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RESEARCH ON THE EFFECT OF 8 WEEKS HIGH INTENSITY COMBINED CIRCUIT TRAINING PROGRAM ON CARDIOVASCULAR, RESPIRATORY SYSTEM AND BODY FAT RATIOS

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Abstract:
The purpose of this study is to investigate the effects of the 8-week high intensity circuit training method on circulation and respiratory system and body fat ratios, which is applied to university students and students with similar sports backgrounds. The participants of the study were at least 5 years of sports age (N = 60) who are educated in Istanbul University of Development and Physical Education and Sports (n = 30) volunteers who were randomly sampled by non-random sampling methods. Body Composition Measurements were analyzed by measuring the body fat ratios and body mass index in the Istanbul University of Development physical education and sports high school performance measurement laboratory and blood pressure was determined by the detection of diastolic and systolic blood pressure. Respiratory parameter measures were determined by cardiopulmonary respiratory function test at Chest Diseases Department of Istanbul University Cerrahpasa Medical Faculty. All measurements were performed before and after the 8-week program. As a result, pre- and post-training diastolic blood pressure results of participants were significantly different between forced vital capacity and forced vital capacity values of 1 second (p> 0,05), A significant difference was found in systolic blood pressure results before and after training (P> 0, 00). There was a significant difference (P> 0.00) between the body mass index results and the weight and fat ratios of participants before and after training. Combined resistance training in combined with high severity contributes to the use of fats as an energy source during exercise and to the weight loss process.

Key words: circuit training, cardiovascular system, cardiopulmonary system, body fat

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1. Introduction

Exercise methods that are specific to all body systems should be considered as a whole for both physical and physiological fitness during fitness training models are designed, Training methods should be selected in accordance with the physiological bases of the exercise and integrated according to the program.

The most important organ in cardiovascular system is the heart. The first activities transpire in the heart as a response to the effect in the exercises. The most common effect of exercise on the cardiovascular system is to increase the oxygen capacity of the organism, thereby preventing the need for heart oxygen (Rasim Kale, 2002).

The number of resting heart rate is lower in the athletes. The increase in heart rate is seen bigger for the individuals who do not exercise compared with individuals who exercise regularly than that of sportsmen. Athletes reach their maximum heart rate later. Therefore, max O_2 consumption is higher for Athletes (Mehmet Günay, 1998).

Heart pressure in the exercise change based on stroke volume and heart outflow. As the resistance to blood vessels decreases due to increased blood flow, blood pressure increases according to the severity of the exercise, the duration and the condition of the athlete. The increase in the systolic blood pressure is greater than the diastolic blood pressure. During endurance training, improvement in blood distribution of the vascular system occurs at the time of loading. The severity of loading enhances the effectiveness of vigorous circulatory system and indication of physical fitness. The expansion of the vessel diameters leads to a drop in blood pressure at each loading step (Sedat M., Hakan Y., 1997).

The respiratory system, which is regarded as the basic indicator of human aerobic capacity, is the basic element of our life. (Faruk Yamaner, 2001) Respiratory system is one of the important pillars that determine the work and performance capacity in our daily life. The efficiency of the respiratory system increases the effectiveness of the person (Necmettin Erkal, 2000).

Respiration is gas exchange between the outside world and the living. Respiration is a process taking O_2 into the respiratory lungs and the release of CO_2 from the lungs. The respiratory system is a regulated system that will create gas exchange between blood and atmosphere air (Figen Çiloğlu ve diğerleri, 1993).

With the regular training noticeable increase breathing volume is seen for the Athletes in the maximal exercise. Depending on this increase, respiratory frequency and respiratory minute volume also increase (Mehmet G., Mansur O., 1999). As a result of training, the maximal minute respiration, tidal volume, breathing frequency, ventilation efficiency, vital capacity, diffusion capacity are increased (Foss F, Bowers, 1998).

The changes and developments that take place in the field of science and technology in the direction of the needs of the century are providing some benefits as well as causing the emergence of negative situation. Many of health problems that might emerge as result of inadequate physical activity can put forward as an example of this. The limited time required for adequate physical movement has brought some requirements in the exercise practice models. The highly intense circuit training technique, one of today's popular fitness exercise methods are designed in accordance with needs of individuals in a short of time offer to do exercise safely, without need of private place and special equipment and tools.

Elements of circuit-style training programs were present early on in history. The modern form of circuit training was developed by R. E. Morgan and G. T. Anderson in 1953 at the University of Leeds in England. It was initially examined as a 9 to 12 exercise protocol where participants performed exercises at a moderate intensity (about 40% to 60% of 1 RM values) for a specified number of repetitions or amount of time. Once the repetitions were performed or time expired, the participant would move to the next exercise station with very little rest. Improvements in muscle strength and endurance were observed, as well as components of aerobic fitness (Kravitz L., 1996).

