THE EFFECT OF PHYSICAL BOYS' BODY COMPOSITION CHANGES ON PHYSICAL EDUCATION CLASS

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ABSTRACT

The purpose of this study is to verify the effectiveness of 120 minutes of physical fitness classes once a week for adult male students in their 20s who majored in physical education, and to determine what changes in body composition and basic metabolic variables when complex exercise programs such as circuit, weight training, and plyometric training are applied to classes. The height of human body was higher after (mean = 177.4±3.83) than before (M=177.7±3.76), and there was a statistically significant difference (t=-3.54, p<.001). Weight was lower after the program (M = 77.99±5.86) than before the program (M = 77.82±6.21), and there was no statistically significant difference (t=-0.35, p>.05). The skeletal muscle mass (SMM) was higher after the program (M = 38.31±2.51) than before (M=37.26±2.51), and there was a statistically significant difference (t=-4.98, p<.001). Circuit training is very time efficient helping to develop strength and stamina in a physical education class.

Keywords: Circuit training, plyometric training, physical education class, weight training.

INTRODUCTION

Training has been explained as aprogramme of exercise designed to improve the skills andincrease the energy capacities of an athlete for a particularevent (Shelvam & Sekhon, 2014). The circuit training exercises is one of classic circuit training routines and the one that develops short-term muscular endurance. This type of strength endurance is important in many prolonged sports with intermittent bouts of activity (Cooper et al., 2018). Even simple circuit training programs could be helped by athletes who play multi-sprint sports (Haugen et al., 2019).

The circuit training is more easily understood by examining its components, or parts. As students have learned in earlier grades, there are two categories of the circuit training components: physical-related training components and skill-related training components. This program can be helpful when students become physical education leaders as well as themselves. In addition, association between physical activity and mental health in young people is evident, but research designs are often weak and effects are small to moderate (Biddle & Asare, 2011).

Circuit training has many educational advantages such as availing mutual respect opportunity among the individuals and respecting those with humble abilities and capabilities equally at the same level of respect to those of higher abilities (Reddy & Jyoti, 2012).

Although resistance circuit-based training has been shown to be an effective method to improve strength and endurance concurrently in the same session (Muñoz-Martínez et al., 2017), circuit training programs might be also designed scientifically and specifically for individual athletes.

Physiologists and trainers measure precise periods of activity that match the athlete's sport and current level of fitness.

Many physical activity programs are designed with an emphasis on sport skill in the expectation that non-sport related values are transferred (Gould & Carson, 2008). Others emphasize fundamental life skills as a priority over sport skill development (Brunelle, Danish, & Forneris, 2007).

Physical education is the foundation of a Comprehensive School Physical Activity Program and an educational process to develop specific knowledge, skills, and understanding that promote physical competence (Centers for Disease Control and Prevention, 2011). It aims to develop students' physical competence and knowledge of movement and safety, and their ability to use these to perform in a wide range of activities associated with the development of an active and healthy lifestyle. Quality physical education programs are needed to increase the physical competence, health-related fitness, self-responsibility and enjoyment of physical activity for all students so that they can be physically active for a lifetime. Physical education programs can only provide these benefits if they are well-planned and well-implemented. A youth program could improve participants' sprint speed, fitness levels, and self-concept (Baghurst et al., 2015).

We hypothesized that a circuit-based workout would yield positive effects of physical-related training components such as skeletal muscle mass compared to the non-athletic (circuit-based excise) student.

METHODOLOGY

Subjects

In this study, 39 people who participated in a 12-week physical education class in the second semester of 2022 were selected as the population for second graders in the Department of Physical Education at D University in Busan Metropolitan City, the Repbulic of Korea. Convenience sampling was used as the study subjects. They targeted students who actively participated in two hours and a total of 120 minutes of classes once a week as students without medical special diseases. Of these, 28 people participated in the preliminary in-body measurement but did not participate in the in-body measurement after class, except for 11 people who used the final data analysis.

Limitations of the study

The subjects of this study were limited to adult men enrolled in the physical education department of the university, and there was no control over physical activity outside of class time among the test participants. And the nutritional, psychological, and genetic factors of the participants in the experiment were not taken into account.

