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Effect of a Trampoline Exercise on the Anthropometric Measures and Motor Performance of Adolescent Students

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ABSTRACT

Background: Physical exercises can influence some anthropometric and fitness components differently. The aim of present study was to evaluate how a relatively long-term training program in 11-14-year-old male Iranian students affects their anthropometric and motor performance measures.

Methods: Measurements were conducted on the anthropometric and fitness components of participants ($n = 28$) prior to and following the program. They trained 20 weeks, 1.5 h/session with 10 min rest, in 4 times trampoline training programs per week. Motor performance of all participants was assessed using standing long jump and vertical jump based on Eurofit Test Battery.

Results: The analysis of variance (ANOVA) repeated measurement test showed a statistically significant main effect of time in calf girth $P = 0.001$, fat% $P = 0.01$, vertical jump $P = 0.001$, and long jump $P = 0.001$. The ANOVA repeated measurement test revealed a statistically significant main effect of group in fat% $P = 0.001$. *Post hoc* paired *t*-tests indicated statistical significant differences in trampoline group between the two measurements about calf girth ($t = -4.35$, $P = 0.001$), fat% ($t = 5.87$, $P = 0.001$), vertical jump ($t = -5.53$, $P = 0.001$), and long jump ($t = -10.00$, $P = 0.001$).

Conclusions: We can conclude that 20-week trampoline training with four physical activity sessions/week in 11–14-year-old students seems to have a significant effect on body fat% reduction and effective results in terms of anaerobic physical fitness. Therefore, it is suggested that different training model approach such as trampoline exercises can help students to promote the level of health and motor performance.

Keywords: Fat, jump, physical ability, students, trampoline exercise

INTRODUCTION

Physical fitness is the ability that helps people to adapt with their environmental conditions and plays an important role in daily activities. It is highly associated to one's health status and has a striking effect on the quality of life, learning and working efficiency, and physical activity contributions. Physical fitness is composed of performance-related physical fitness and health-related physical fitness.[1] Indeed, genetic somehow determines physical fitness, but environmental factors[2] including

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physical activity levels,[3,4] socioeconomic status,[5] television viewing,[6] and anthropometric factors[7] highly modify it. Since fitness level drops with aging,[8] physical involvement should be highly suggested. Sports participation lead to higher fitness and lower body fat significantly.[9] Furthermore, continuous physical activity is associated with decreased level of adiposity.[10] However, inactive life affects body muscle and functioning ability negatively, and people are vulnerable to chronic diseases as consequences. A higher quality of life can be obtained through moderate exercises to develop or maintain physical fitness. Lamb declared that individuals can successfully cope with challenges in their life via optimal physical fitness.[11]

Physical training program can be effective for athletes and nonathletes in different ages to improve aerobic power,[12] muscle strength,[13] anaerobic power,[14] jumping ability,[14] and local muscle endurance.[13] Additional strength training and plyometric training in 9–12-year-old soccer players for 2 years showed a significant improvement of motor performance factors.[15] Mini-trampoline exercises may need higher levels of involvement in the muscles of lower extremities.[16,17] Since mini-trampoline exercises comprise a multicomponent approach, numerous physical factors including strength, body stability, muscle coordinative responses, joint movement amplitudes, and spatial integration can be affected positively.[18] Heitkamp *et al*. indicated not only balance and strength improvement but also muscular imbalances equalization of the two limbs due to mini-trampoline training.[17] Giagazoglou *et al*. showed improvement in motor performance of participants with intellectual disabilities after applying trampoline training intervention.[19] However, rebounding exercise for 11 weeks revealed minimal cardiorespiratory fitness improvement and no significant body composition changes in 17 sedentary women. Very few studies were conducted to detect specific contributions derived from trampoline exercise as a different training model approach. Therefore, the purpose of this study was to examine the effect of trampoline training intervention on anthropometric variables and physical fitness components of 11–14-year-old male students, Iran.