HICT may be an extremely effective and efficient means by which to increase an individual's VO_2max, a well-established marker of cardiopulmonary health. When HICT protocols have been compared with traditional steady state protocols in the laboratory, HICT elicits similar and sometimes greater gains in VO2max, despite significantly lower exercise volume (Gibala M. J. , Little J. P., Essen M. V., et al, 2006) (Little J. P., Safdar A., Wilkin G. P., Ranopolsky M. A., Gibala M. J., 2010).

HICT can be a fast and efficient way to lose excess body weight and body fat (Gibala M. J., Little J. P., Essen M. V., et al, 2006) (Murphy E., Schwarzkopf R., 1992) (Trapp E. G., Chisholm D. J., Fruend J., Bouthcher S. H., 2008) (Wernbom M., Augustsson J., Thomee R., 2007).

The incorporated resistance training contributes significantly to the amount of fat burned during a workout (Scott C. B., Leighton B. H., Ahearn K. J., McManus J. J., 2011). When resistance training exercises using multiple large muscles are used with very little rest between sets, they can elicit aerobic and metabolic benefits (Murphy E., Schwarzkopf R., 1992) (Elliot D. L., Goldberg L., Kuehl K. S., 1992) (Haltom R., Kraemer R. R., Sloan R. A., Frank K., Tryniecki J.L., 1999).

This is thought to be from the increased level of catecholamines and growth hormone found in the blood both during and after high-intensity resistance training exercise with shortened rest periods (<30 seconds) (Moller N., Schmitz O., Porksen N., Moller J., Jorgenson J. O., 1992) (Murphy E., Schwarzkopf R., 1992). Research has found that these metabolic benefits can be present for up to 72 hours after a high-intensity exercise bout has been completed (Heden L., Lox C., Rose P., Reid S., Kirk E. P., 2011).

The purpose of this study is to investigate the effects of the 8-week high intensity circuit training method on circulation and respiratory system and body fat ratios, which is applied to university students and students with similar sports backgrounds.

2. Material and methods

Information form (age, height, weight, sports history) was applied as data collection tool. All information were given to participants before related tests applied. Participants' height, body weight were measured and body mass indexes were calculated by formula. Subcutaneous fat ratios with the skinfold caliper were determined and the results were recorded by mm measurement base. Diastolic and systolic blood pressure was determined by using a digital blood pressure monitor and the results were recorded by minutes / ml measurements base.

Cardiopulmonary respiratory function test was carried out by İstanbul University Cerrahpaşa Medical, The Department of Chest Diseases with the specialist spirometer. During the respiratory function test, after attaching nose catch to the nose of the participants a suitable disposable mouthpiece was placed between the lips and tightly secured. After 4-5 normal tidal breaths, breathe as deep and strong as possible and to breathe unexpectedly quickly and strongly, allowing the participant to continue breathing for at least 6 seconds with difficulty. After sufficient breathing, deep breathing was allowed again, the test was terminated, and the test which had the highest values was chosen among at least three successive tests.

3. Statistical Analysis

The averages and standard deviations of the variables measured before and after exercise were calculated for all the participants. Differences between the pre- and post-exercise variables were analyzed. In our study, measurement findings were evaluated in SPSS 10.0 for Windows package program. The descriptive statistics (mean and standard deviation) of the data were calculated. The comparison of two measured results obtained at different times and evaluated by using the "-t" test. With regard to noticeability, 0.05 and 0.01 was taken for noticeability crucial level.

3.1 Training Programme

A combined 10-station high-intensity circular training program was applied. All movements were carried out in combination with the fitness of the participants in terms of sports history, both with body weight and with auxiliary fitness equipment. The movements that are activating all muscle groups were determined to develop different skills according to the parts of the body.

After each movement applied for 30 seconds, a resting time of 15 seconds was given for the change between movements. Each set was given a resting time of 45 seconds. The training program was applied as 3 sets.

