Strength training adaptations associated with an 8-week suspension training program in prepubecent boys

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6 authors, including:

Carlos Marta
Polytechnic Institute of Guarda

Ana Ruivo Alves
Polytechnic Institute of Beja

Pedro Tiago Esteves
Polytechnic Institute of Guarda

Natalina Casanova
Polytechnic Institute of Guarda

STRENGTH TRAINING ADAPTATIONS ASSOCIATED WITH AN 8-WEEK SUSPENSION TRAINING PROGRAM IN PREPUBESCENT BOYS

Resumo

O objetivo do estudo foi analisar os efeitos de treino de força (ST) com TRX® na força explosiva em rapazes pré-púberes. Trinta e oito rapazes (10.87±0.50 anos) foram distribuídos aleatoriamente num grupo experimental (ST: n=20) para treinar duas vezes por semana, durante 8 semanas, e um grupo de controlo (C: n=18; sem programa de treino). No pós-treino, foi observado um efeito estatisticamente significativo e de elevada dimensão do fator grupo na força explosiva induzida pelo treino ($F_{(1,36)}$=15.30, p<0.001, $\eta_p^2 \eta_p^2$ =0.74). As medidas de força explosiva melhoraram significativamente apenas no grupo ST. Observaram-se diferenças nos lançamentos de bolas medicinais de 1 e 3 kg (5.8 e 8.8%, respetivamente, p<0.001), no salto vertical com contramovimento (7.2%, p<0.001), no salto longitudinal (7.4%, p<0.001) e no tempo de corrida de 20m (1.2%, p<0.001). O treino de força com TRX® poderá ser considerado como alternativa para otimizar o treino da força explosiva na escola.

Palavras-chave

Juventude; exercício; potência

Abstract

The aim of the study was to analyse the effects of strength training (ST) with TRX® on explosive strength in prepubescent boys. Thirty-eight boys (10.87±0.50 years) were randomly assigned into an experimental group (ST: n=20) to train twice a week for 8 weeks, and a control group (C: n=18; no training program). In the post-training, it was observed a significant difference and large effect size of group on training-induced explosive strength ($F_{(1,36)}$=15.30, p<0.001, $\eta_p^2 \eta_p^2$ =0.74). Explosive strength measures significantly increased only on the ST group. Differences were observed in the 1 and 3 kg medicine ball throws (5.8 and 8.8%, respectively, p<0.001), in the counter movement vertical jump (7.2%, p<0.001), in the standing long jump (7.4%, p<0.001) and

in the time-at-20m (1.2%, $p<0.001$). This could be considered an alternative methodology to optimize explosive strength training in school-based programs.

Key-words

Youth; exercise; power

INTRODUCTION

There exist evidences suggesting that physical fitness and physical activity have declined worldwide in the last decades among children and adolescents (1). Because of the low aerobic capacity in children is associated with risk factors of cardiovascular disease, the majority of the research has focused on activities that enhance cardiorespiratory fitness disregarding, for instance, neuromuscular fitness conditions based on muscular strength (2). However, it is recognized that youth strength training can be a safe and effective method of conditioning and should be an important component of youth fitness programs, health promotion objectives, and injury prevention (3, 4).

The effectiveness of the implementation of a strength training program using a TRX® in prepubescent, according to our best knowledge, has yet to be investigated. However, the few studies published in this field with adults has addressed the physiological mechanisms controlling stability (5) and only a small number of studies have examined the effects on performance measurements (strength, power).

In theory, performing strength exercises with the suspension trainer should require greater muscle activation than the equivalent exercises performed without it, thereby potentially having a greater impact on strength (6). Therefore, the purpose of the present study was to determine the general effects of suspension on muscle strength in healthy prepubescent boys.

METHODOLOGY

Subjects

The sample consisted of 38 prepubescent boys aged between 10 and 11 years old (Decimal age: Control group (C)=10.81±0.57, Strength Training (ST) =10.92±0.45; Height(cm): C= 139.56±7.08, ST= 141.04±6.11; Weight(kg): C= 37.84±7.68, ST= 38.82±5.36), all of whom volunteered for this study. The following exclusion criteria were used: subjects with a chronic pediatric disease or with

an orthopedic limitation, and subjects with regular extra-curricular physical activity. This study was approved by the institutional review boards of the University of Beira Interior (UBI) and Polytechnic Institute of Guarda (IPG), Portugal. To fulfil the ethical procedures of the Helsinki statement, an informed consent was obtained prior to all testing children's parents.

Experimental design and training program

Thirty-eight children comprised the study' sample divided into one training group (8 weeks training program, twice a week) and one control group as follows: one group performing strength training, which uses a webbing system to allow users to work against their own body weight (ST: 20 boys); and another group followed the physical education classes curriculum, with no specific training program (C: 18 boys).

After the warm-up period, the ST group underwent a suspension training program, using a webbing system (TRX® Pro Pack, USA), that included chest press, push-up, triceps press, triceps extension, squat, lunge and sprinter start exercises. Before the start of the training, subjects completed two familiarization sessions to practice the drill and routines they would further perform during the training period (i.e., suspension training bodyweight exercises). The same researcher conducted the training program and the anthropometric and physical fitness assessments.