METHODS

Participants

Thirty-eight healthy school-aged male students (mean age: 12.6 years, standard deviation: 2.1) were selected randomly from the junior high schools of Ardabil, Iran. They were divided into two groups of 19 students based on gender, residential school, and no trampoline training experience. Participants and their parents were entirely informed about the study and provided written consent. The first five students were omitted as they had prior experience, and the second five students were excluded because they had failed to attend the exercise sessions consistently [Figure 1]. The study protocol received approval from the Ethics Committee of the University of Urmia, and it was in accordance with the Declaration of Helsinki (last modified in 2000).

Anthropometry and body composition

Evaluation process of participants was conducted within a 2-day period by the same researcher. The 1st day was assigned to anthropometric measurement and the 2nd day for motor ability tests. Anthropometry and motor ability of the participants were measured before and after the 20 weeks trampoline training intervention.

All anthropometric characteristics were measured using the techniques provided by Lohmann *et al*. and the median value of three measures was considered as

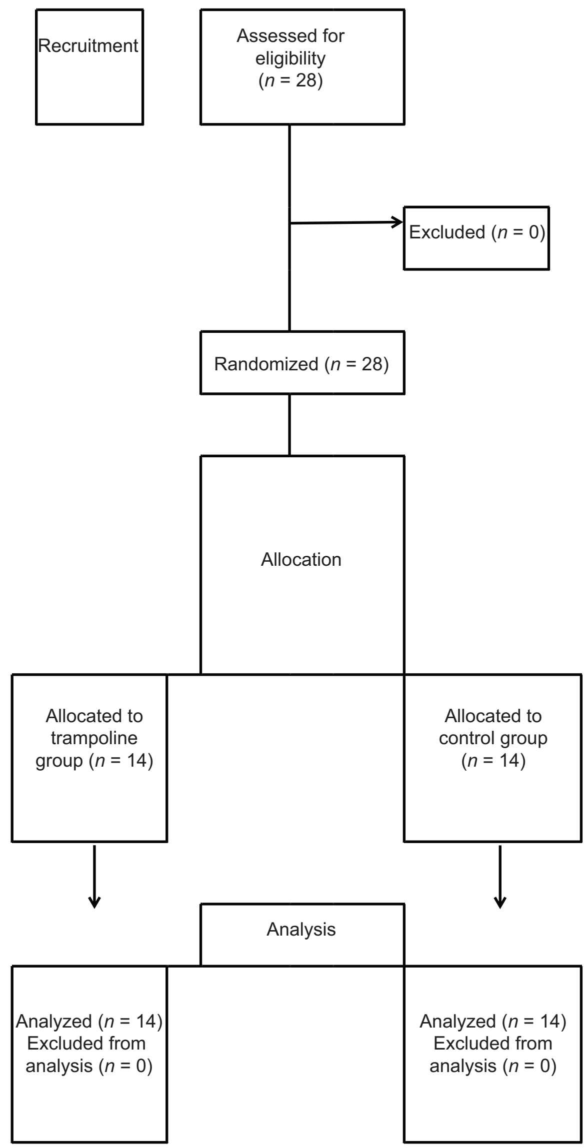

Figure 1: Flow chart of the progress through the phases of the study according to the CONSORT statements

criterion.[20] Stature (Holtain Ltd., Crymych, Dyfed, UK) and weight (Model DS-410, Seiko, Tokyo, Japan) were assessed to the nearest 10 mm and 0.1 kg respectively, and body mass index was calculated using following formula: weight (kg)/(height [m])^2. Moreover, lower extremity girths including thigh and calf were measured on the right side of each participant. Skinfolds thickness was measured at three body sites (triceps, subscapula, and suprailiac) with a Harpenden Skinfold Caliper.[21]

Trampoline training

Participants in experimental group trained 20-week, 1.5 h/session with 10 min rest, in 4 times trampoline training programs per week. Although none of the students had balance problems, some important safety guidelines were considered to prevent the possibility of injury. All participants were instructed to perform variety of movements with eyes opened including one foot and two-foot jump, hop with rotation in different directions, hand and toe contacts in the air, and alternate sit and stand movement. The instructor started to teach forward and backward somersault when participants were familiar with spatial awareness, spatial orientation, and body control after performing all of the mentioned movements. Finally, students were asked to combine individual movements and execute them as a routine throughout the training sessions. However, participants in the control group only participated in school physical education classes 2 times/week for 45 min.

