EFFECTS OF 7 WEEKS OF ROPE-JUMP TRAINING ON CARDIOVASCULAR ENDURANCE, SPEED, AND AGILITY IN MIDDLE SCHOOL STUDENT BOYS

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Abstract

The purpose of this study was to investigate the effects of a 7-week of rope-jump training on speed, endurance and agility in middle school male students. Twenty eight male students (age 11.87±0.33 year, weight 40.30±9.72, height 1.49±0.08 m) were recruited from pre-high school and randomly were assigned into rope-jump training (n = 14) and control (n =14) groups. The rope-jump training group (RJT) underwent 7 weeks of jump rope training (15-50 min/d, 3 d/wk). The 7-wk rope jump training significantly improved cardiovascular endurance (10.33%) and agility (3.17%) compared to control group. The 50-m sprint test was also improved by 0.29% in RJT compared to control group (p>0.05). In conclusion, the current findings indicate that 7 weeks rope jump training is a feasible and safe training method for improving cardiovascular endurance and agility in middle school student boys. However, rope jump training confers small improvements in sprint performance in middle school student boys.

Key words: *rope jump training, cardiovascular endurance, sprint performance, agility*

Introduction

The benefits of regular physical activity in adults have been well studied (Fletcher, et al., 1992; Pate, et al., 1995), but the effects of regular physical activity on the health of children have not been well studied (Riddoch, et al., 1998). Based on Janssen and LeBlanc (Janssen & LeBlanc, 2010) children and youth 5-17 years of age should increase the time they spend on moderate-to-vigorous intensity physical activity by 30 minutes per day, and over a 5 month period progress to adding an additional 90 minutes of daily physical activity. Aerobic activities should make up the majority of the physical activity. Rope jumping has been around for many years as a recreational activity for kids and for physical exercise, e.g. in warm-ups and cardio for boxers (Aagaard, 2012). Recently, rope training exercises were added to exercise program in Iranian middle schools. Jumping rope involved the muscles of the arms and the legs, and improved cardiovascular functions and metabolism. In addition, the jump rope is extremely portable, requires a minimum of space and is incredibly inexpensive compared to other equipment. In previous researches, the effects of jumping rope on health-related physical fitness in students with mild intellectual impairment or visual impairment have been studied, and found that jumping rope significantly improved balance, cardiovascular endurance, muscular strength, body composition, and flexibility (Chen, 2010; Tsai, 2009; Yeh, 2007). Studies also suggested that with effective exercise prescriptions involving jumping rope, individuals demonstrated an improvement in cardiovascular function, body composition, flexibility, and muscular strength and endurance, which further contributed to advancements in health-related physical fitness (Yeh, 2007; Feng, 2007; Lee, 2010; Shen & Huang, 2000; So & Lin, 2001; Wu, 2002).

Recently, Chao-Chien and Yi-Chun (2012) studied the effect of 12-week jumping rope training on the health-related physical fitness in students with intellectual impairment. The jumping rope training demonstrated significant effects on cardiovascular endurance, flexibility, and muscular strength and endurance. Also, Kim et al. (2007) reported that six weeks of jump rope exercise improved triglyceride and insulin sensitivity and increased adiponectin levels in obese Korean male adolescents. Although, previous studies showed the effects of rope-jump training on health-related physical fitness in mild intellectual impairment or visual impairment, few studies have been conducted among healthy middle school students. Therefore, the purpose of the present study was to investigate the effects of a 7-week of rope-jump training on speed, endurance and agility in middle school male students.

Material and Methods

Subjects

Twenty eight middle school male students (age 11.87±0.33 year, weight 40.30±9.72, height 1.49±0.08 m) were recruited from pre-high school and randomly were assigned into rope-jump training (n = 14) and control (n =14) groups. Subjects were sixth grade students aged ~11-12 years old. Subjects were not participating in any regular physical activities except school physical education class. Subjects in the exercise group participated in jump roping exercise in addition to regular physical education class, while the control group participated in only a regular physical education class. The rope-jump training group (RJT) underwent 7 weeks of jump rope training (15-50 min/d, 3 d/wk). The study protocol was approved by local authorities of the school, including the school director, the teacher's committee council, the parent's committee council

and student representatives. Informed consent was obtained from the parents to allow students to participate in the study. The study was conducted between January 19th, 2012 and 14th March, 2013. Every Sunday, Monday, Wednesday, the jumping rope training was administered from 15:30 to 16:45. Anthropometric variables, endurance, speed and agility were measured before and after 7 weeks of jump rope exercise in both groups. Body weight was measured with a digital scale (sensitivity of 0.1 kg) and height was measured to the nearest millimeter. BMI was calculated as weight in kilograms divided by the square of height in meters.

