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Effects of Short-Term Interval Training Courses on Fitness and Weight Loss of Untrained Girls

¹Khadijeh Pour-Abdi*, ²Saeed Shakerian, ³Zeinab Pour-Abdi,
²Maryam Janbozorgi

1- Islamic Azad University–Izeh Branch, Izeh, Khouzeestan, Iran.

2- Department of Exercise Physiology, Faculty of Physical Education and Sport Science, Shahid Chamran University, Ahvaz, Khouzeestan, Iran.

3. Department of Physiotherapy, Faculty of Medical Science, University of Isfahan, Isfahan, Iran.

ABSTRACT

Due to the increase in obesity and sedentary lifestyle in today's world, encouraging the individuals to do appropriate and academic physical activities and studying sports programs with different structures are of great importance. The present paper aims to study the effect of 30 minutes interval short courses of running (4 rounds × 7:30 minutes) with a mean intensity of 60-75% of heart rate reserve (HRR) for 6 weeks on body composition and aerobic capacity (Vo₂max) in untrained girl university students. Twenty six untrained girl university students aged 19 to 23 years old with a percentage of body fat (PBF) of more than 30 and a Vo₂max of less than 40 ml/kg/min were randomly selected and divided into two groups including training group (n=16) and the control (n=10). Weight, body mass index (BMI), percentage of body fat (BF%), lean body mass (LBM), and maximal oxygen uptake (VO₂max) were measured as indicators of health before and after six weeks of trial. Findings of the present study showed that 6 weeks of interval running improved body composition and aerobic capacity of untrained girls. This means that there was a significant decrease in PBF, weight, and BMI of untrained girls. In addition, maximal oxygen consumption showed a significant increase (p≤0.05), while no significant change was observed in lean body mass. Findings of the present study indicate the importance of combining the short courses of work and rest for 30 min in a day. The present study merely discusses the effective role of interval short course training in stimulating and changing physiological adaptations and consequently improving the performance of cardiovascular system and body composition in untrained girls.

Key Words: low activity; obesity; interval training; aerobic capacity; percentage of body fat; body mass index.

Corresponding Author:

Khadijeh Pour-Abdi

E-mail: pourabdi_kh184@yahoo.com

INTRODUCTION

Tremendous advances in technology and mechanical lifestyle of people in this century have made many works easier from one hand and caused a significant decrease in physical activity level, lifestyle change, inactivity and low mobility of individuals, and obesity (1). Disorders caused by obesity and low mobility are highly related to body fat which decreases the performance of cardiovascular system, increases the adipose tissue, and put the human health at risk directly or indirectly. In fact, it is the body fat which has a great impact on the relationship between physical fitness and obesity-related risk factors (2, 3). Extra fat limits activity capacity of individuals and leads to decreased fitness. This reduces the level of activity and the result is more fat storage in adipose tissue. Hence, extra fat and body weight control has beneficial effects on health and fitness. Physical inactivity is a major factor in the development of cardiovascular diseases and other diseases. Health experts have a consensus on the fact that observance of sanitary and medical principles is effective in dealing with diseases and death more than expected. In active persons are deprived of the joy of activity, excitement caused by physical fitness changes, the feeling of discovering a victory, and achieving their potentials (4).

Body composition and cardiorespiratory fitness are introduced as the most important health-related factors of physical fitness and play a great role in determining the quality of life, health acquisition, and preventing the diseases especially cardiovascular ones (5). Aerobic fitness, because of its determining role in increasing a person's capacity to carry out daily tasks and exercise, has been introduced as the primary factor affecting the health of people in the future (6, 7). Low levels of cardiorespiratory fitness and lack of physical activity are considered the most

important factors in increasing the adipose tissue. However, the role of physical activity is obvious as a solution for achieving normal body composition, energy balance, decreased fat, and increased aerobic capacity (8). Physiological pressure resulting from physical activity is one of the potential regulators of energy balance (9), which reduces body fat by increasing energy expenditure, affecting fat percentage, and hormonal changes. Indicators such as percentage of body fat, body mass index, cellular water, and muscle mass are parameters of body composition that are particularly influenced by exercise program and any changes in these factors is closely related to changes of aerobic fitness and efficiency of cardiovascular system (5).

