EFFECTS OF RESISTANCE TRAINING PROGRAM ON DYNAMIC MUSCLE POTENTIAL IN YOUNG BASKETBALL PLAYERS

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(Original scientific paper)

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Apstract:

The purpose of this study was to investigate the effects of resistance training program (with free weight and machines) for young athletes that are already engaged in regular training process for several years. The study participants (n= 28) were young basketball players. The experimental group performed a 12 week, whole-body resistance-training. The measures of power were obtained via a computer-interfaced FÎTROdyne dynamometer attached to the barbell. A device measured maximal power at 30%, 40%, 50%, 60% of 1RM at bench press for each subject. Although both groups increased their maximal muscular power and strength the magnitude of increase was significantly different between them (P < 0.01). Resistance training program induced less changes than previously observed, probably because the subjects were already involved in training process for several years and were already well adapted.

Key words: e*xperimental group, control group, a training program dynamometry, testing*

INTRODUCTION

Resistance training offers many advantages over other types of exercise, it fits the youth activity preference alternating brief bouts of high-effort movement with longer periods of rest/recovery. It's also an important component of a comprehensive physical training program for young athletes. But the development of muscle strength and power through resistance training in children and adolescents is still the subject of some debate and criticism. Early studies (Docherty, Wenger, Collis, & Quinney (1987); Hetherington (1976) that failed to demonstrate strength increases in children who participated in a resistance training program lead to opinion that resistance training is ineffectiveness in children. American Academy of Pediatric even concluded in the policy statement (American Academy of Paediatrics, 1976) that prepubertal boys don't significantly improve strength or increase muscle mass in a weight training program because of insufficient circulating androgens in the blood.

There are several benefits to young athletes should participate in resistance training. Biggest initial impact of resistance training is on nervous system which reflects on muscle strength and power. Other benefits for youth athletes performing resistance training are: Improved self confidence and self esteem, potential to prevent injury, improved strength and body awareness, increased bone density, improved strength of tendons and ligaments, potential to prevent childhood obesity, hard work and discipline and off course fun.

Also, improved performance in many sports is determined by the athlete's physical abilities, and it is reasonable to assume that athletes with higher level of physical fitness will perform better. Basketball, as well as many other team sports, requires the exercise of several components of physical fitness. Power and strength, among other fitness components, are demanded in varying

degrees for success, constituting an essential part of any young athlete's overall training program.

The majority of the recent research (Szymanski, Szymanski, Bradford, Schade, & Pascoe (2007).; Tsolakis, C, Vagenas, G, & Dessypris (2004); Faigenbaum & Mediate, (2006); Faigenbaum, Milliken, Moulton, & Westcott (2005); Faigenbaum, Loud, O'Connell, Glover, & Westcott (2001); Faigenbaum, McFarland, Keiper, Tevlin, Kang, Ratamess, & Hoffman (2007) provides convincing evidence that children and adolescents enrolled with properly designed resistance training program can significantly increase their muscle strength and power, above and beyond growth and maturation. Also, position stands of leading world fitness and health organizations (American Academy of Pediatrics, 2008; American College of Sports Medicine, 2006; British Association of Sport and Exercise Science, 2004; Canadian Society for Exercise Physiology, 2008; National Strength and Conditioning Association, 2009) and review articles (Faigenbaum 2000, 2007; Hass, Feigenbaum, & Franklin (2001) all state that strength training can be very beneficial for children and adolescents if done properly.

METHODS

Subjects

The subjects of this study (n=28) were young basketball players (16.5±0.7 yrs) without previous experience in organized resistance training. Fourteen participants (age 16.6±0.8 yrs, height 187.6±6.7 cm, weight 75.7±9.1 kg) performed 12 weeks' resistance training program, while fourteen (age 16.5±0.8 yrs, height 187±6.9 cm, weight 76,4±8 kg) served as controls. Participants were enrolled only if they were involved in a basketball training process for more than 3 years. All subjects were members of basketball clubs in Niš. All the players volunteered to participate in the study. Before the beginning of the study, participants were notified about the potential risks involved with this study, and were required to give their written informed consent and complete a Physical Activity Readiness Questionnaire.

Experimental design and program

Subjects initially participated in a familiarization session to become acquainted with all testing and training procedures. Following two familiarization session, subjects began a 12 week, whole-body resistance-training. The subjects participated in two training sessions every week during the period of twelve weeks (total of 24 training sessions). Strength exercises were performed for 9 exercises per session, with 2-3 exercises chosen to isolate the major muscle groups as follows: chest, upper back, shoulders, arms, abdomen, and legs, with 2-3 sets per exercise, 8-12 repetitions per set, and around 90 seconds of recovery time between sets. Subjects were instructed to complete the prescribed number of repetitions or until 10-12 repetitions with correct technique; if a greater number of repetitions was achieved, the weight was increased during the following session to permit progressive adaptation. Their initial level of resistance was adjusted according to the level of success in each individual exercise. During one training week (2 sessions) all major muscle group were exercised only once. Each session lasted approximately 60-70 minutes. The first 5 minutes were spent in dynamic warm-up to set the tone for the training session and the last 5 minutes were spent in some stretching exercise to help relax the body. All participants continued with their regular basketball training activities (1h/day, 4days/week). The resistance training program and regular training sessions were not held on the same day. All testing sessions took place at the time of the day similar to the usual training-session times of the participants.

