THE EFFECTS OF DIFFERENT GYMNASTICS TRAININGS ON BODY COMPOSITION AND SOME PERFORMANCE COMPONENTS IN ADULT MALE NON-GYMNASTS

Burak Gündoğan, Erkan Demirkan, Erbil Murat Aydın and Abdüsselam Turgut

Faculty of Sport Sciences, Hitit University, Çorum, Turkey

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Abstract

The aim of this study was to compare the effects of artistic and trampoline gymnastics training on body composition and some of the physical fitness components in adult non-gymnasts. Forty-eight adult non-gymnasts were randomly assigned to three groups: a trampoline gymnastics group (TG) (n = 16), an artistic gymnastics group (AG) (n = 16), and a control group (CG) (n = 16). Two of the group except the CG performed different gymnastics training, including artistic and trampoline gymnastics twice a week during 12 weeks. The control group performed only a warm-up exercise twice a week along the study. To determine the effects of each gymnastics training on body composition, Y dynamic balance test that including six postural tasks, vertical jump, standing long jump and two different flexibility tests, were performed before and after the study for all groups. The AG and TG were significantly ($p<0,05$) improved when it comes to all bio-motor abilities in adult non-gymnasts after 12 weeks of training. But the trampoline gymnastics exercises may be seen to be more efficient compared to the artistic gymnastics exercises. The trampoline exercises may be recommended as an alternative mode of exercise for improving bio-motor abilities.

Keywords: *gymnastics, balance, vertical jump, standing long jump, flexibility.*

INTRODUCTION

In daily life, while walking, stepping up the stairs, and in sports activities like in football, rugby, judo, and wrestling etc., the control of body posture is critical and necessary. All the activities associated with movements require both the control of posture and the control of a steady posture (Asseman, Caron, & Crémieux, 2008). Today it is believed that it is necessary to begin the training in early childhood to perform a high level of complex motor performance in many sports disciplines (Boraczyński, Boraczyński, Boraczyńska, & Michels, 2013). Strength, flexibility, and muscular endurance, combined with speed and coordination are required for the sport of gymnastics (Bencke et al., 2002; Jemni, Sands, Friemel, Stone, & Cooke, 2006). Artistic gymnastics training leads to develop the natural postural control in most gymnasts who start their training at an early age of 6-7 years (Kochanowicz, Boraczynska, & Boraczynski, 2009; Garcia, Barela, Viana, & Barela, 2011). The studies' result presents that modern artistic gymnasts need to have an essential greater

strength and power because of the ever-increasing technical difficulties (French et al., 2004). Trampoline is described by a dynamic movement pattern (Atilgan, 2013). Different types of jumps are performed on trampoline equipment. There are different sizes and shapes, and according to the elementary division it is distinguished as large, double mini and a mini trampoline (Atiković, Mujanović, Mehinović, Mujanović, & Bilalić, 2018). The lower extremities are used mostly in trampoline exercises and it particularly includes balance and movement control. The body position control is important at the time of jumps, and to use convenient balanced landing and jumping techniques in trampoline exercises (Atilgan, 2013).

There have been no published studies about the different gymnastics training effects with respect to characteristics of fitness in adult groups. The aim of this study was to compare the effects of artistic and trampoline gymnastics training on body composition and some selected components of physical fitness in adult non-gymnasts, who started an introductory level of gymnastics and after the completion of gymnastics training. It has been hypothesized that trampoline gymnastics training would affect the jumping and dynamic balance performance more than artistic gymnastics. However, artistic gymnastics would affect the flexibility more than trampoline gymnastics.

METHODS

48 healthy males who did not perform any sports activity regularly participated voluntarily in this study. Subjects who have any lower extremity injury past 3 months were excluded from this study. Before starting the study, all subjects were informed about it and signed an informed consent form. The study was approved by the Ethical Committee of Hitit University.

Subjects were randomly assigned to 3 groups as follows: Artistic Gymnastics Group (AG), Trampoline Gymnastics Group (TG) and Control Group (CG). All subjects participated in training twice a week through 12 weeks. Subjects in the CG performed only warm up and cool down activities. Subjects in the AG and TG performed gymnastics training which differs from the CG. The gymnastics exercises for the AG and TG are described below.