For those who want to preserve and enhance their cardiorespiratory ability American College of Sport Medicine (ACSM) proposes 3-5 times per week exercise with an intensity of 55-65% to 90% of heart rate reserve for 20 to 60 minutes per day including rhythmic aerobic activities which involve large muscle groups, such as walking, running, biking, and aerobic (10). Therefore, in order to facilitate adaptation in the body, maintain the proper level of physical activity, and weight control, taking advantage of scientific exercise methods and evaluating different methods of exercise which properly affect cardiorespiratory fitness and body composition of individuals are of great importance as an aspect of primary prevention and treatment of obesity and promotion of society health. To achieve this, an effective exercise program should be consisted of intensity, duration, number of sessions, and type of exercise to apply extra load on body organs and achieve an adaptation. Special adaptation of exercise, depending on its type, can be an increase in body mass and lean body mass as a result of strength exercise, decreased fat as a result of endurance and aerobic exercise, and

achieving an optimal body composition (11). In the middle of the 1990s, many studies were conducted on interval trainings, in most of them it was generally agreed that combination of short sport courses has a high potential to increase aerobic capacity. However, other beneficial effects of this method are still unknown (12-15). According to previous studies on the effect of exercise on body composition and aerobic fitness in sedentary individuals, it is generally assumed that participating in physical exercises causes optimal changes in aerobic fitness, weight, and body mass in these individuals. However, there are contrasts in the results of studies on the effect of different methods with different intensities and exercise types. Exercises that are looking for health and reducing the body fat are basically restricted to endurance activities like hiking, jogging, swimming, cycling, and skiing. These programs are fully recommended as common strategies to achieve general health and weight loss. But most people are reluctant to participate in these sports programs (16, 17)

Given that the efficiency and effectiveness of a society depend on healthy people who are active in, planning for public sport especially for women and supporting them are of measures that should be regarded as a national plan. People should be educated and encouraged to follow an active lifestyle. Based on previous studies, it seems that long duration of exercise protocols (more than 8 weeks and more than 30 minutes in each session) is one of the biggest causes of fatigue, loss of motivation, and lack of interest to participate in fitness and weight loss programs. Due to contradictory responses of obese people to exercise, focus of most studies on long-term activities, and lack of information on interval activities, it was attempted in this study to shorten the time of exercise and use short courses of work and rest to both maintain the interesting and entertainment aspect of

exercises and also investigate the effects of such exercises on body composition and aerobic capacity of untrained obese girls.

MATERIALS AND METHODS

Subjects. This study was a quasi-experimental research. Non-athletic girl university students living in the dormitory of Shahid Chamran University of Ahvaz were publicly asked to participate in this study. After the students declared their readiness, a questionnaire about sports experience and health status was handed out among them. Among healthy and non-athletic girl students who had no history of exercise and sports activity over the past two years, 70 girls were randomly selected. After conducting some experiments in sports clinic of the physical education college to determine percentage of body fat (%BF) and aerobic fitness, subjects were entered into the study according to the following procedure. The subcutaneous fat of four areas of body (Biceps brachii, triceps brachii, the scapular, and the pelvic) was measured using calipers. By calculating body fat percentage, 50 subjects with a body fat percentage greater than 30 were separated as obese. Bruce treadmill test was used to determine maximal oxygen consumption and 40 subjects with a VO_{2max} above 35 ml.kg.min were selected as untrained girls. Finally, among the university students who did not take the course of General Physical Education at the moment, 26 girls aged 19 to 23 years old with a of 27.02 ± 4.77 and a body fat percentage more than 30 were randomly selected and divided into two groups including training group ($n = 16$) and the control ($n = 10$).

