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The effect of core stabilization exercises on the physical fitness in children 9-12 years

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Abstract. The purpose of this study was to determine the effects of core stability exercises program on physical fitness of children aged between 9-12 years. Subjects were divided randomly into two groups, training (TRN: n=19) and control (CTL: n=17). TRN group performed a core stabilization program for 6 weeks, three sessions per week. Pre- and post-tests measurements were taken for shuttle run, long jump, abdominal curl, push up and trust tests was done for two groups afterward. Results showed that training groups improved in significantly ($p<0.05$) in five dependent variables. Core stability exercises appear to be a viable and effective way to improve physical fitness capacity of the children.
Key words: *physical training, resistance exercise, Swiss balls, physical fitness, spinal stabilization*.

Introduction

Children need to participate regularly in physical activities that enhance and maintain their cardiovascular and musculoskeletal health. Regular physical activity during adolescence is associated with numerous physiological and psychosocial benefits and has the potential to improve the quality of life for boys and girls (1). Furthermore, it appears that physical activity habits established early in life may persist into adulthood (2). Yet despite these potential health benefits, numerous studies show that children and adolescents are often physically inactive (3).

The need to improve the physical fitness of youth has prompted the development of new and creative approaches that provide an opportunity for all boys and girls to participate in regular, healthful physical activity. While children and adolescents have traditionally been encouraged to participate in aerobic activities such as jogging and swimming, compelling scientific evidence suggests that resistance training (also called strength training) can be a safe and effective method of conditioning for boys and girls, provided that appropriate training guidelines are followed (4).

Resistance training is a specialized method of physical conditioning that involves the progressive use of a wide range of resistive loads –from medicine balls to high intensity plyometrics - that enhance or maintain muscular fitness (i.e. muscular strength, muscular power, and local muscular endurance). Research into the effects of resistance exercise on youth has increased over the past decade, and the qualified acceptance of youth resistance training by medical and fitness organizations is becoming universal (4).

In addition to enhancing motor skills and sports performance, regular participation in a youth resistance training program has the potential to positively influence several measurable indices of health. It helps strengthen bone, facilitate weight control, enhance psychosocial well-being and improve one's cardiovascular risk profile (5).

Moreover, a stronger musculoskeletal system will enable boys and girls to perform daily activities with more energy and vigor, and may help to enhance functional abilities and reduce the likelihood of developing some chronic diseases such as osteoporosis later in life (6). Therefore, the importance of resistance training needs be emphasized early in life as part of a multifaceted approach to lifetime health and fitness.

Some physical education teachers, however, have started to incorporate Swiss balls training into their lessons.

Swiss balls are relatively inexpensive weighted balls that are available in a variety of colors, shapes and sizes.

Physical education teachers are now rediscovering the many benefits that can be achieved by incorporating Swiss balls in their classes. Unlike other approaches to resistance training, core stability training provides students the opportunity to strength their bodies through dynamic movements that require balance and coordination. The core encompasses the lumbo-pelvic-hip complex (with 29 muscles of insertion) in which the center of gravity is located and where all movements begin (7). Core stability is the motor control and muscular capacity of the lumbo-pelvic-hip complex.

Normal function of the stabilizing system is to provide sufficient stability to the spine to match the instantaneously varying stability demands due to changes in spinal posture and static and dynamic loads (8). Panjabi proposes that spinal stabilization is dependent on the interplay between passive, active and neural control systems so that if deficit occurs in one of the systems, other systems will try to compensate with prevention of injury (9), stated that the core function to maintain postural alignment and dynamic postural equilibrium during functional activities, which helps to avoid serial distortion patterns, thus improving athletic performance. King MA (10) suggests that core stability is one of the factors related to lower extremity injury. Also, core stabilization training is a main portion of rehabilitation programs in people with low back pain (11). There is experimental evidence from studies that core stabilization exercise has beneficial effects on fitness (12). These studies are done on athletes so that core stabilization training program is included in athletic movement. Also, there are different reports about type and time of training protocol.