Table 1: Characteristics of the study participants

Variable	Control group (*n*=14)				Trampoline group (*n*=14)				*P*
	Pretraining		Posttraining		Pretraining		Posttraining		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Height (m)	1.53	0.12	1.63	0.13	1.46	0.14	1.56	0.16	0.12
Weight (kg)	45.4	12.7	50.8	12.3	40.7	14.5	44.8	12.9	0.36
BMI (kg/m^2)	18	2.1	18.5	2.2	18.2	3	18.4	3	0.93

SD=Standard deviation

Physical fitness measures

Motor ability of all participants was assessed after a short period of warm up using standing long jump and vertical jump based on Eurofit Test Battery.[22] The best value of three attempts was the score of motor ability tests.

Vertical jump test

Vertical jump test measures the lower limb power. Each participant standing reach height, tip of middle finger in the hand closest to the wall while participant stood side on to the wall, was marked. Then, participant used both arms and legs contributions to project the body as high as possible while standing away from the wall. The standing reach height and the jump height difference were the score.

Standing long jump test

The lower limb power is measured via standing long jump test. Each participant stood behind the marked line on the ground with swinging arms and bending knees. The take-off was done when the arms reached forward to lead participant as far as possible.

Statistical analysis

Descriptive statistics (means and 95% confidence intervals) were performed for all variables. Normal distribution of all variables was checked using the Kolmogorov–Smirnov test. A two-way repeated measures analysis of variance (ANOVA) (condition [2] × trial [2]) with repeated measures on both factors was used. To further analyze the responses of the groups were compared using *t*-tests for independent and paired samples. The level of significance was set at $P \leq 0.05$.

RESULTS

Anthropometric and physical fitness variables of the two groups are reported in Tables 1 and 2. The ANOVA repeated measurement test showed a statistically significant main effect of time in calf girth $P = 0.001$, fat% $P = 0.01$, vertical jump $P = 0.001$, and long jump $P = 0.001$. The ANOVA repeated measurement test revealed a statistically significant main effect of group in fat% $P = 0.001$.

Table 2: Differences between pre- and post-training of anthropometric and physical fitness indicators in the trampoline and control groups

Variable	Control group (*n*=14)				Δ%	Trampoline group (*n*=14)				Δ%	*P* (effect size f)		
	Pretraining		Posttraining			Pretraining		Posttraining			Main effect: Time	Main effect: Group	Interaction: Time×group
	Mean	SD	Mean	SD		Mean	SD	Mean	SD				
Body fat (%)	13.25	3.99	13.92	3.26	4.8	11.74	1.98	9.56	1.51	22.8	0.01 (0.2)	0.001 (0.3)	0.001 (0.4)
Thigh girth (m)	0.40	0.05	0.41	0.05	2.4	0.43	0.05	0.44	0.05	2.2	0.12 (0.08)	0.12 (0.08)	0.85 (0.01)
Calf girth (m)	0.29	0.04	0.31	0.04	6.4	0.30	0.04	0.32	0.03	6.2	0.001 (0.64)	0.51 (0.01)	0.99 (0.00)
Long jump (m)	2.06	0.34	2.15	0.35	4.1	1.98	0.42	2.18	0.45	9.2	0.001 (0.8)	0.86 (0.01)	0.001 (0.4)
Vertical jump (m)	0.56	0.09	0.68	0.11	17.6	0.52	0.10	0.71	0.12	26.8	0.001 (0.6)	0.59 (0.01)	0.02 (0.17)
Agility (s)	10.06	0.8	9.74	0.73	3.2	10	0.66	9.67	0.38	3.3	0.001 (0.38)	0.68 (0.01)	0.63 (0.01)

