Effect of Supervised Circuit Resistant Training (CRT) Program on Cardiorespiratory Endurance of Adolescents

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Abstract: The focus of the study was to apply for the supervised circuit resistant training (CRT) Program on cardiorespiratory functions of an adolescent having the same age, gender, and exercise schedule from the Department of Sports Sciences and Physical Education, Dera Ismail Khan. The subjects of the study were accordingly divided into two equal groups, where a was labeled as the Experimental Group (EG) and group B was named as the Control Group (CG). For this purpose, 20 subjects as an experimental group (EG) and 20 subjects as a control group (CG) were selected. The experimental group was given a CRT protocol of eight-week to check the influence of exercise upon functions of cardiorespiratory, whereas the control group was given no treatment. The desired parameters were tested before and after the prescribed exercise protocol for the overall assessment of cardiorespiratory fitness. For this purpose, the researcher used the sphygmomanometer and spirometer to get the readings. The researcher collected the data from all the participants under the guidance of the research supervisor used for further evaluation. According to the analyzed data, the participants of an experimental group showed statistical significant differences in Hip Circumference (HP), Waist-hip ratio (WHR) and Body Mass Index (MBI), Furthermore, results of the test revealed a significant increase in the cardiorespiratory indices (CO, SV, IRV, ERV) among the participants' experimental group.

Key Words: Circuit Resistant Training, Stroke Volume, Cardiac Output, Inspiratory Reserve Volume, Expiratory Reserve Volume

Introduction

Experts in the fields of exercise and training have long emphasized the importance of cardio-respiratory fitness. Other factors of physical fitness such as muscular strength and flexibility are also considered as important components of physical fitness. As more research needs about how the body responds to exercise or training, however, it becomes apparent that these other factors of fitness have a very significant role in the development of health, wellness and overall quality of life (Gu, Chang, & Solmon, 2016). Muscles make up more than 40% of the body mass. Individuals depend on them for movement, and, because of their mass, they are the site of a large portion of the energy reactions that take place in the body. Strong and well-developed muscle helps to perform daily activities with greater ease (Bompa, Di-Pasquale, & Cornacchia, 2012). Henceforth, this particular study focuses on the effect of circuit-resistant training (CRT) on cardio-respiratory endurance of college adolescentsCardiorespiratory endurance is an indication of a person's overall physical health. Other names for cardiorespiratory endurance include cardiovascular fitness, cardiovascular endurance, and cardiorespiratory fitness. There is convincing evidence that cardiorespiratory fitness is considered as one of the important health-related components of physical fitness. The important functions of

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cardiorespiratory endurance include the provision of oxygenated blood, which performed any kind of physical activity. Maximum oxygen up-take assess through different exercises just like cycle ergo-meter and treadmill (Wang *et al*., 2010; Church *et al*., 2007; Jackson *et al*., 2009). The research study indicated that people with higher cardiorespiratory endurance are less likely to develop high blood pressure than those with lower cardiorespiratory endurance (Sui *et al*., 2017). Researchers found a positive correlation between cardiorespiratory endurance levels and multi-task performance among adults aged between 59 and 80 years (Wong *et al*., 2015). Improving cardiorespiratory endurance may decrease the risk of coronary heart disease and all-cause mortality (Gander *et al*., 2015). People who take part in long time exercise or training have better cardio and respiratory functions. Improved cardiorespiratory endurance helps in maintaining good health, not quickly tired, and avoid from all types of cardiorespiratory diseases (Cheng *et al*., 2019).

People can improve their cardiorespiratory endurance though regular exercise. A study reported that resistance training, endurance training, and high-intensity interval training led to improvements in cardiorespiratory endurance and muscular strength among adults (Amaro-Gahete, 2019). A study investigated the effectiveness of a 12-week cross-circuit training program with students who were overweight and had intellectual disabilities. The researchers found participants who followed the training program had improved exercise endurance, muscle strength, and body mass index (Velez, Golem, & Arent, 2010).