Warm up and cool down exercises. All subjects started every training session with 5 minutes of walking and jogging. After that, they performed gymnastics stretching exercises including upper and lower body extremities for 10 minutes. Subjects performed 5 minutes jogging for a cool down at the end of each training session.

Artistic gymnastics exercises. Subjects in the AG performed 30 minutes training programs which included forward-backward acrobatics and non-acrobatic exercises on the floor mat after the warm up protocol. International Gymnastics Federation (FIG) approved mat (Spieth/ Germany) was used as a floor. Subjects performed each move 8 times in one session. Artistic gymnastics exercises are described in Table 1.

Trampoline gymnastics exercises. Subjects in the TG performed 30 minutes training programs which included basic jumps, landing, rolling and twisting exercises on a mini trampoline to a mat after the warm up protocol. The International Gymnastics Federation (FIG) approved mini trampoline (Minitramp 125, Article ID: 60500, Eurotramp/Germany) was used as a mini trampoline. Subjects performed each move 8 times in one session. Trampoline gymnastics exercises are described in Table 2.

In this study subjects performed performance tests twice throughout 12 weeks. The first one was performed before starting the training program and the second one was performed by the end of the 12 weeks training program. Performance tests were carried out on 3 separate days. The subjects performed a familiarization session for all the performance tests before the

formal testing to eliminate the learning effect. First day: The subjects' body weight, height and body composition analysis were measured. Second day: The subjects' sit and reach and trunk flexibility tests were performed. Third day: balance, vertical and standing long jump tests were carried out. All performance tests were performed at the same time of the day (10:00-12:00 a.m.) by the same researcher. Subjects were instructed to avoid consuming caffeine or any other stimulant before the performance tests. 5 minutes of running and 2 minutes of walking were carried out by subjects before the performance tests.

Body composition. The subjects' body height was measured by using Seca 213 stadiometer. Body weight and body composition were measured by using the Tanita BC-418 body composition analyzer.

Flexibility tests. Sit and reach, trunk flexibility tests were used to obtain subjects' flexibility scores. Subjects performed two trials within 1-minute rest period between the trials for flexibility tests. The best score was recorded. The subject was asked to wait at least 2 seconds at the maximum reached distance. The trial was not considered successful if the subject: a) failed to maintain the contact with the target (e.g. kicking the target), b) failed to maintain position at least 2 seconds at maximum reached distance.

The subject lied down on a mat with a prone position and the researcher stabilized the subject from the hip. The subject was asked to raise slowly the chest and head to the maximum height with interlaced fingers behind the head. The maximum chin height from the mat was measured and recorded as trunk flexibility (Miller, 2006).

Dynamic balance test. Y balance test was used to obtain subjects' dynamic balance performance. The Y balance test tool consists of a footplate to which three pieces of cylindrical wooden are attached in the anterior, posteromedial, and posterolateral directions. There is a 135 degrees angle between the posterior parts and the anterior part. The angle between the posterior parts is 45 degrees. The subject pushes the target on the cylindrical wooden part along the all directions (Plisky et al., 2009).

All subjects performed the test without shoes. The subjects stood on one leg on the footplate so as not to cross the starting line. While standing with the single leg on the footplate, the subjects were asked to reach a maximum distance with the free limb along the anterior, posteromedial and posterolateral directions respectively. The trial was considered successful when the free limb was brought back to the starting line on the footplate. The trial was not considered successful if the subject: a) failed to maintain single leg stance on the platform, b) failed to maintain free limb contact with the target on the wooden part while it was in motion, c) used the target for stance support, d) failed to return the free limb to the starting position under control. The trial was repeated when the subject failed (Plisky et al., 2009). All subjects performed 3 successful trials for each direction. After 3 successful trials, the maximum distance reached by the subject was recorded as a centimeter. This procedure was repeated for both legs. The reached distance was normalized by the length of the limb. The normalized value was calculated by dividing the reached distance by the length of the limb and then multiplying by 100 to express as a percentage.