Anthropometric measurements

All anthropometric measurements were assessed according to international standards for anthropometric assessment (7) and were carried out prior to any physical performance test. The participants were barefoot and wore only underwear. Body mass (in kg) was measured to the nearest 0.1 kg using a standard digital floor scale (Seca, model 841, Germany). To evaluate body height (in cm) a precision stadiometer with a range scale of 0.10 cm was used (Seca, model 214, Germany). Maturity level based on Tanner stages was self-assessed (8).

Testing procedures

Sample groups were assessed for upper and lower body explosive strength (medicine ball throwing and standing long jump and vertical jump, respectively) and running speed (20-m sprint run) before and after 8-weeks of training program. Each subject was familiarized with all tests.

The counter movement vertical jump was evaluated as described by Linthorne (9). This test has shown an Intraclass Correlation Coefficient (ICC) of 0.94. The standing long jump was assessed

using the EUROFIT test battery (10). This test has shown an ICC of 0.94. Medicine-ball throwing was performed according to the protocol described by Mayhew et al. (11). The ICC of data for 1kg and 3 kg medicine ball throwing was 0.94 and 0.97, respectively. Time to run 20m was obtained using photocells (Brower Timing System, Fairlee, Vermont, USA), and has shown an ICC of 0.97.

Statistical analyses

All standard statistical methods were used for calculation of the means and standard deviations. The training-related effects were assessed using a paired-samples t-test. To determine the effect of the factor group on the post-training explosive strength, we estimated a multivariate analysis of covariance (MANCOVA), with the pre-training measures as covariates. Data were analysed using SPSS 24.0. The statistical significance was set at $p \leq 0.05$.

RESULTS

At baseline, there were no significant differences between groups for age, Tanner ratings or anthropometric and physical performance measures. In the post-training, it was observed a significant difference and large effect size of group on training-induced explosive strength ($F(1,36)=15.30$, $p<0.001$, $\eta_p^2=0.74$). Explosive strength measures significantly increased only on the ST group. Differences were observed in the 1 and 3 kg medicine ball throws (5.8 and 8.8%, respectively, $p<0.001$), counter movement vertical jump (7.2%, $p<0.001$), standing long jump (7.4%, $p<0.001$) and time-at-20m (1.2%, $p<0.001$) (Table 1).

Table 1. Mean ± SD and paired t-test to explosive strength variables pre- and post-training momentum in strength training (ST) and control (C) groups.

		Pre	Post	Difference (Pre - Post)	*t*	*p*
ST	CM Jump	24.59±3.17	26.37±3.84	-1.77±1.15	-5.288	< 0.001
	SL Jump	137.80±9.56	148.05±11.56	-10.25±6.98	-6.567	< 0.001
	1kg Ball-Throw	381.75±64.59	404.00±67.31	-22.25±8.59	-11.576	< 0.001
	3kg Ball-Throw	241.45±36.20	262.75±36.36	-21.30±7.51	-12.680	< 0.001
	20m Sprint	4.19±0.13	4.14±0.30	0.05±0.03	6.445	< 0.001
C	CM Jump	23.43±5.23	24.27±6.26	-0.83±2.20	-1.611	0.125
	SL Jump	140.16±21.94	145.16±27.48	-5.00±12.84	-1.652	0.117
	1kg Ball-Throw	375.33±74.56	378.55±75.79	-3.22±10.18	-1.342	0.197
	3kg Ball-Throw	233.22±44.53	236.55±45.73	-3.33±13.43	-1.052	0.307
	20m Sprint	4.37±0.27	4.34±0.27	0.02±0.56	1.823	0.086

DISCUSSION

The aim of this study was to analyse the effectiveness of 8-weeks training period of strength training (ST) with TRX® on explosive strength of prepubescent. The main results suggested that ST are effective, well-rounded exercise program that can be performed to improve initial and/or general strength in healthy prepubescent boys.

There is some controversy in the available literature about the benefits of strength training on unstable surfaces. Some studies with adults suggested that loads in unstable conditions may not be a sufficient stimulus to produce adaptations and gains in strength and power (12). In this sense, stiffness of the joints performing the action may limit strength and power gains (13) in instability conditions. Contrarily, other studies report that training in unstable conditions stress the neuromuscular system to a greater extent than traditional resistance training programs. Strength gains can be attributed to both increases in muscle cross-sectional area and improvements in neuromuscular coordination (12). It has been reported that neural adaptations play the most important role in strength gains in the early stages of a resistance training program (12). This evidence is pertinent to analyse the obtained results, if it is considered that in prepubescent children without adequate levels of circulating testosterone to stimulate increases in muscle size, the neural adaptations (i.e.: changes in motor unit coordination, recruitment, and firing) are primarily responsible for training-induced strength gains (14).

However, a training program design different than in this particular study, or different methods of organizing training workouts, can lead to different results, due to several factors that may influence the level created by training. It can be considered as main limitations: (i) the training period of 8 weeks is quite short; (ii) due to the methodological approach (i.e., no electrophysiological measures) it was not possible to clarify the underlying mechanisms responsible for the observed effects.

CONCLUSION

Our data suggest that strength training seems to be effective in improving strength in age-school children. In this sense, in order to increase the variety and motivation in the physical education classes, strength training programs with TRX® should be considered in school-based programs.

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