On one side, day to day development as a result of the economy, the labor work has been performed by many kinds of machinery, resulting in a negative effect on health or life. On the other hand, physical inactivity or training plays a vital role in global mortality. The result's estimation revealed that 60 to 85% younger in the world live static life, and every third child has insufficient physical training or activity, which has a negative impact on human health (Clausen *et al*., 2018). Physical inactivity is the fourth leading cause of death worldwide (Kohl *et al*., 2012). Physical inactivity is associated with the alteration of normal physiologic processes leading to muscle atrophy, reduced exercise capacity, insulin resistance, and altered energy balance (Biolo *et al*., 2005). Physical inactivity has reached epidemic levels in developed countries and is being recognized as a serious public health problem (Lee *et al*., 2012). Recent evidence shows high percentages of individuals worldwide who are physically inactive. Living in sedentary lifestyle is one of the leading causes of deaths and a high risk factor for several chronic diseases, like cancer, cardiovascular disease, diabetes type 2, and osteoporosis (Kruk, 2014).

Different kinds of training program are used to improve cardio and respiratory fitness. Some improvement comes with aerobic training and some comes from combined (aerobic/resistance) training (Häkkinen *et al*., 2003). Many authors say that Aerobic training improves to the capillary density of muscles, and the skeleton, improve mitochondrial oxidative and aerobic capacity (Daussin *et al*., 2008). Resistance training improves muscles mass and maximum aerobic capacity (Caruso *et al*., 2015). It is suggesting that combined both aerobic and resistance training increase in cardio and respiratory fitness (Nygaard *et al*., 2003).

Circuit training is carried out by performing one exercise after another in a circuit. In this method of training, exercise is performed with no or little rest between exercises. However, it can vary based on the type of circuit being carried out. Cardio respiratory fitness, sometimes called cardio, cardio endurance, aerobic fitness, or aerobic capacity, is one of the basic components of physical fitness. Cardio-respiratory fitness is a condition in which the body's cardiovascular (circulatory) and respiratory systems function together, especially during exercise or work, to ensure that adequate oxygen is supplied to the working muscles to produce energy (Jackson *et al*., 2009). There is a way of circuit training in which participants turn through many stations, perform at least the rest of the time until the circuit is completed or perform different exercises for re-doing. There are different ways of building a circuit, but they usually contain several movements, including body weight, weight and dynamic exercises.

The human body develops rapidly during childhood and adolescence. During this period, physical fitness directly affects one's health state and becomes the basis of healthy adulthood. Therefore, suitable physical activity in children and adolescents contributes to the development of their physique, strength, and balance. Many developed countries have national projects designed to encourage students to enhance their physical fitness, e.g., FITNESSGRAM in the United States, Trimming 130 in Germany, EUROFIT in Europe. A lack of studies exist to assess the effect of circuit resistant training upon cardio-respiratory endurance of adolescents aged 20-

24, especially in our country. To fill this gap, the researcher conducted this study to add in the existing literature and device suitable circuit resistant training protocol that could help in developing cardio-respiratory endurance.

Objectives of the Study

1. To assess the effect of circuit resistant training on.
   i. Cardiac Output
   ii. Stroke Volume.
2. To assess the effect of circuit resistant training on.
   i. Inspiratory Reserve Volume (IRV)
   ii. Expiratory Reserve Volume (ERV)

Hypotheses of the Study

The researcher formulated the following hypotheses to reach at certain facts about the effect of CRT on various parameters of Cardio-respiratory endurance.

H 1 Circuit resistant training will produce a positive effect on;

i. Cardiac Output
ii. Stroke Volume

H 2 Circuit resistant training will produce a positive effect on;

i. Inspiratory Reserve Volume (IRV)
ii. Expiratory Reserve Volume (ERV)

Research Methodology

The method and material section of the research deals with a detail description of all the steps that is used to conduct a study. Therefore; this chapter of the research thesis consists of the following material and procedure.

Research Design Adopted

A pre-test and post-test experimental design is said where the measurements are obtained both before and after treatment is known as pre-test post-test design. A detailed discretion of the design has been given in the following diagram.