SD=Standard deviation

Post hoc paired *t*-tests indicated statistical significant differences in trampoline group between the two measurements about calf girth ($t = -4.35$, $P = 0.001$), fat% ($t = 5.87$, $P = 0.001$), vertical jump ($t = -5.53$, $P = 0.001$), and long jump ($t = -10.00$, $P = 0.001$). *Post hoc* paired *t*-tests showed statistical significant differences in control group between the two measurements concerning calf girth ($t = -5.67$, $P = 0.001$), vertical jump ($t = -3.88$, $P = 0.002$), and long jump ($t = -4.22$, $P = 0.001$). The analysis of independent *t*-test (pre- to post-subtraction between two groups) indicated significant differences in fat% $P = 0.001$, high jump $P = 0.02$, and long jump $P = 0.02$.

DISCUSSION

Since fitness level drops with aging,[8] physical involvement is highly suggested. This study investigated whether anthropometric measures and motor performance components are changed via trampoline training considering that this is the first study in a relatively longer period.

Since athletes increase metabolism through practice, our finding indicated significant changes of body fat% as a result of trampoline training that is not consistent with the findings of Edin *et al*.[23] Indeed, no significance changes of body composition variables in the study of Edin *et al* (1990) may be attributed to the 11 weeks exercise that is limited in terms of training period compared to our study.[22] Although trampoline exercises are not basically aerobic, long-term training program made significant changes in body fat% between the two groups. Lower limb characteristics such as thigh girth and calf girth were improved considering pre-test and post-test differences. However, we found no significant difference between experimental and control group in this regard. The improved lower limb muscle sizes are related to participant's growth process, and trampoline training has no significant effect on the hypertrophy of lower limb muscles.

Previous studies investigated trampoline training programs in healthy and physically challenged people. Aragão *et al*. (2011) reported balance improvement due to mini-trampoline exercises in elderly participants. Giagazoglou *et al*. (2013) indicated improvement in motor performance of participants with intellectual disabilities after applying trampoline training intervention. Our findings are in agreement with those studies in this regard and showed significant improvement of jumping ability in healthy trampoline participants compared to control group. This improvement can be attributed to the higher amount of biomechanical stimuli with jumping on a trampoline compared to other forms of activity like running. Furthermore, body segments coordination due to training programs can help participants to use the ideal motor patterns for performing jumping tests. Trampoline training stimulates proprioceptive sense that can facilitate motor performance and prevent musculoskeletal injuries as a result of sudden fall in life. Since the nature of this training intervention is recreational, people in different ages can be involved to promote the quality of their life.

CONCLUSIONS

Based on these finding, we can conclude that a 20-week trampoline training with four physical activity sessions/week in 11–14-year-old students seem to have a significant effect on body fat% reduction and effective results in terms of anaerobic physical fitness. Therefore, it is suggested that different training model approach such as trampoline exercises can help students to promote the level of health and motor performance.

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Conflicts of interest
There are no conflicts of interest.