Lower limb length measurement. Lower limb length was measured while the subjects lied down with the supine position on a mat table. The subjects' limb length was measured in centimeters with a cloth tape measure. The measurement was performed from the anterior superior iliac spine to the most distal portion of the medial malleolus (Plisky, Rauh, Kaminski, & Underwood, 2006).

Vertical jump test. A tape measure was taped on the wall to obtain the subjects' vertical jump heights. The subject stood with the dominant side towards to wall. The

subject was asked to reach as high as possible and make a mark on the wall and then jump as high as possible and make another mark on the wall. The difference between reached and jumped marks wasmeasured and recorded as a vertical jump height. All subjects performed 3 trials. The best trial was recorded as a centimeter (Sargent, 1921).

Standing long jump test. A tape measure was taped to the floor. The subject stood with feet shoulder width apart and toes just behind the starting line. The subject jumped forward as far as possible with both feet by bending the knees and swinging the arms. Maximum distance from the starting line was recorded as a standing long jump score. 3 trials were performed by all subjects. The best trial was recorded as a centimeter (Adam, Klissouras, Ravazzolo, Renson, & Tuxworth, 1988).

The data were described by mean ± standard deviation (SD). The normal distribution and homogeneity of data were confirmed by the Shapiro-Wilk test and Levene's test respectively. Paired sample t-test was used to compare the difference between pre-test and post-test values of body composition, flexibility, vertical jump and standing long jump for all groups. One-way ANOVA test applied to compare the differences between pre-test and post-test values of groups. Tukey post-hoc test was used to determine the difference between groups. Wilcoxon signed rank test was used to compare the pre-test and post-test values of dynamic balance for all groups. Kruskal Wallis test was used to compare the differences between pre-test and post-test values of groups. IBM SPSS 25 package program was used for statistical analysis. For statistical analysis, the significance level was set up as $p \leq 0,05$.

Table 1
Artistic gymnastics training program.

Week	Exercises
1	Forward and backward roll
2	Forward and backward straddle roll
3	Straddle cartwheel with help
4	Straddle cartwheel
5	Handstand with help
6	Handstand and handstand walking
7	Backward block fall from handstand hoop on the springboard
8	Front handspring with help
9	Cartwheel with help
10	Cartwheel
11	Back handspring with help
12	Back handspring

Table 2
Trampoline gymnastics training program.

Week	Exercises
1	Running to mini trampoline on basic jump exercise on trampoline
2	Learning body position during jumping on mini trampoline
3	High jump from mini trampoline and landing on the floor
4	Jumping with straight body position from mini trampoline and landing
5	Jumping with tucked body position from mini trampoline and landing
6	Straddle jump from mini trampoline and landing
7	Jump with 180° twist from mini trampoline and landing
8	Jump with 360° twist from mini trampoline and landing
9	Jump to handstand from mini trampoline to high mat
10	Jump from mini trampoline to handstand and handstand forward roll on the mat
11	Dive roll from mini trampoline to the mat
12	Salto forward from mini trampoline to the mat

RESULTS

The subjects' body composition changes presented in Table 4. The AG and CG groups showed a significant increase in body weight, body mass index, the fat percentage from pre-test to post-test. No significant differences were found in fat-free masses for all groups from pre-test to post-test. There were significant differences between groups in body weight, body mass index, and fat percentage. Post hoc analysis showed that there were significant differences between the TG and CG in body weight and body mass index. Besides, there were significant differences between the training groups (AG, TG) and the CG in fat percentage.

The Y balance test results showed a significant increase in the balance performance for the AG and TG groups, in comparison to a significant decrease for the CG from pre-test to post-test (Table 5). Significant differences were founded between all groups, such as the TG showed a strong increase for Y balance test results.

Significant differences were observed for all groups from pre-test to post-test values for vertical jump, standing long jump, sit and reach, and trunk flexibility (Table 6). Significant differences between groups were observed for vertical jump and standing long jump results. Although strong significant differences were observed between the training groups (AG, TG) and control group, there were none between the AG and the TG groups in regard to sit and reach trunk flexibility results.