Table 1. Rope-Jump training program

		Exercise duration		
Week	Intensity (jumps/ min)	Warm up (5 min)	Exercise	Cool down (5 min)
1	60	Stretching	60 rep × 1 min with 30 second rest (15 min exercise)	Stretching
2	60		60 rep × 1 min with 30 second rest (20 min exercise)	
3	70		70 rep × 1 min with 30 second rest (30 min exercise)	
4	70		70 rep × 1 min with 30 second rest (35 min exercise)	
5	80		80 rep × 1 min with 30 second rest (40 min exercise)	
6	85		85 rep × 1 min with 30 second rest (45 min exercise)	
7	95		95 rep × 1 min with 30 second rest (50 min exercise)	

Rope jump training
Subjects in the exercise group participated in supervised interval endurance rope training three times per week, 15-50 min/d for 7 weeks. The detailed exercise training program is summarized in Table 1.

Physical fitness test

Measure of cardiorespiratory endurance
Cardiorespiratory endurance was measured by 540 m run test on in an outdoor volleyball court. After warming up, participant started running around the rectangular court (volleyball court) that the dimensions were 18×9 m (Figure 1). Subjects run 10 times around the volleyball court. Time used to complete 540 m distance is recorded in minute: second. Subjects should walk for 3-5 min immediately after test to cool down. *The 50-m sprint test* was completed on in an outdoor track. This test is highly correlated with anaerobic capacity of the body and has been used in school-age children. Five trials were allowed for the participants to become familiar with the 50-m sprint test. Each sprint commenced with a 5-s countdown and a 2-min recovery was given between trials. The fastest time achieved (seconds) was recorded.

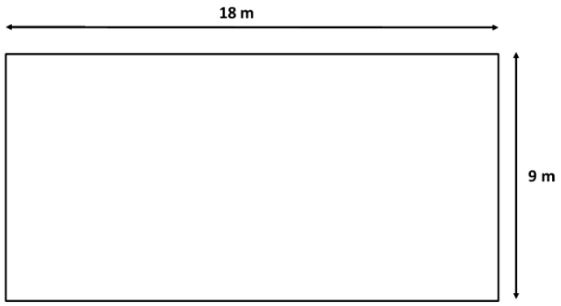

Figure 1. The rectangular court (volleyball court) that the dimensions were 18×9 m.

The 30-yard T-drill is an agility and conditioning test (Figure 2) that start in a two-point stance, then sprint forward 5 yard (4.6 m) to a marked spot on the ground, side-shuffle to the right and touch a line 5 yard away with the right hand, shuffle back to the left 10 yard (9 m) touch the far line 5 with the left hand, shuffle back to the right 5 yard to the marked spot, touch the marked spot with either foot and backpedal through the star line to the finish (Brown & Ferrigno 2005).

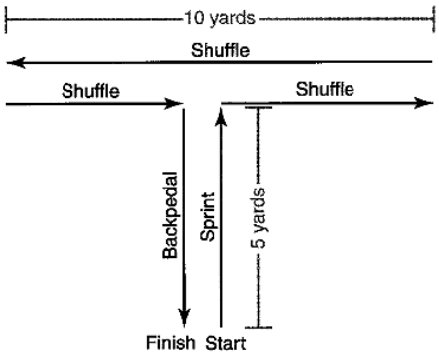

Figure 2. The 30-yard T-drill test [16].

Statistical Analysis
Dependent t-student and independent t-student were used to compare the difference between data related to before and after the training session and to compare two groups with each other, respectively. All data are presented in mean±SD. Statistical significance was set at $p<0.05$ for dependent and independent t-student. All obtained data were analyzed using SPSS 16.0.

Results

At baseline, no significant difference was found in body weight, body mass, BMI, Endurance 540 m test, 50-m sprint test and T test between the rope jump training and control group. Descriptive data (Mean±SD) on anthropometry are depicted in table 2. Descriptive data on endurance 540 m test, 50-m sprint test and T test in both groups were demonstrated in table 3. The 7-wk rope jump training significantly improved cardiovascular endurance (10.33%) and agility (3.17%) compared to control group. The 50-m sprint test was also improved by 0.29% in rope jump training group compared to control group ($p>0.05$).

Table 2. Descriptive data (Mean±SD) on anthropometry in sixth grade boy students

	Rope jump training group (n=14)		Mean % Changes	Control group (n=14)		Mean % Changes
	Pre	Post		Pre	Post	
Chronological age (yrs)	11.85±0.36	11.85±0.36	0	11.89±0.31	11.89±0.31	0
Body height (cm)	1.49±0.07	1.50±0.06	0	1.49±0.09	1.49±0.08	0
Body mass (kg)	40.67±7.44	37.64±6.90	4.66	40.02±11.31	40.23±11.82	-6.15
BMI ($kg.m^{-1}$)	18.31±0.25	16.72±0.18	-0.086	18.02±0.32	18.12±0.11	0.005

BMI, body mass index; %, relative change from the initial value at Pre.