Exercise Training Procedure. Interval running was done in 4 replicates of 4 minutes and 30 seconds with an intensity of 75% of HRR and three minutes active rest including jogging and light running with an intensity of 60% of HRR (14). Exercise programs were done in 6 weeks, 3 days a

week, and 28-30 minutes for each session with an intensity of 60% to 75% of HRR. To control workout intensity, all the subjects wore a wrist stethoscope. Subjects in the control group participated in no organized and regular exercise program. Four subjects were discarded from the study because of disease or irregular participation in programs.

Research Design. Before and after 6 weeks of exercise program, the following measurements were taken for all subjects. All measurements were performed in one day for each subject. The subjects were asked to avoid consuming any food (except water) and performing any exercise 12 hours before the test. First of all, subcutaneous fat was measured by Skyndex calipers with a pressure of 10 gr/mm² and using the 4-area equation of Durnin and Womersley (Biceps, triceps brachii, pelvic, and scapular) (18) and Siri (19) equations. Body Composition Analysis device was used to calculate weight, body mass index, and lean body mass. Bruce treadmill test was also used to estimate aerobic capacity. Data on age, height, weight, maximum heart rate (220 – age), and training heart rate range was given to the stethoscope. A chest digital sensor was attached to the chest of subjects and the screen of stethoscope was attached to the left hand of them.

Statistical Analysis. Dependent sample t-test was used to analyze the difference between body composition and maximal oxygen consumption pre vs post test. Independent sample t-test was also used to compare the mean differences of studied indicators between the training and control groups. Significance level was considered $p \leq 0.05$ in the present study. All statistical analyses were done using SPSS software.

RESULTS

The results of the present study are shown in Table 1. Analysis of body composition results showed that mean

percentage of body fat of subjects in the training group decreased from 35.72 ± 1.67 percent to 34.34 ± 1.7 percent after 6 weeks of exercise, which was statistically significant ($p \leq 0.05$). Mean and standard deviation of weight of subjects in the training group in pretest and post test were 69.88 ± 6.11 and 65.5 ± 6.15 , respectively which showed a significant reduction after 6 weeks. Additionally, a significant decrease was observed in body mass index of training group after 6 weeks of interval training ($p \leq 0.05$). There was no significant change in lean body mass ($p = 0.234$). Other findings showed that average values of maximum oxygen consumption significantly increased from 26.51 ± 4.16 to 29.23 ± 4.13 ml.kg.min ($p \leq 0.05$). No significant change was observed in studied variables for the control group.

DISCUSSION

Findings of the present study showed that 6 weeks of interval running improved body composition and aerobic fitness of untrained girls. This means that, as a result of the six-week interval running, a significant decrease in weight, body mass index, and subcutaneous fat and a significant increase in maximal oxygen consumption of the subjects were observed. On the other hand, no significant change was observed in lean body fat of the training group.

In recent years, some studies have surveyed and compared biological responses of some short bouts with long-term training courses in the same and specific time periods. For example, Jakicic *et al* (2005) showed that 30-40 minutes of interval running has a greater impact on weight loss and increased cardiovascular endurance in obese women compared with the same amount of continuous exercise (20). Schmidt *et al* (2001) observed a significant increase in maximal oxygen consumption and a significant decrease in weight and subcutaneous fat of 3 training groups after

30min of exercise with short periods (2×15, 3×10) and long periods (1×30) for 12 weeks and 5 days per week with an intensity of 75% of HRR (15). They state that interval exercise with short periods in a day shares the same effects with a continuous training course on aerobic fitness and weight loss of young obese girls (15). de Souza e Silva *et al* (2009) showed that 50 minutes of exercise

(2×20 min of exercise and 10 min rest) for 12 weeks and 5 days per week caused significant increase in maximal oxygen consumption and a significant decrease in percentage of body fat and waist circumference of the subjects which is consistent with the results of the present study (13).