DISCUSSION

The present study is the first one to compare the effects of artistic and trampoline gymnastics training on body composition and selected components of physical fitness; including balance, vertical jump, standing long jump, and flexibility in adult non-gymnasts who started an introductory level of gymnastics. The first

main findings were that body weight (1,64% for the AG, 2,98 % for the CG), body mass index (1,55 % for the AG, 2,98 % for the CG), and especially fat percentage (the increasing: 8,85 % for the AG, 18,47 % for the CG) showed a significant increase from pre-test to post-test in the AG and CG groups during the 12-week training. However, in the TG group, fat percentage (13,42±4,73 – 13,51±4,66 % from pre-test to post-test) was not changed significantly during the trampoline training. Additionally, a marked increase did not occur in body weight (76,93±11,05 – 76,98± 12,05 kg from pre-test to post-test) in periods of the trampoline training (Table 4). Aalizadeh, Mohammadzadeh, Khazani, and Dadras (2016) reported that 20-week trampoline training decreased significantly body fat % in 11–14-year-old students and had positive effective results in anaerobic physical fitness. Witassek et al. (2018) reported that after an 8-week mini-trampoline training, body fat percentage was reduced to 5,4% in the study group. There are not enough studies (Aalizadeh et al., 2016; Witassek, Nitzsche, Schulz, 2018) made for the purpose of evaluating body composition changing. The results of study present that the trampoline training may be used to protect body weight and fat percentage without changing them. However, the studies may not be seen to enough for a clear conclusion; because of that, the effects on body composition should be examined separately in future training studies.

In the present study, the scores of the gymnastics groups have statistically increased significantly, according to the Y dynamic balance test, but comparing the scores between the groups, the most remarkable increasing (the range of increasing: 10,38 – 16,76 % in the TG; 5,16 – 8,35 % in the AG) in all direction occurred in the TG. In contrast to these results, in the CG Y balance scores were affected negatively (the range of decreasing: 2,03 – 3,19 % in the CG) (Table 5). The results of the Y balance indicate that trampoline gymnastics training seems to be of a more "increasing" status compared to the artistic gymnastics training. In an examination of the literature, Sadeghi and Baqlaei (2018) conducted a study including the superiority of the underwater trampoline training compared to traditional aquatic training. The study results indicated that the underwater trampoline exercise group improved 65 % on the static balance variable, while the aquatic exercise group improved by 20%. Kidgell, Horvath, Jackson, and Seymour (2007) reported that trampoline exercises were practiced in the standing position, which led to more muscle involvement in the body and develops the balance. Aragão, Karamanidis, Vaz, and Arampatzis (2011) studied the effects of mini-trampoline exercise for dynamic stability on the ability of elderly participants, who regained balance improvement of about 35%. Besides, the subjects who took part in the exercise group showed an improvement in muscle strength of the triceps surae muscles by about 10% after the intervention. Witassek et al. (2018) reported that after the mini trampoline training, the subjects' jumping height performance increased by 7,7 %, and the control group increased by 4,4 %, but not found statistically significant differences between pre and post-test. Atilgan (2013) found that 12 weeks of trampoline training had positive effects on the jump, leg strength, static and dynamic balance of boys who don't do any exercises regularly. de Oliveira, da Silva, Dascal, and Teixeira (2014) reported that 12 weeks of mini-trampoline, floor, and aquatic gymnastics training improved the postural balance of elderly women. Boraczyński et al. (2013) evaluated the effects of a 12 month artistic gymnastics training program on body composition and physical fitness on girls aged 7 years. The participants' static balance test results significantly improved by 36,77 % between the pre and post-test. The results of these studies approve that trampoline training had positive effects on dynamic balance. The findings of the study

are in agreement with the previous studies (Boraczyński et al., 2013; Atilgan, 2013; Witassek et al., 2018; Sadeghi & Baqlaei, 2018; Kidgell et al., 2007; Aragão et al., 2011; de Oliveira et al., 2014; Karakollukçu, Aslan, Paoli, Bianco, & Sahin, 2015). As a consequence, taking into account the study and literature's findings, we may suggest that for improving balance, the training programs could include more trampoline exercises to provide more improvement in balance ability.