Testing procedure

Power testing

A FÎTROdyne dynamometer (Fitronic; Bratislava, Slovakia) was used to measure the muscle power output. This device attaches to the conventional resistance training equipment and measures the speed and position of the vertical motion of the load during the lift movement. The measures of power were obtained via a computer-interfaced FÎTROdyne dynamometer attached to the barbell via a tether. A high degree of reliability in muscle power measurement was confirmed by Jennings, Viljoen, Durandt, and Lambert, (2005). The testing was performed in bench press (BP) with four different loads (30, 40, 50 and 60% of 1RM). The participants were required to lift the load with maximum speed. The period of rest, which ranged between 1 and 3 minutes for each repetition and load, was determined by the examinees themselves. Three trials for each load in each lift protocol were performed. The best attempts for each load were

Table 1. Basic descriptive statistics parameters for the Experimental group

Variables (unit)	Experimental group				Control group			
	Initial		Final		Initial		Final	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1RM (kg)	60,5	10,1	67,1	8,6	59,6	9,1	61,1	9,3
Power 30% (W)	443,2	99,7	490,3	95,5	418,3	88,9	424,1	87,2
Power 40% (W)	472,6	99,6	513,2	101,3	441,1	91,1	467,2	98,7
Power 50% (W)	494,6	103,5	543,2	99,4	487,7	80,6	499,8	90,5
Power 60% (W)	476,2	102,9	501,4	99,3	467,4	92,8	475,2	96,2

accepted for further analysis.

Statistical Analysis

Data analyses were performed using SPSS version 16.0 for Windows statistical software (SPSS, Inc., Chicago, IL, USA). Descriptive data for subject characteristics and experimental variables were calculated as mean and SD. A repeated analysis of variance (ANOVA) was conducted to compare the 1RM scores within tests (pre- post) and between groups (exp-con). Because of the interrelated nature of the dependent variables (power measurement at specific resistance of 1RM) the data were analyzed using a repeated-measures multivariate analysis of variance (MANOVA) to determine if there were significant differences in maximal power measurements across two testing sessions between the experimental and control groups. Statistical significance was set at a p? 0.05.

RESULTS

The basic descriptive statistics parameters of the investigated variables are shown in

Table 1.

The effects of the resistance training program were observed in both groups. Strength, measured as 1RM, increased by 6,6 kg in absolute terms and by 10,9% in relative terms in the experimental group, whereas the control group improved strength by 1,5 kg or 2,5%, respectively (Fig. 2). Although both groups increased 1RM, the magnitude of increase was significantly different between them (*P* ? 0.01, interaction effect of ANOVA-Table 3.). A MANOVA (table 2, revealed significant differences (F= 5.23; P<0.01) in power measurements between groups. Post hoc analysis revealed significant changes in (30, 40 and 50% of 1RM).

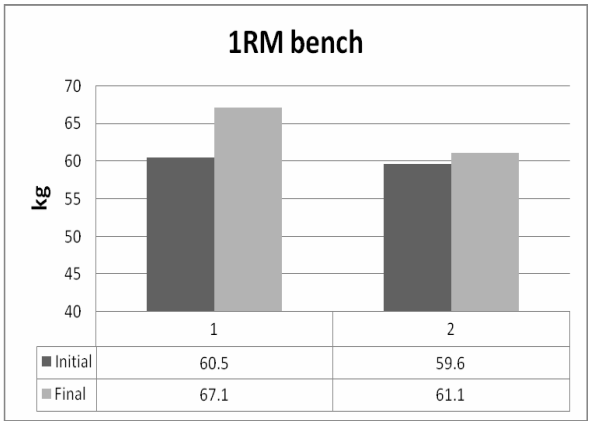

Figure 1. Bench press 1RM

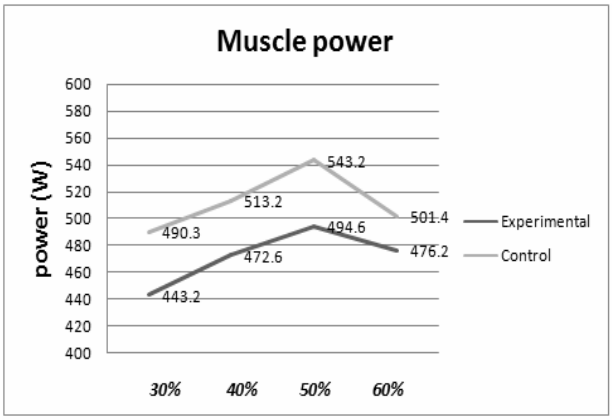

Figure 2. Muscle power in bench press

DISCUSSION AND CONCLUSION

Experimental program induced statistically significant changes in strength and power parameters. Resistance training program that was designed following the recommendations of some leading world field organization and experts (National