Table 1. Variables Statistics of the Exercise and Control groups before and after 6-week physical activity

Variables		EG (N=)			CG (N=)		
		Mean±SD	t	p	Mean±SD	t	p
Weight (kg)	Pre	6.11±88.69	7.22	0.002*#	87.26±5.14	1.75	0.232
	Post	6.15±65.5			86.14±3.11		
BMI (Kg/m ²)	Pre	27.25±1/87	5.15	0.001*#	27.41±1.84	4.41	0.007
	Post	25.27±3.9			27.20±2.14		
BF (%)	Pre	35.72±1.67	5.80	0.001*#	35.63±1.67	1.448	0.181
	Post	34.34±1.71			35.25±1.70		
LBM (kg)	Pre	44.90±2.92	1.25	0.234	45.72±2.43	532	0.607
	Post	45.15±3.0			45.66±2.56		
VO2MAX (ml/kg/min)	Pre	26.51±4.16	6.21	0.001*#	26.43±5.17	-1.05	0.320
	Post	29.23±4.13			26.63±4.7		

BMI: Body Mass Index. **CG:** Control Group. **EG:** Exercise Group. Data were presented as the Mean value ± Standard Deviation. *: $P \leq 0.05$, Significant difference from Pre-EG vs Post-EG (T-test). #: $P \leq 0.05$, Significant difference from Post-EG vs Post-CG (T-test)

In interval trainings, due to frequent breaks between activities, more oxygen can available to muscles, improving the interactions and energy saving. Interval exercise scan cause significant changes in muscle metabolism through the expansion of the capillary network and increasing the content of mitochondrial enzymes. These changes lead to increased oxidation of fats, reduced adipose tissue, remaining glycogen storage, lower lactic acid production, and less feeling of fatigue (21). In addition to these factors, the effective role of exercise in calling the fats. During exercise, fatty acids are released from their storage slots for

metabolism and energy production. Various studies have suggested that growth hormone may be responsible for increased recruitment of fatty acids. Growth hormone rapidly increases with increasing exercise and remains at the increased level at recovery period for hours after the activity. Other researchers have suggested that during the exercise adipose tissue becomes more sensitive to the sympathetic nervous system or to the increased level of catecholamines of blood circulating system that both of them increases the recruitment of fatty acids (22). Another finding of the present study shows that interval running for six weeks has a

significant impact on maximal oxygen consumption in untrained girls. This means that 6 weeks of interval running has improved their aerobic capacity and cardiovascular fitness through increasing the maximal oxygen consumption. Due to the numerous breaks between activities, the times heart sends out more amount of blood also increases in interval training, which is effective in strengthening the heart. Such exercises improve the power of heart beats, because heart is like a muscle whose beats become stronger as working more. Researchers have reported that increase of maximal oxygen consumption in interval trainings is due to both environmental factor (Arterial and venous oxygen difference and increased capillary density) and central adaptations (changes in cardiac output) (15, 23).

In the present study, interval running improved body composition by affecting only subcutaneous fat and BMI, while it had no significant effect on lean body fat. About the significant effect of 6 weeks of interval running on maximal oxygen consumption and percentage of body fat, it can be said that although both aerobic (activities with lower intensity) and anaerobic (high intensity activities) systems are used to supply energy in interval training, the involvement of aerobic system the present study was observed to be more than anaerobic one. In this case, the amount of lean body mass (LBM) remains unchanged or changes slightly. Low-intensity aerobic exercises accompanied with rest periods

expand the capillary network, oxidative capacity in muscles, and endurance capacity, leading more use of aerobic system and fat metabolism. On the other hand, high-intensity activities expand central factors such as the heart's pumping capacity which is closely related to maximal oxygen consumption. The results of the present study are consistent with the findings of Daussin *et al* (2008), Gao *et al* (2008), King *et al* (2009), Kerksick *et al* (2009), Krastrap *et al* (2010), Knoepfli-Lenzin *et al* (2010), Matsuo *et al* (2012), Sijie *et al* (2012) and Astorino *et al* (2013). (3, 14, 24-30) On the other hand, the results of the present study are inconsistent with the findings of Osei-Tutu *et al* (2005), who studied the effect of 8 weeks of short-term interval exercise (3 ten-minute rounds) on changes of percentage of body fat but did not achieve significant results (31). The possible reason can be explained by considering the training practice; Osei-Tutu and colleagues used longer periods and fewer replicates (3 ten-minute replicate activity periods) which were likely unsuitable to stimulate physiological adaptations for fat oxidation.