Table 3
The characteristic of features of groups.

Variables	AG Mean ± SD	TG Mean ± SD	CG Mean ± SD
Age	20,44± 2,03	21,81± 1,68	20,88± 1,67
Height (cm)	173,51± 6,74	177,76± 7,86	172,88± 6,04
Weight (kg)	67,68 ± 5,24	76,93± 11,05	72,16± 7,34
BMI (kg/m^2)	22,53± 1,96	24,32± 2,90	24,16± 2,37
Fat (%)	10,39± 2,91	13,42± 4,73	14,73± 2,54

Table 4
Results of body compositions.

Variables	Groups	Pre-Test Mean ±SD	Post –Test Mean±SD	Δ%	p
Weight (kg)	AG	67,68± 5,24	68,79± 5,30	1,64	0,016
	TG	76,93± 11,05	76,98± 12,05	0,06	0,927
	CG	72,16± 7,34	74,31± 7,47	2,98	0,000
Body Mass Index	AG	22,53±1,96	22,88±1,78	1,55	0,019
	TG	24,32± 2,90	24,28±2,81	-0,16	0,849
	CG	24,16±2,37	24,88±2,40	2,98	0,000
Fat %	AG	10,39± 2,91	11,31± 3,07	8,85	0,007
	TG	13,42±4,73	13,51±4,66	0,67	0,805
	CG	14,73± 2,54	17,45±2,33	18,47	0,000
FFM (kg)	AG	60,56±3,71	60,92±3,79	0,59	0,145
	TG	66,35±8,41	66,26±8,78	-0,14	0,652
	CG	61,42±5,38	61,24±5,23	-0,29	0,224

Note: Δ%: Percent change between pre-test and post-test, AG: Artistic gymnastics group, TG: Trampoline gymnastics group, CG: Control group.
$p \leq 0,05$

Table 5
Results of the dynamic balance test.

	Groups	Pre-Test		Post-Test		Δ%	p
		Mean±SD	Median	Mean±SD	Median		
Y Balance Right Anterior	AG	66,76 ± 4,35	66,50	72,02 ± 5,19	73,33	7,88	0,000
	TG	66,04 ± 3,56	66,35	77,11 ± 2,56	76,90	16,76	0,000
	CG	68,39 ± 2,81	68,73	66,59 ± 3,29	67,15	-2,63	0,000
Y Balance Right Posteromedial	AG	98,82 ± 6,40	99,97	106,19± 4,23	106,24	7,46	0,000
	TG	99,43 ± 5,19	100,48	110,35 ± 4,35	110,50	10,98	0,000
	CG	99,32 ± 5,42	100,82	97,30 ± 6,22	98,57	-2,03	0,001
Y Balance Right Posterolateral	AG	97,72 ± 5,75	97,56	104,60 ± 5,15	103,13	7,04	0,000
	TG	96,07 ± 5,65	95,95	107,62 ± 4,32	108,29	12,02	0,000
	CG	97,09 ± 4,95	98,96	94,86 ± 4,83	96,94	-2,30	0,000
Y Balance Left Anterior	AG	66,12 ± 4,72	65,23	71,64 ± 5,45	73,64	8,35	0,000
	TG	66,00 ± 3,97	65,23	75,46 ± 3,40	75,12	14,33	0,000
	CG	66,52 ± 3,74	65,93	64,40 ± 3,95	64,40	-3,19	0,000
Y Balance Left Posteromedial	AG	101,13 ± 6,53	100,71	106,35 ± 4,64	106,93	5,16	0,000
	TG	97,24 ± 5,58	97,10	107,33 ± 4,92	107,12	10,38	0,000
	CG	97,91 ± 5,21	99,15	95,19 ± 5,85	96,17	-2,78	0,000
Y Balance Left Posterolateral	AG	98,60 ± 7,11	97,98	105,75 ± 4,84	106,24	7,25	0,000
	TG	96,58 ± 5,24	97,08	106,82 ± 3,61	107,11	10,60	0,000
	CG	95,99 ± 5,58	97,93	93,43 ± 6,22	96,04	-2,67	0,000

Note:Δ%: Percent change between pre-test and post-test, AG: Artistic gymnastics group, TG: Trampoline gymnastics group, CG: Control group.
$p \leq 0,05$

Table 6
Results of some selected physical fitness parameters.