Table 2. Rezults of MANOVA/ANOVA

Manova	F	p
Power measurement	5.23	.01

ANOVA	F	p
1RM	6.73	.01
Power 30%	5.10	.02
Power 40%	5.54	.02
Power 50%	6.32	.01
Power 60%	2.82	.07

Strength and Conditioning Association, 2009; Canadian Society for Exercise Physiology, 2008; Ignjatovic, Stankovic, Radovanovic, Markovic, & Cvecka, 2009; Fleck & Kraemer, 2003) induced less changes than previously observed. In short-term (8 to 20 weeks) resistance training programs, the expected progress in strength in children and adolescents is around 30% (National Strength and Conditioning Association, 2009). The (Falk & Tenenbaum (1996) meta-analysis found that gains in muscle strength were approximately 13-30% greater than that which would be expected to result from growth and maturation. Some authors found even greater strength gains (from 55 to 74%) after 8 weeks of resistance training (1992; Faigenbaum, Zaichkowsky, Westcott, Micheli & Fehlandt (1993). However, most of the previously cited studies used untrained or moderately trained children and adolescents as subjects.

In the conducted study the increase of muscle strength expressed as 1RM Bench after 12 weeks of resistance training program was 10,9%, while the increase above the value expected from growth and maturation only, was above 7%. This relatively small progress compared with other investigations could be explained by the fact that most of the other studies were done on previously untrained subjects and that almost any stimulus lead to significant gains. In subjects exposed to the impact of long term organized training programs (over 3 years), a significant physiological adaptation had been were already achieved. Increasing the volume or intensity of the resistance training program might lead to better adaptation, but it would also increase the risk of injury. Possible strains, sprains, fractures or even more serious, growth cartilage injury or stunted growth are all reasons for avoiding more intense resistance training programs in youths (American Academy of Pediatrics , 2008; American College of Sports Medicine, 2006; National Strength and Conditioning Association , 2009; Ignjatovic et.al, 2009). Noteworthy is the fact that during our training program no injuries were reported.

Although it is generally accepted that properly designed resistance training programs will over time increase the force-generating capability of a muscle, there is still considerable debate among field specialists about the loads that should be used to maximize power gains (Baker, Nance & Moore, 2001; Cronin, Mcnair, Marshall, 2001) and the level of load at which maximum power will be produced. Early training studies using untrained individuals reported that the optimal load for improving power was approximately 30% of 1 repetition maximum (Wilson, Newton, Murphy & Humphries (1993). Later studies using the individuals who were experienced in explosive exercises reported that loads between 40 and 70% of 1RM were most effective in *power* production improvements (Baker, et,al (2001); Cronin, et.al (2001); Seigel, Gilders, Staron & Hagerman, 2002). Results from our study, with the training load between 30% and 50% of 1RM, would lead to maximum power gains.

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ЕФЕКТИТЕ НА ТРЕНИНГОТ СО ОПТОВАРУВАЊЕ НА ДИНАМИЧКИ МУСКУЛЕН ПОТЕНЦИЈАЛ КАЈ МЛАДИТЕ КОШАРКАРИ

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(Оригинален научен труд)

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Апстракт:

Целта на ова истражување е утврдувањето ефектите на тренингот со оптоварување кај младите кошаркари кои биле во повеќе годишен тренажен процес. Примерокот на испитаниците се состоеше од млади кошаркари (N=28). Во истражувањето беа вклучени експериментална и контролна група. Експерименталната група беше третирана со тренажен процес кој траеше 12 недели. Мерена е мускулната снага со динамометар FÎTROdyne кој беше закачен за шипка со тегови. Тој беше поврзан и со компјутер. Снагата е мерена при 30%, 40%, 50% и 60% од 1PM. Двете вклучени групи во истражувањето ги подобрија своите иницијални резултати, но тоа во експерименталната група беше статистички значајно на ниво (P<0.01). Тренингот со оптоварувањето покажа ефективност на подобрување во однос на претходно утврдениете резултати. Но тоа, беше помало од очекувањата, што може да се објасни со фактот дека примерокот беше сочинет од испитаници кои беа во повеќегодишен тренажен процес кој веќе кај нив предизвикал адаптивни трансформациони капацитети.

Клучни зборови: *експериментална група, контролна група, тренажна програма, динамометрија, тестирање, МАНОВА*