Material and Method

In this study we attempt to investigate the effect of core stabilization training on physical training in children 9-12 years.

The subjects of this research were divided, randomly, into two groups, training (TRN: n = 19) and control (CTL: n = 17) (table I).

Standardized protocols for fitness testing were followed according to methods previously described. Briefly, lower body power was evaluated by the standing long jump test. Abdominal strength was measured by abdominal curl. To perform this test, subjects were positioned on their backs with knees bent at 90°, and Subjects curled forward lifting their shoulder blades off the floor as they touched the hand with both hands and then returned to the starting position. Upper body strength was assessed by push-up. While in the push-up position, subjects placed both hands on the floor. They lowered their chests to the floor and then returned to the starting position, with back flat, arms extended and feet positioned wider than shoulders. Upper body power was evaluated with the trust test. The subject takes a squat position with the feet and hands on the mat. At the command, the subjects take their weight upon their hands; then thrusts their legs straight back and then return to the starting position. The number of thrusts is recorded during 20 seconds. Speed and agility were evaluated with the shuttle run test. Subjects sat on the floor with their legs fully extended and the heels of both feet on floor. On command, the subject stood up and ran to a second point placed 15 feet away. The subject touched the second point and then ran back through a line where the first point was positioned (13)

Core Strength Training Protocol (CST). The control group did not receive the CST protocol. The subjects were instructed to maintain their training routines and to report any alterations to the investigator. The CST group received a program that consists in 5 core-related exercises performed 3 times per week for 6 weeks. The following 5 exercises were visually demonstrated and verbally instructed by the investigator after the pre training test: a) abdominal crunch on a stability ball to target abdominal muscles, b) back extension on a stability ball to target back extensor muscles, c) supine opposite 1-arm.1-leg raise to target back. Hip extensor muscles, d) hip raise on a stability ball to target back. Hip extensor muscles, and e) Russian twist on a stability ball to target abdominal muscles.

These exercises have been used in previous studies to determine the effects of CST. The exercises are relatively well balanced, targeting core muscles (abdominal, hip flexor & extensor and back extensor muscles). Even though those exercises are relatively novice level, some of them are considered a challenge for those who have no experience in CST. All exercises were fully instructed and demonstrated by a certified strength and conditioning specialist to ensure the understanding of the proper mechanics after the pre training laboratory test.

In addition, the CST group received a hard copy of exercise instructions including pictures and training logs. Stability balls were provided to the

experimental group because the treatment is intended for home training. They were instructed to fill out the training log after each session, and they also were contacted by the investigator at the end of each week to ensure adherence or to answer any concerns.

Table II lists the volume of the training for the 6 weeks. According to Casio Lima et al, the total session volume should increase to challenge strength improvement rather than performing the same volume throughout the treatment. Therefore, this study was designed to increase the volume of exercise sessions every 2 weeks (14).

Table I. General characteristics of subjects

Group	Age(years) Mean ± SD	Height(cm) Mean ± SD	Weight(kg) Mean ± SD
TRN	12.23±1.64	151±5.17	39.19±3.43
CTL	12. 43±2.12	152±6/65	43.34±6.21

Table II. Training volume for the 6 Weeks

	Sets	Repetitions
First 2 weeks	2	10
Second 2 weeks	2	15
Third 2 weeks	3	12

Results

Comparison of group changes for the dependent variables can be found in Table III. The group thatparticipated in the core stability training program made significantly greater gains in the shuttle run, long jump, abdominal curl, push-up and trust tests as compared to the control group ($p < 0.05$).