	Groups	Pre-Test	Post-Test	Δ%	p
Vertical Jump	AG	48,31±3,40	48,69±3,53	0,79	0,009
	TG	42,38±3,32	44,00±3,16	3,82	0,000
	CG	43,88±4,91	42,81±4,71	-2,44	0,000
Standing Long Jump	AG	229,44±8,82	233,19±8,97	1,63	0,000
	TG	211,56±12,89	221,63±11,90	4,76	0,000
	CG	215,31±13,17	209,44±12,53	-2,73	0,000
Sit and Reach	AG	28,44±4,34	31,88±3,61	12,10	0,000
	TG	27,75±4,42	32,25±3,40	16,22	0,000
	CG	26,75±4,14	23,06±3,89	-13,79	0,000
Trunk Flexibility	AG	41,94±3,77	48,94±5,72	16,69	0,000
	TG	42,31±5,68	49,75±5,85	17,58	0,000
	CG	40,19±4,90	35,00±4,98	-12,91	0,000

Note: Δ%: Percent change between pre-test and post-test, AG: Artistic gymnastics group, TG: Trampoline gymnastics group, CG: Control group.
$p \leq 0,05$

In addition, as the balance level increases via gymnastics training, some of the physical fitness components, including vertical jump, standing long jump, flexibility (sit and reach, trunk), are also affected positively via gymnastics training, and that is an another important result of the present study. When comparing the pre and post-test scores in all vertical jump, standing long jump, flexibility, etc., the most noticeable increase was seen in the trampoline training group (Δ%: 3,82 %, 4,76 %, 16,22 %, 17,58 % respectively) (Table 6). In review of literature studies, a gymnastics training was performed during a six-month training three times a week on children (Obreshkov & Simeonova, 2012). As a result, they reported that the ability to jump, flexibility and speed improved considerably in comparison to the tests during the pre and post-test. Karakollukçu et al. (2015) implemented a study for male gymnasts. They reported that 12 weeks of trampoline exercise significantly improved the subjects' standing long jump, vertical jump, 20-meter sprint speed, and anaerobic power. Boraczyński et al. (2013) reported that a 12-month artistic gymnastics training program led to improve the participants' flexibility (sit and reach) results by 43,55 %. Giagazoglou et al. (2013) evaluated the effects of 12 weeks of trampoline training intervention program on some performance parameters in the participants with intellectual disability. The study indicated that trampoline intervention led to significant improvements of participants' flexibility (pre: -13,11±7,27, post: -7,00 ±6,52), long jump (pre: 73,33±30,84, post: 103,44±32,94) vertical jump (pre: 12,89±6,25, post: 19,11±6,45) and balance test performance. Koca, Baykara, Demirel, and Berk (2019) found out that the 15-minutes exercise program on the mini-trampoline was more effective as a heating technique and had more positive effect on

muscle elasticity than the 15-minutes walking exercise. As a conclusion, these findings are a contribution to further scientific research in order to reach more accurately clear findings.

CONCLUSIONS

Both the TG and the AG groups' exercises are effective for improving dynamic balance, vertical jump, standing long jump, and flexibility in non-gymnast after 12 weeks of training. But the trampoline exercises are seen to be more efficient on dynamic balance (all directions), jumping performance (vertical and standing long) and flexibility (sit and reach – trunk flexibility). The trampoline exercises may be recommended as an alternative mode of exercise for improving balance and bio-motor abilities, in particular the sports branches that require jumping performance, which may have an extra importance for better results. With respect to the results, the trampoline practices that include both fun and improving performance, may be suggested as a diversity for the training programs.

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Corresponding author:

Erbil Murat Aydın
Hitit University
Faculty of Sport Sciences, Hitit University, 19030, Çorum, Turkey
Email: emurataydin@hitit.edu.tr
Tel and fax num: +903642193700

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