical fitness superior to the urban area. In turn, a study in Portugal, by Rodrigues Bezerra and Saraiva¹¹ met mixed results, ie, urban boys

reached higher levels in some tests. This done, According Dumith,⁹ is the due to socioeconomic status, as well as environmental and social factors. The analysis of the studies cited above,

In this follow-up proves itself, according to Greco,¹² age, maturity, gender, previous experience, frequency, duration, volume and training intensity will influence the development of the individual's power capacity. One can not overlook the fact that the improvement of motor skills is directly correlated with maturation and in this case also fits the abdominal resistance force. As can be said, according to Braga,¹³ which force is capable of being improved by maturing. In an analysis of the results we can say that strength training takes effect with respect to gain maximum strength and abdominal strength, as well as the increased strength can be greater than the gains made solely by the individual maturation.

It was possible to analyze a statistical difference in the horizontal jump if compare the pre training with the average strength after training. In a study of Braga,¹³ a division has been made, the "control group" and an "experimental group" with the induction of resistance training in a 12 week period for "control group" and the experimental group only. They participated in physical education classes, but were measured strength variables of the two groups. After 12 weeks were measured strength variables. It was found that the control group had a significant development of strength, however, the experimental group had the decreased results.

Based on the study of Braga,¹³ it is clear that female strength gain was not significant, but there was an increase in strength, the explanation for the strength gain has not been significant can afford the period training. Given that individuals who did not have the strength training had the results reduced for the explosive power of expression strength training during physical education classes, it was effective, although the gain is not significant.

When it comes to using strength training at school, Duarte,¹⁴ developed a study that aimed to determine whether the school had physical conditions for operating the TF and teachers apply this training in a playful manner. The results show that 33% of the sample said they use the strength training in their physical education classes, and only 4% of respondents said that schools provide materials to use in class and 100% said that the best way to apply this training would be a playful manner.

According to Duarte,¹⁴ teachers of elementary school physical education of Cabo Frio Municipal schools do not develop the workforce in their classes and present as an intervening factor that training the dissatisfaction of teachers with the space provided by the school. In another study Sousa¹⁵ evaluated the use of physical force quality application in high school of Cabo Frio schools-RJ (Brazil) and found that 60% of respondents teachers applied the strength training in their classes, but not adequately targeting to improve this quality sports enhancement purpose in other modes and only 30% applied this training using the body's own weight or colleague.

Roetert,¹⁶ states that the number of children and young people who participate in sports or physical education classes, as they advance in their academic life, decrease their involvement time with physical activity. Considering the socioeconomic level, it has been observed that children and low-income young people tend to be less active, and consequently, those with the lowest levels of physical fitness. To Haaf,¹⁷ the reduction of the presence of children and youth in physical education classes, as they advance in age, is partly the lack of planning

that takes into account the interest, motivation and success of children in the implementation of activities, determining factors for higher or lower participation of children in sporting events.

So that children and adolescents get success in sports and recreational activities it is necessary that the force component, among others, is developed, because this capability, specifically, is a fundamental part throughout the movement executed.¹⁸⁻²⁴

Conclusion

Through this work it was found that it is possible to gain strength in the conditions of the Physical Education class. To this end, it is not necessary to resort to weight materials or other type to develop the strength of the students. Spatial and material conditions of schools serve perfectly for the teacher in a creative way, planned, organized and intense of his class, work and develop the strength and other physical abilities. This point becomes increasingly important due to increased inactivity of young people who will inevitably have future influence on your health and physical fitness.

Thus, to analyze the importance of strength for improved health progress is very important for the teacher to plan your lessons that develop motor skills within the content that permeate the school physical education. Therefore, it is important to conduct new studies that seek to review the literature aspects addressed in this work as well as those who perform interventions with training programs in the public referred to herein are developed in order to seek further information about the training effects force in school children and youth.

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Conflicts of interests

Authors declare that there is no conflict of interest.

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