Research Design and Circuit Training

In this study, 39 college students were subjected to 12 weeks of circuit and weight training and plyometric training, and pre- and post-mortem tests were conducted to find out the correlation between changes in body composition and variables in physical education classes (Table 1).
Circuit training precautions are as follows. After selecting other athletic events, it is performed for 1 minute per event. There are no breaks between events, and at the end of the first set, there is a two-minute break. The detailed program consists of 6 rotational exercises with a total of 4 sets. The order of exercise is 1(start)→2→3→4→5→6 (finish). Bare-body (September: 4

weeks), kettlebell (October: 4 weeks), step box (November: 4 weeks), and weight equipment circuit training programs are conducted weekly.

The plyometric program consists of the following (Table 2): push up, plank, jumping squats, side step, leg raise, and mountain climber. The kettlebell program consisted of the following: overhead Kettlebell (shoulder), Kettlebell Dead lift (erector spinal muscle), Kettlebell swings (predecessor), Kettlebell squats (legs), Kettlebell windmill (the waist beside the body), Kettlebell Upright row (mitral muscle).
The step box program consists of the following: Side Step Squat, going up and down stairs, 3-beat side step, Knee-up, a jump step, Twist the hips

Table 1. 12 week training program content for boy students

No.	Month (period: weeks)		
	September (4 weeks)	October (4 weeks)	November (4 weeks)
1	Power clear	Power clear	Running machine
2	Bench press	Cable crossover	Lying dumbbell press
3	Seated machine press	Side lateral raise	Barbell push press
4	High lat pull-down	Seated row	Hyper extension
5	Lying triceps extension	Barbell curl	Wrist roller
6	Squat	Leg extension	Barbell dead lift

Precautions: Machine weight is 4 levels. Running machine speed is 12 km. Dumbbell weighs (7 kg). Barbell disc weighs (5 kg).

Table 2. 12-week circuit training program guide

Athletic section	Time (min.)	Program	Note
Warm-up exercise	5	1) A light jog 2) Streching	Slowly raise your body temperature and heart rate, stretching muscles, tendons, ligaments, etc
Main exercise	40	1) Plyometric Program 2) Kettlebell program 3) Stepbox Program	4 weeks each: 1) → 2) → 3)
	10	Rest	Go to weight training room from the indoor gym
	40	Equipment set training	Weight training room
Organizing exercise	5	Static stretching	

Statistical analyses

All data from this study were calculated using the Window SPSS 18.0 statistical program to calculate the mean and standard deviation through descriptive statistical analysis of the population. To test the effect of exercise by year, repeated measures ANOVA was performed, and the independent t-test method was used to compare the differences between the groups before and after the experiment. Alternatively, if there was an interaction between the group

and the test, the difference between the pre- and post-test within the group was matched t-test as a post-test. The statistical significance level of the results was set to p<.05.

RESULTS

We examined 28 participants at the Busan in Republic of Korea. Their In-Body measurement results before circuit training and after circuit training are shown in Table 3 and Table 4, respectively. Table 5 shows the results of the paired sample t-verification to find out the pre- and post effects of the circuit training program conducted for 12 weeks. The height of human body was higher after (mean, M = 177.4±3.83) than before (M = 177.7±3.76), and there was a statistically significant difference (t = -3.54, p<.001). Weight was lower after the program (M = 77.99±5.86) than before the program (M = 77.82±6.21), and there was no statistically significant difference (t=-0.35, p>.05). The skeletal muscle mass (SMM) was higher after the program (M = 38.31±2.51) than before (M = 37.26±2.51), and there was a statistically significant difference (t = -4.98, p<.001). The amount of body fat (BFM) was higher after the program (M = 11.72±3.30) than before (M = 12.79±4.57), and there was statistically significant difference (p<.001). BMI showed lower post-the program (M = 24.67±1.85) than before (M = 24.71±2.06), and there was no statistically significant difference (p>.05). The percentage of body fat (PBF) was lower after (M = 14.76±3.41) than before (M = 16.28±3.57), and there was a statistically significant difference (p<.001). The basal metabolic rate (BMR) was higher after (M = 1807.0±81.91) than before (M = 1773.04±88.18), and there was a statistically significant difference (p<.001).