CONCLUSION

The present study showed that a period of CRT causes a clear increase in FEV1, MVV, FEF 25%-75%, and PEF. So results of our study may suggest that the CRT can improve some pulmonary function factors of healthy young inactive women beside of other benefits of this type of training for women.

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تازه‌های علوم کاربردی ورزش
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اثر دوره‌های تمرینی کوتاه مدت اینتروال بر آمادگی و کاهش وزن دختران غیرورزشکار

خدیجه پورعبدی^{*}، سعید شاکریان^۳، زینب پورعبدی^۲، مریم جانبزرگی^۱

۱. دانشگاه آزاد اسلامی واحد ایذه، ایذه، خوزستان، ایران.
۲. گروه فیزیولوژی ورزشی، دانشکده تربیت بدنی و علوم ورزشی، دانشگاه شهید چمران، اهواز، خوزستان، ایران.
۳. گروه فیزیوتراپی، دانشکده علوم پزشکی، دانشگاه اصفهان، اصفهان، ایران.

چکیده

با توجه به افزایش چاقی و کم تحرکی در جامعه امروزی، تشویق و ترغیب افراد جامعه به انجام فعالیت‌های بدنی مناسب و علمی و بررسی برنامه‌های ورزشی با ساختار مختلف امری مهم است. در این پژوهش اثر ۳۰ دقیقه دوره‌های کوتاه مدت دوییدن اینتروال (۴ دوره × دقیقه ۷:۳۰) با شدت متوسط ۶۰-۷۵٪ ضربان قلب ذخیره به مدت ۶ هفته بر ترکیب بدن و آمادگی هوازی، دختران دانشجوی غیرورزشکار بررسی شده است. بدین منظور ۲۶ دانشجوی دختر غیرورزشکار ۱۹ تا ۲۳ سال با درصد چربی بزرگتر از ۳۰، و بیشینه اکسیژن مصرفی (VO_{2max}) زیر ۴۰ میلی‌لیتر/کیلوگرم/دقیقه؛ به صورت تصادفی در دو گروه تمرین ($n = 16$)، و کنترل ($n = 10$) تقسیم‌بندی شدند. وزن، شاخص توده بدن، درصد چربی زیرپوستی، توده بدون چربی و VO_{2max} به عنوان شاخص‌های سلامتی افراد؛ قبل و پس از شش هفته مورد اندازه‌گیری قرار گرفت. یافته‌های تحقیق حاضر نشان داد که شش هفته تمرین دوییدن اینتروال باعث بهبود در متغیرهای ترکیب بدن و آمادگی هوازی دختران غیرورزشکار شده است. به این معنی که در نتیجه اجرای شش هفته تمرین دوییدن اینتروال، کاهش معنی‌داری در درصد چربی زیر پوستی، وزن و شاخص توده بدن دختران غیرورزشکار مشاهده شد و همچنین VO_{2max} دختران غیرورزشکار تحقیق پس از ۶ هفته تمرین اینتروال افزایش معناداری نشان داد ($p \leq 0.05$) در حالی که تغییرات توده بدون چربی این گروه تمرینی معنی‌دار نبوده است. یافته‌های پژوهش حاضر بیانگر اهمیت ترکیب دوره‌های کوتاه مدت کار و استراحت برای ۳۰ دقیقه در روز می‌باشد. این تحقیق منحصراً به نقش مؤثر برنامه تمرین تناوبی کوتاه مدت در تحریک و تغییر سازگاری‌های فیزیولوژیکی و در نتیجه بهبود عملکرد دستگاه قلبی عروقی و ترکیب بدن دختران غیرورزشکار اشاره دارد.

واژگان کلیدی: کم تحرکی، چاقی، تمرین اینتروال، ظرفیت هوازی، درصد چربی، شاخص توده بدن.

* - نویسنده مسئول:

خدیجه پورعبدی

پست الکترونیک: pourabdi_kh184@yahoo.com