Table 3. Descriptive data (Mean±SD) on Physical fitness test in sixth grade boy students

	Rope jump training group (n=14)		Mean % Changes	Control group (n=14)		Mean % Changes
	Pre	Post		Pre	Post	
Endurance 540 m test (min:s)	2.44±0.22	2.18±0.11*§	10.33†	2.52±0.05	2.38±0.30*	4.67
50 m test (s)	8.42±0.44	8.38±0.56§	0.29	9.21±0.82	9.50±0.81	-3.89
T test (s)	8.58±0.64	8.26±0.58*§	3.17†	9.23±0.48	8.96±0.43	2.65

*****, Significance change between Pre and Post ($p < 0.05$) **†**, Significance difference in relative change before intervention ($p < 0.05$); **§**,Significance difference between groups; %, relative change from the initial value at Pre.

Discussion and conclusion

The aim of the present study was to assess whether the 7-week jumping rope training could be used to improve cardiovascular endurance, speed and agility in adolescent boy (sixth grade boy students). There is limited information regarding whether rope jump training can be used as training method to improve physical fitness in adolescent boy. The main findings of this study indicated that 7-week jumping rope training for 15-50 min/d, 3 d/wk significantly improved cardiovascular endurance (10.33%) and agility (3.17%) in adolescent boys. These results indicate that rope jump training for 7 weeks is a feasible and effective method for improving cardiovascular endurance and agility performance in adolescent boys. These findings are accordance with Chao-Chien and Yi-Chun (2012) demonstrated that the 12-week jumping rope training significantly affects on cardiovascular endurance, flexibility, muscular strength and endurance in students with intellectual impairment. Also, our finding are consistent with previous studies reported that jumping rope training significantly improved balance, cardiovascular endurance, muscular strength, body composition, and flexibility (Chen, 2010; Tsai, 2009; Yeh, 2007). Chao-Chien, and Yi-Chun (2012) demonstrated significant improvement after rope jump training in visually impaired students.

Ozer et al. (2011) was assessed the effects of a 12-week "rope jumping" and "weighted rope jumping" training programs on functional parameters including multi-joint coordination and proprioception, strength, endurance in adolescent female volleyball players. They demonstrated significant improvement in physical fitness variables. In addition, our finding demonstrated non-significant improvement by 0.29% in speed performance as measured by 50 m test after 7-week jumping rope training. However, there is less information concerning the influence of rope jump training on speed performance. In addition to the effects of rope jump training on physical fitness variables, the beneficial effects of such training on lymphocyte ABCA1 protein expression and lipid profiles among overweight and obese boy adolescents was evaluated (Ghorbanian, et al., 2013). Takai, et al., (Takai, et al., 2013) reported the 8-wk body mass-based squat training (100 reps/day, 45 sessions) significantly decreased percent body fat (4.2%) and significantly increased the lean body mass (2.7%), muscle thickness (3.2%) and strength of the knee extensors (16.0%), compared to control group. In conclusion, the current findings indicate that 7 weeks rope jump training is a feasible and safe training method for improving cardiovascular endurance and agility in middle school student boys. However, rope jump training confers small improvements in sprint performance in middle school student boys.

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UČINCI 7-TJEDNOG TRENINGA PRESKAKANJA KONOPCA U AEROBNOJ IZDRŽLJIVOSTI, BRZINI I SPRETNOSTI KOD SREDNJOŠKOLACA

Sažetak

Svrha ove studije bilo je istraživanje učinaka učinaka 7-tjednog treninga vijačom na brzinu, izdržljivost i agilnost kod srednjoškolskih muških studenata. Dvadeset osam muških studenata (uzrasta 11.87±0.33 g., mase 40.30±9.72 kg., visine 1.49±0.08 m) odabrano je i po slučajnom ključu pridruženo treningu vijače (n = 14) i kontrolnoj grupi (n = 14). Grupa koja je trenirala s vijačom (RJT) polazila je 7 tjedana trening vijačom (15-50 min/dan, 3 dana/tjedno). Sedmotjedni trening preskakanja vijače poboljšao je kardiovaskularnu izdržljivost (10.33 %) i agilnost (3.17 %) u odnosu na kontrolnu grupu. Trčanje na 50 m sprinta također je poboljšano u odnosu na kontriolnu grupu ali za 0.29 % (p > 0.05). Zaključno, tekući rezultati ukazuju da je 7 tjedana preskakivanja vijače dobra i sigurna trenažna metoda za poboljšanje kardiovaskularne izdržljivosti i agilnosti kod srednjškolaca. Međutim, trening preskakanja vijače donio je minorna poboljšanja u izvedbi sprinta kod srednjoškolaca.

Ključne riječi: *trening preskakivanja vijače, kardiovaskularna izdržljivost, izvedba sprinta, agilnost*

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