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REFERENCES

1. Fang CL. Theory and practice of physical fitness. Taipei: Science; 1997.
2. Esmaeilzadeh S, Kalantari H, Nakhostin-Roohi B. Cardiorespiratory fitness, activity level, health-related anthropometric variables, sedentary behaviour and socioeconomic status in a sample of Iranian 7-11 year old boys. Biol Sport 2013;30:67-71.
3. Gutin B, Yin Z, Humphries MC, Barbeau P. Relations of moderate and vigorous physical activity to fitness and fatness in adolescents. Am J Clin Nutr 2005;81:746-50.
4. Ruiz JR, Rizzo NS, Hurtig-Wennlöf A, Ortega FB, Wärnberg J, Sjöström M. Relations of total physical activity and intensity to fitness and fatness in children: The European Youth Heart Study. Am J Clin Nutr 2006;84:299-303.
5. Jiménez-Pavón D, Ortega FB, Ruiz JR, Chillón P, Castillo R, Artero EG, *et al.* Influence of socioeconomic factors on fitness and fatness in Spanish adolescents: The AVENA study. Int J Pediatr Obes 2010;5:467-73.
6. Pate RR, Ross JG. The national children and youth fitness study II: Factors associated with health related fitness. J Phys Educ Recreation Dance 1987;58:93-5.
7. Mota J, Flores L, Flores L, Ribeiro JC, Santos MP. Relationship of single measures of cardiorespiratory fitness and obesity in young schoolchildren. Am J Hum Biol 2006;18:335-41.
8. Bouchard C, Shephard RJ. Physical Activity, Fitness, and Health: The Model and Key Concepts Physical Activity, Fitness and Health, International Proceedings and Consensus Statement. Champaign, IL: Human Kinetics Publishers; 1994.
9. Telford RM, Telford RD, Cochrane T, Cunningham RB, Olive LS, Davey R. The influence of sport club participation on physical activity, fitness and body fat during childhood and adolescence: The LOOK Longitudinal Study. J Sci Med Sport 2015. pii: S1440-244000090-0.
10. Basterfield L, Reilly JK, Pearce MS, Parkinson KN, Adamson AJ, Reilly JJ, *et al.* Longitudinal associations between sports participation, body composition and physical activity from childhood to adolescence. J Sci Med Sport 2015;18:178-82.
11. Lamb DR. Physiology of Exercise: Responses and Adaptations. 2nd ed. New York: Macmillan; 1984.
12. Baquet G, Berthoin S, Dupont SG, Gerbeaux M, van Praagh E. Effects of high intensity intermittent training on peak VO_2 max in prepubertal children. Int J Sports Med 2002;23:439-44.
13. Faigenbaum AD, Loud RL, O'Connell J, Glover S, O'Connell J, Westcott WL.

Effects of different resistance training protocols on upper-body strength and endurance development in children. J Strength Cond Res 2001;15:459-65.
14. Diallo O, Dore E, Duche P, Van Praagh E. Effects of plyometric training followed by a reduced training programme on physical performance in prepubescent soccer players. J Sports Med Phys Fitness 2001;41:342-8.
15. Keiner M, Sander A, Wirth K, Schmidtbleicher D. The impact of 2 years of additional athletic training on the jump performance of young athletes. Sci Sports 2014;29:e39-46.
16. Crowther RG, Spinks WL, Leicht AS, Spinks CD. Kinematic responses to plyometric exercises conducted on compliant and noncompliant surfaces. J Strength Cond Res 2007;21:460-5.
17. Heitkamp HC, Horstmann T, Mayer F, Weller J, Dickhuth HH. Gain in strength and muscular balance after balance training. Int J Sports Med 2001;22:285-90.
18. Aragão FA, Karamanidis K, Vaz MA, Arampatzis A. Mini-trampoline exercise related to mechanisms of dynamic stability improves the ability to regain balance in elderly. J Electromyogr Kinesiol 2011;21:512-8.
19. Giagazoglou P, Kokaridas D, Sidiropoulou M, Patsiaouras A, Karra C, Neofotistou K. Effects of a trampoline exercise intervention on motor performance and balance ability of children with intellectual disabilities. Res Dev Disabil 2013;34:2701-7.
20. Lohmann TG, Roche AF, Martorell R. Anthropometric Standardization Reference Manual. Champaign, IL: Human Kinetics Books; 1988.
21. Thorland WG, Johnson GO, Fagot TG, Tharp GD, Hammer RW. Body composition and somatotype characteristics of junior Olympic athletes. Med Sci Sports Exerc 1981;13:332-8.
22. Mac Donncha C, Watson AS, McSweeney T, O'Donovan D. Reliability of Eurofit physical items for adolescent males with and without mental retardation. Adapt Phys Act Quart 1999;16:86-95.
23. Edin JB, Gerberich SG, Leon AS, McNally C, Serfass R, Shaw G, *et al.* Analysis of the training effects of minitrampoline rebounding on physical fitness, body composition, and blood lipids. J Cardiopulm Rehabil Prev 1990;10:401-8.