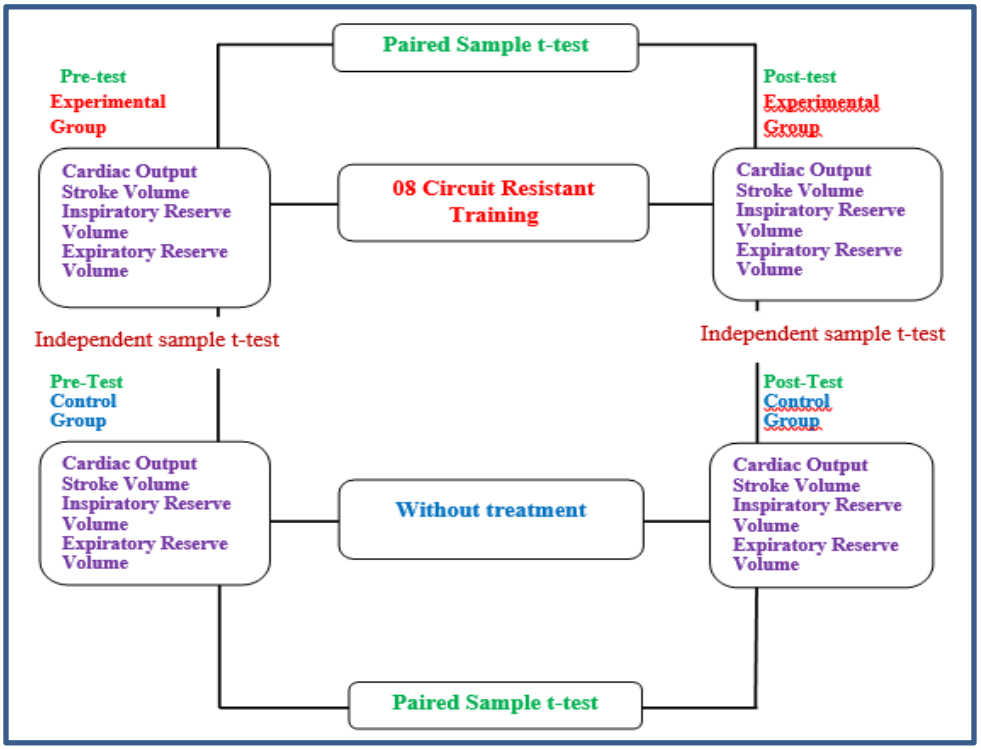

Figure 1: Showing Pre-test and Post-test Experimental Research Design.

Participants

The participants of the present research consisted the students having the same age, gender, and exercise schedule from the Department of Sports Sciences and Physical Education, Dera Ismail Khan.

Inclusion Criteria

The following inclusion criteria were applied to ensure the subject appropriateness for the study, and to minimize withdrawal.

1. Only male students were included in the study.
2. Subjects aged 18-22 year.
3. A subject having no chronic health problems.
4. Subject who regularly participated in the study

Result

This chapter of the research work deals with the analysis and presentation of data. Therefore, this chapter is divided into different parts. Part (A) deals with the description of demographic attributes such as Age, height, weight, Waist Circumference, Hip Circumference and Waist Hip Ratio (cm) of the control group and experimental group, while part (B) comprises of the effect of the circuit resistant training (CRT) upon Waist Circumference (WC), Hip Circumference (HC), Waist Hip Ratio (WHR), cardiac output (CO), stroke volume (SV), Inspiratory Reserve Volume (IRV), and Expiratory Reserve Volume (ERV). Part (C) deals with the comparison of international standards with the results of the current study.

Table 1. *Results of Paired t-test (pre and post interventions)*

Variable		Control Group (20)		Experimental Group (20)	
		t-value	p-value	t-value	p-value
PRE HC- POST HC	-1.000	0.330		3.198	.005
PRE WHR- POST WHR	-0.138	0.892		1.775	.092
PRE BMI- POST BMI	-3.329	0.004		2.144	.045

HC: Hip Circumference, WHR: Waist-hip ratio, BMI: Body mass index

Table 2. *Results of Paired t-test (pre and post interventions)*

Variable		Control Group (20)		Experimental Group (20)	
		t-value	p-value	t-value	p-value
PRE CO- POST CO	-0.136	0.893		-2.254	.036
PRE SV- POST SV	-1.000	0.330		-2.722	.014