Table 3. In-Body measurement results before circuit training

No.	H (㎝)	Weight (㎏)	SMM (㎏)	BFM (㎏)	BMI (㎏/㎡)	PBF	BMR (㎉)
1	176.4	72.3	37.3	7.5	23.2	10.4	1769
2	174.5	74.3	34.8	12.6	24.4	17.0	1702
3	180.4	86.0	41.2	14.3	26.4	16.7	1918
4	178.1	75.3	35.4	13.6	23.7	18.1	1702
5	176.7	81.8	36.3	18.1	26.2	22.1	1746
6	179.0	73.3	36.4	9.2	22.9	12.5	1755
7	171.0	75.9	36.7	12.0	26.0	15.9	1750
8	185.1	79.4	39.3	10.8	23.2	13.6	1851
9	174.4	70.1	32.9	12.2	23.0	17.4	1620
10	179.4	77.5	38.3	10.7	24.1	13.8	1813
11	179.3	75.1	36.4	11.2	23.4	14.9	1751
12	178.0	74.3	35.0	12.5	23.4	16.8	1704
13	181.0	83.1	39.4	15.2	25.2	18.4	1835
14	175.0	74.5	39.0	7.6	24.5	10.2	1768
15	177.7	84.9	39.4	16.6	26.9	19.6	1845

16	184.0	85.9	41.9	12.9	25.4	14.9	1948
17	181.9	71.3	34.4	11.0	21.5	15.5	1671
18	172.8	70.0	34.1	10.2	23.0	14.6	1661
19	168.2	82.4	36.0	19.8	29.1	24.0	1722
20	178.7	92.1	42.1	19.5	28.8	21.1	1945
21	178.6	82.6	38.5	15.6	25.9	19.0	1816
22	176.3	73,5	38.5	7.1	23.6	9.6	1805
23	174.0	71.7	34.9	10.1	23.7	14.1	1700
24	177.1	74.3	35.7	12.6	23.7	17.0	1703
25	174.6	70.7	34.4	10.1	23.2	14.3	1678
26	179.1	83.7	40.2	13.5	26.1	16.1	1887
27	183.0	73.9	35.5	11.5	22.1	15.6	1718
28	174.1	89.1	39.4	20.0	29.3	22.5	1862

SMM: skeletal muscle mass, BFM: body fat mass, BMI: Body mass index, PBF: percentage of body fat, BMR: basal metabolic rate.

Table 4. In-Body measurement results after circuit training

No.	H (㎝)	Weight (㎏)	SMM (㎏)	BFM (㎏)	BMI (㎏/㎡)	PBF	BMR (㎉)
1	176.5	74.3	38.6	7.5	23.9	10.1	1812
2	174.6	76.5	36.6	12.5	25.1	16.3	1751
3	180.0	87.7	43.6	12.5	27.1	14.3	1993
4	178.8	78.5	38.7	11.5	24.6	14.7	1816
5	177.2	85.7	39.0	17.9	27.3	20.9	1833
6	179.7	72.4	37.7	6.5	22.4	9.0	1793
7	171.5	73.3	36.8	9.8	24.9	13.4	1741
8	185.9	78.2	39.3	10.1	22.6	13.0	1840
9	175.0	72.7	34.2	12.9	23.7	17.7	1661
10	179.4	83.1	41.1	11.8	25.8	14.2	1909
11	179.2	78.0	37.3	12.8	24.3	16.4	1778
12	178.7	75.8	36.5	11.7	23.7	15.4	1754
13	181.7	82.3	39.4	13.9	25.1	17.0	1847
14	174.8	71.1	37.3	6.4	23.3	9.0	1823
15	178.0	84.8	38.9	16.9	26.8	19.0	1837
16	184.2	85.2	42.3	12.1	24.1	13.9	1951