1. Jumping squat
2. Triceps bench dips
3. Lunge
4. Bosu crunch

5. Burpee with bosu
6. Dumbell biceps curl
7. Parallel deep squat
8. Side plank
9. Pelvic tilt
10. High knees running in place x 3

4. Findings

Table 1: Demographic characteristics of the participants

	N	Min	Max	X± Sd
Weight1	30	46,70	105,00	75,86±12,04
Weight2	30	45,00	100,00	74,07±12,01
Body Fat1	30	6,40	22,50	13,43±4,86
Body Fat2	30	2,67	18,00	10,46±4,14
Body Mass Index1	30	18,40	30,40	24,26±2,85
Body Mass Index1	30	18,00	29,40	23,74±2,91

As the Table 1 examined average of the participants' pre-training weight ratios 75,86±12,04, body fat ratios 13,43±4,86, body mass index ratio 24,26±2,85, post training. weight ratios 74,07±12,01, body fat ratios 10,46±4,14, body mass index ratio 23,74±2,91 were determined.

Table 2: Pre- and post-training systolic, diastolic blood pressures, forced vital and forced vital capacity of 1 second results of the participants

		N	X± Sd	t	p
Systolic Blood Pressures	Pre Test	30	113,93±11,67	6,818	,000
	Post Test	30	101,72±9,28		
Diastolic Blood Pressures	Pre Test	30	53,76±11,12	1,599	,121
	Post Test	30	51,03±12,84		
Forced Vital Capacity	Pre Test	30	5,35±0,89	-,020	,984
	Post Test	30	5,35±0,84		
Vital Capacity of 1 Second	Pre Test	30	4,52±0,58	,527	,603
	Post Test	30	4,50±0,58		

As the Table 2 examined average of the participants' pre-training systolic blood pressures ratios 113,93±11,67, diastolic blood pressures 53,76±11,12, forced vital capacity 5,35±0,89, vital capacity of 1 second 4,52±0,58, post training systolic blood pressures ratios 101,72±9,28, diastolic blood pressures 51,03±12,84, forced vital capacity 5,35±0,84, vital capacity of 1 second 4,50±0,58 were determined. As a result, pre- and post-training diastolic blood pressure results of participants were significantly different between forced vital capacity and forced vital capacity values of 1 second ($p > 0,05$), A significant difference was found in systolic blood pressure results before and after training ($P > 0,00$).

Table 3: Pre and post training weight, body fat and body mass index ratio of participants

		N	X± Sd	t	p
Weight	Pre Test	30	75,86±12,04	5,703	,000
	Post Test	30	74,07±12,01		
Body Fat	Pre Test	30	13,43±4,86	5,935	,000
	Post Test	30	10,46±4,14		
Body Mass Index	Pre Test	30	24,26±2,85	5,217	,000
	Post Test	30	23,74±2,91		

As the Table 3 is examined average of the participants' pre-training weight ratios 75,86±12,04, body fat 13,43±4,86, body mass index 24,26±2,85, post training weight ratios 74,07±12,01, body fat 10,46±4,14, body mass index 23,74±2,91 were determined. There was a significant difference (P> 0.00) between the body mass index results and the weight and fat ratios of participants before and after training.

5. Discussion

Participants had a mean systolic blood pressure of 113,93 ± 11,67 mmHg, a diastolic blood pressure of 53,76 ± 11,12 mmHg, a forced vital capacity of 5,35 ± 0,89, a forced vital capacity of 1 second of 4,52 ± 0, 58, mean post-training systolic blood pressure 101,72 ± 9,28 mmHg, diastolic blood pressure 51,03 ± 12,84 mmHg, forced vital capacity 5,35 ± 0,84, 1-second forced vital capacity 4,50 ± 0,58 , Respectively. As the results were found to have a positive improvement in systolic blood pressure of the participants. Oğuzhan Yüksel, in his work called 'Effects of Aerobic and Anaerobic Exercises on Cardiovascular and Respiratory Systems and Body Fat Ratios Applied to Male Students in University' found that, aerobic group pre-training systolic blood pressure ratio was found 12.4 ± 0.73, post training 11,5 ±0,51, pre training diastolic blood pressures 8,13 ±0,84, post training 7,5 ±0,51, pre training forced vital capacity 4,10 ± 0,26, post training 5,14 ±0,29, pre training 1 second forced vital capacity 3,96 ± 0,26, post training 5,00 ±0,31, anaerobic group pre-training systolic blood pressure ratio was found 12,2 ± 0,79, post training 11,5 ±0,63, pre training diastolic blood pressures 7,66 ±0,48, post training 7,53 ± 0,74, pre training forced vital capacity 4,09 ± 0,21, post training 4,32 ± 1,17, pre training 1 second forced vital capacity 3,93± 0,22, post training 4,24 ± 1,99 (Oğuzhan Yüksel, 2009).