Key: CO: Cardiac Output, SV: Stroke Volume

Table 3. *Results of Paired t-test (pre and post interventions)*

Variable		Control Group (20)		Experimental Group (20)	
		t-value	p-value	t-value	p-value
PRE IRV- POST IRV	-0.010	0.992		-2.470	.023
PRE ERV-POST ERV	1.121	0.276		-2.275	.035

Key: IRV: Inspiratory Reserve Volume, ERV: Expiratory Reserve Volume

Discussion

The present research was conducted to evaluate the Circuit Resistant Training (CRT) program on cardio-respiratory endurance of adults aging 18-22. In the current study forty (40) healthy volunteers equally divided into two different groups namely, the experimental group (EG) and a control group (CG) were selected for the study. According to the analyzed data, the participants of an experimental group showed a statistical significant differences in Hip Circumference (HP), Waist-hip ratio (WHR), and Body mass index (BMI) (Table 4.8). Furthermore, the results of the t-test revealed a significant increase in the cardiorespiratory indices (CO, SV, IRV, ERV) among the participants of the experimental group (Table 4.9 & 4.10). These results tend to interpret that the cardiorespiratory fitness of adults can be

improved with the help of 06 week (CRT) program. These results are substantiated by previous research that studied the effects of a circuit training program on different components of health-related fitness (Romero-Arenas *et al.*, 2013), but little have investigated the effect of circuit-resistant training (CRT) among adults at higher educational institutions. Therefore, the findings of the current add to the existing body of literature. Similar studies have found that circuit training helps in increasing VO_2 max (Brentano *et al.*, 2008). Research studies using CT have also revealed the same results of improvement in various indices of cardiorespiratory fitness among other populace (Wong *et al.*, 2015). One study indicated that a least-duration CT program helps in enhancing VO_2 max (Romero-Arenas *et al.*, 2013). One of the most important outcomes of the current study was that circuit-resistant training, which lasted six weeks, was helpful for enhancing and maintaining cardiorespiratory endurance in adults. Despite the fact that further research is required to validate these findings, detraining and following management systems are hoped to become a core factor of this regard. It is suggested that further studies could include a longitudinal follow-up to assess the fairly long consequences of circuit-resistant training in this particular group of population. Therefore, CRT is a realistic and successful solution to exercise training.

Finding, Conclusion, Limitation, and Future Direction Conclusion

Findings

The following hypotheses have emerged from the data analysis;

1. According to the analyzed data, the participants of an experimental group shown statistically significant differences in Hip Circumference (HP), Waist-hip ratio (WHR), and Body mass index (BMI). (Table 4.8)
2. Furthermore, the results of the t-test revealed a significant increase in the cardiorespiratory indices (CO, SV, IRV, ERV) among the participants of the experimental group. (Table 4.9)
3. As a result, the difference between Pre and Post-test of the Experimental Group has shown a significant increase in IRV and ERV due to Circuit Resistant Training (CRT) continued for 6 weeks. (Table 4.10)

Physical fitness is required for success in both sports and everyday life. Greater and more strength is gained as the degrees of fitness components rise. This strength in numerous organs of the body has contributed to great achievements in sport career and other vital parts of life. Trainers, coaches, and physical educationists in sports continue to measure various aspects of fitness, while researchers continue to look for new strategies to improve and maintain physical fitness. The current study's findings imply that CRT can aid in the development of adult cardiorespiratory parameters. It is hoped that this research will lead to the development of a test model for players in higher education institutions in the future. Our athletes will achieve optimal cardiorespiratory endurance if we use the CRT programs used in the current study. To achieve a high standard in cardiorespiratory while also meeting our athletes' fitness needs, more research and innovation is required.

Limitations

The current study was only conducted at the Department of Sports Sciences and Physical Education, Gomal University, Dera Ismail Khan. The results of the study would not be effective at the High or middle school level. Participants included in the current study were having uniformity in their age, gender, and exercise schedule and come from the same department. Because of these uniformities, it is not clear if CRT would have an effect on adolescents from other ages, gender, and exercise schedule.

Future Action

Results of the study indicated that Circuit resistant training is effective in improving cardiorespiratory endurance, CRT is going to become part of a health education program for the students. It is going to be an important requirement that teachers assist students in doing CRT and other exercises program through which students can develop their physical as well as mental health.

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