17	181.0	70.4	35.2	11.5	21.4	15.2	1689
18	172.1	71.2	34.7	10.7	24.0	14.1	1673
19	169.1	80.2	38.5	14.0	28.0	17.5	1799
20	178.2	90.1	43.7	18.2	28.4	19.6	1952
21	179.6	79.9	39.2	12.0	24.8	15.0	1836
22	176.2	72.9	39.3	6.8	23.5	8.5	1834
23	175.6	71.0	36.6	6.9	23.0	9.6	1755
24	177.4	73.1	36.3	11.2	23.2	16.7	1711
25	174.9	70.7	36.5	7.4	23.1	10.5	1737
26	178.9	83.0	39.4	14.0	25.9	16.9	1860
27	183	76.9	36.6	12.5	23.0	16.3	1761
28	174.5	84.6	39.5	16.1	27.8	19.0	1850

SMM, PBF, and BBMR were shown in Table 3.

Table 5. Pair sample *t*-verification for body composition and basal metabolic rate

Variable	Training	Mean	SD	*t*	*p*
H (㎝)	Before	177.4	3.8	-3.544	<0.01
	After	177.7	3.8		
Weight (㎏)	Before	77.8	6.2	-0.345	>0.05
	After	78.0	5.9		
SMM (㎏)	Before	37.3	2.5	-4.981	<0.001
	After	38.3	2.4		
BFM (㎏)	Before	12.8	3.6	4.289	<0.001
	After	11.7	3.3		
BMI (㎏/㎡)	Before	24.7	2.1	0.238	>0.05
	After	24.7	1.8		
PBF	Before	16.3	3.6	5.501	<0.001
	After	14.8	3.4		
BMR (㎉)	Before	1773.0	88.2	-4.313	<0.001
	After	1807.0	81.9		

The critical values of t (0.05, 2, 27) = 2.052, t (0.01, 2, 27) = 2.771, t (0.001, 2, 27) = 3.690. SMM, PBF, and BBMR were shown in Table 3.

DISCUSSION

The circuit training exercises below require only basic, inexpensive equipment – a set of

relatively light dumbbells, skipping rope and an exercise mat for example. Circuit training is a workout that typically includes 8-10 different exercises, usually referred to as stations (Kraviz, 1996). Each of the circuit training exercises has been grouped into one of four categories: total body, upper body, lower body, and core region. In the case of total body exercise, a lot of activity is given such as squat jumps, burpees, skipping, dumbbell squat and swings, tuck jumps, treadmills, high knees, fast feet on box, jumping jacks, alternating split squat, squat to presses, ricochets, and cardio equipment. In the case of upper body exercise, push-ups, wide push-ups, diamond push-ups, plyometric push-ups, and bench dips activities are given.

Ferraz et al (2020) analyzed the effect of a training circuit, applied for 3 weeks, during the warm-up phase of practical physical education classes, and to verify the resulting effects on the analyzed variables. Twenty-five students participated in their study (mean ± age = 15.67 ± 1.02), weight (67.31 ± 9.29 kg), height (1.72 ± 0.08 m). Duncan et al. (2009) reported the effect of 6-week circuit-based training on body esteem and body mass index (BMI) in 68 British children (34 boys and 34 girls, aged 10–11 years, 16% overweight, 7% obese). Similarly, the investigation by Sacchetti et al. (2013) concluded that a two years intervention with two more classes of 50 minutes per week improved the test (running test and long jump) in the experimental group, but without significant differences for BMI, therefore this study is also in line with ours.

The shuttle test variable was the only one that showed significant differences after the application of a training circuit in the school context, manifesting changes between the pre-and the post-test, which contradicts previous studies (McKenzie, 2019; Loureiro et al., 2020; Xiao et al., 2021). In this regard, Almeida (2012) also found improvements in the performance of the shuttle test, concluding that circuit training could be an effective way to develop resilience in school physical programs. The action scheme such as the application of training circuits is enhanced and developed using repeated action, which occurs in all sports movements and gives muscular strength and muscular endurance capacity as well as a reduction in the risk of occurrences of injuries during the practice of physical and recreational activities. The health benefits of physical activity and exercise are clear; virtually everyone can benefit from becoming more physically active (Warburton & Bredin, 2017).

In conclusion, circuit training in physical class were a relatively important component of total weekly activity for both male students in Busan City. This investigation also presents a different proposal for the initial part of the physical education class that could be more motivating for the students.

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