Recep Kürkçü, Fatih Hazar, Hale Hazar, in their work called, 'Effects of Wrestling Training on MaxVo2 and Respiratory Functions in 12-14-year-old Wrestlers' The wrestlers' pre-season tough vital capacity ratio 2.73 ± 0,52, 3,54 ± 1,04 at the middle of the season, 3,69 ± 1,11 at the end of the season, 2,670 ± 0,59 at the beginning of the season, 3,26 ± 1,00 at the beginning of the season, 3.67 ± 1.07 were determined (Recep K., Fatih H., Hale H., 2010).

Taner Yılmaz, in his work called, 'Aerobic Powers of Adolescents, Respiratory Functions and Body Balances of 8 Week Swimming Exercises found that the experimental group's ratios of forced vital capacity pre training 1,59±0,45, post training

1,59±0,31, control group pre training 2,27±0,59, post training 2,55±0,89 (Taner Yılmaz, 2012)

Canan Gülbin Eskiyecek, in her work called 'Investigation of Respiratory Function, Echocardiography, Some Physical and Anthropometric Parameters on 12-16 years old females basket ballers' that found, the experimental group's ratio of forced vital capacity pre training 2.736 ± 0.411, post training 3.029 ± 0.449, control group pre training 2.359 ± 0.420, post training 2.412 ± 0.444, 1 second the experimental group's ratio of forced vital capacity pre training 2.623 ± 0.388, post training 2.767 ± 0.363, control group pre training 2.265 ± 0.419, post training 2.281 ± 0.423(24).As the results average of the participants' pre-training weight ratios 75,86±12,04, body fat 13,43±4,86, body mass index 24,26±2,85, post training weight ratios 74,07±12,01, body fat 10,46±4,14, body mass index 23,74±2,91 were determined. There was a significant difference (P> 0.00) between the body mass index results and the weight and fat ratios of participants before and after training. (Canan Gülbin Eskiyecek, 2012)

Kübra Altunsoy, in her work called, 'Investigation of Effects of Aerobic Exercise and Combined Exercise Applications on Body Composition and Resting Metabolic Rate' that found, pre training the combined exercise group' ratio of body mass index, 23,28 ± 1,84, aerobic exercises group 24,04 ± 1,71, control group 22,92 ± 2,19, post training the combined exercise group' ratio of body mass index, 23,00±1,84, aerobic exercises group 23,52±1,48, control group 22,97±2,05, pre training the combined exercise group' ratio of body fat, 29,67 ± 2,94, aerobic exercises group 29,61 ± 2,06, control group 27,25 ± 3,12, post training the combined exercise group' ratio of body fat 29,52±2,24, aerobic exercises group 29,33±2,33, control group 27,27±3,23 (Kübra Altunsoy, 2014).

Aslı Keleş, in her work called 'Comparison of the Effect of Priority Usage of Aerobic and Strength Training on Fat Burning in an Exercise Program' found that, In firs test The body mass index was measured as 22.82 ± 2.29 for those who initially strength training later aerobic training, aerobic training later strength 21,98±2,37, In second test The body mass index was measured as 22,40±2,21 for those who initially strength training later aerobic training, aerobic training later strength 21,66±2,23, In third test The body mass index was measured as 21,92±2,25 for those who initially strength training later aerobic training, aerobic training later strength 21,57±2,06, In fourth test The body mass index was measured as 21,59±2,24 those who initially strength training later aerobic training, aerobic training later strength 21,48±1,99,

In firs test The body fat was measured as 29,23±5,19 for those who initially strength training later aerobic training, aerobic training later strength 26,41±5,58, In second test The body mass index was measured as 27,24±94for those who initially strength training later aerobic training, aerobic training later strength 25,31±5,18, In third test The body mass index was measured as 25,67±4,74 for those who initially strength traning later aerobic training, aerobic training later strength 23,74±6,26, In fourth test The body fat was measured as 24,20±4,30 those who initially strength training later aerobic training, aerobic training later strength 22,80±5,46 (Aslı Keleş, 2007).

6. Conclusion

Participants' improvement in systolic blood pressures may be attributed physiologically, at the time of loading at high intensity training, by the adaptation of the vessel diameters to exercise intensity, and as a drop in blood pressure at each loading step.

Significant changes in weight and fat ratios and body mass index results of pre and post training participants were due to increased levels of catecholamines and growth hormone in the bloodstream with high severity exercises and the use of fat as an energy source in this process.

One of the reasons for the significant differences in respiratory parameters is the lack of an aerobic training program in attendance. Improvement in cardiopulmonary function can be achieved through the integration of these types of training into fitness exercise methods. Most of the exercises for the development of physical and physiological parameters should be considered as a whole of the human body system and the special training programs in each system should be designed for the purpose and needs of individuals.

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