Table III. Pre and post training results for the physical fitness test

Variable	Group	Pre test	Post test	p value
Shuttle run	Control	4.3±0/45	4.2±o/37	0.01
	Exercise	4.8±0/65	4/1±0/27	
Long jump	Control	142.6±27.4	141.32±34.4	0.04
	Exercise	136.7±19.8	147.6±23.9	
Abdominal Curl	Control	12.3±5.8	11.9±9.8	0.05
	Exercise	15.3±2.5	19.6±6.8	
Push-up	Control	13.6±4	12.5±6	0.04
	Exercise	8.5±3.1	12.3±3.7	
Trust test	Control	11.3±5.1	12.4 ±2.1	0.03
	Exercise	13.21 ±3.7	18.7 ±4.3	

Discussion

The primary finding of this investigation was that regular participation in a progressive core stability training program produced greater magnitudes of improvement in muscular fitness and specific motor performances than traditional physical education lessons in children students after short-term training. Since both groups participated in

physical education lessons for the same period of time, such differences are likely due to the specific training adaptations that resulted from core stability training.

The present observations suggest that incorporating core stability training into the physical education curriculum may be a safe and valid means to promote physical fitness in children students. These findings have important practical relevance for designing physical education lessons for children students since muscular fitness is an important health-related fitness component that contributes to tasks of daily life, participation in recreational activities, and reduction of disease (15).

Today, it is generally accepted that resistance exercise can be safe and worthwhile for children and teenagers provided that the training intensity and training duration are sufficient (16).

In general, it seems that boys and girls can increase their strength by about 30-50% during the first eight weeks of resistance training (16). The present results are comparable with these findings as the progressive training program that included explosive types of core stability exercises resulted in gains in upper body strength and abdominal strength.

The mechanisms responsible for these gains are not entirely understood nor were they examined in this study, but changes in motor unit activation and motor unit coordination, recruitment and firing are probable mechanisms that can explain, at least in part, these short-term training induced gains (17).

There is a limited amount of information about the effects of resistance training on motor performance skulls in youth. Although it is attractive to assume that stronger and more powerful children will perform better on motor performance tests, the data is equivocal.

Several studies involving youth have noted significant improvements in the long jump, vertical jump, sprint speed and agility run time following resistance training (18). However, others have noted significant gains in strength without significant improvements in motor performance skills (5). It is likely that these inconsistent findings could be explained by the design of the resistance training program. That is, programs that include exercises on weight machines that are less specific to the test may be less likely to enhance motor skills performance than programs characterized by more specific exercises that involve body weight exercises, free weights and Swiss balls.

This is consistent with the well known principle of training specificity which states that training adaptations are specific to the muscles trained, the intensity of the exercise performed and the metabolic demands of the exercise (18). In the present study, students who participated in the core stability training program made significantly greater gains on the shuttle run, long jump, abdominal curl, push up and trust tests.

These results show that children students respond to core stability training by increasing their ability to perform selected strength and motor skills. Unlike training on weight machines, some Swiss ball exercises require the body to function as a unit instead of separate parts. Moreover, core stability provides a unique type of resistance that can be used for a variety of exercises that can be performed at different movement speeds (from slow to explosive). Thus it is likely that the ability of core stability training to enhance motor performance skills is due to the ability to create exercises with Swiss balls that mimic natural body positions and movement speeds that occur in daily life and game situations. These observed flexibility gains were consistent with others who examined the effects of resistance training on youth (5).

It must be emphasized, however, that the core stability training program in the present study included upper and lower body flexibility exercises. These findings suggest that resistance training with Swiss balls will not result in a loss of flexibility, but may actually improve flexibility as long as dynamic stretching exercises with swiss balls are incorporated into the training program.

In summary, regular participation in physical education lessons can make an important contra provided that students have opportunities to participate in a variety of meaningful physical. Activities that enable them to achieve health-related levels of physical fitness. While aerobic games and activities are often part of the obligatory physical education curriculum, a growing body of evidence suggests that resistance exercise can offer observable and fitness value to boys and girls (5).

The present findings are consistent with the results of earlier studies that noted significant gains in muscular fitness in youth following resistance training using other modes of training (15), the magnitude of muscular fitness

adaptations in the present study resulting from Swiss ball training are novel. Owing to the growing popularity of resistance training among children students, future long-term studies are needed to evaluate the effects of different resistance training programs on health and fitness measures in youth.

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