THE UNIVERSITY OF LAHORE

Volume 5, No.1. Jan-Dec 2021

IJPESS International Journal of Physical Education and Sports Sciences

EFFECT OF CIRCUIT RESISTANT TRAINING ON CARDIORESPIRATORY INDICES; IMPLICATION FOR DEVELOPING A TEST MODEL FOR SOCCER PLAYERS OF HIGHER EDUCATION INSTITUTIONS

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Abstract

The current research aimed to incorporate appropriate circuit resistant training protocol in the current literature and device that could help improve cardio-respiratory endurance of soccer players. A pre-test and post-test longitudinal research format was applied because the suggested parameters of cardiorespiratory endurance were appropriately calculated by such research designs. A sample of (n=40) healthy volunteers equally distributed into two different groups namely, an experimental group (EG) and a control group (CG). The circuit resistant training (CRT) 3 times per week with specified intensity, repetition, set and rest period continued for 06 weeks among experimental group. Results of the analyzed data revealed a significant increase in the cardiorespiratory indices (CO, SV, IRV, ERV) among the participants of experimental group ($p < .05$). These results tend to interpret that cardiorespiratory fitness of soccer's players can be improved with the help of 06 week (CRT) program.

Apart from this, health and physical education teachers, physiotherapists and other relevant persons can recommend CRT for lifestyles improvement.

Keywords: effect, circuit resistant training, cardio, respiratory, indices

Introduction

The information concerning physical status of soccer's players is very much important for both players and coaches. These physical measurements of the players significantly contributing in the process of team selection and training purposes. Different physiological tests can be used to collect this information. Presently, the proponents of sport, health and physical education, and recreation have their direct fitness assessed in laboratory, whilst indirect measures are also performed in the field. The present research work is undertaken to assess soccer's player's health-related fitness variable with a specific focus on cardiorespiratory indices. A strong difference in functionality and

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specificity is well known in the literature between field experiments and laboratory tests. The results of the review emphasize field experiments over research laboratory experiments, not only for the purpose of commodities, but also for reasons of motivation and precision (Jemni, Prince & Baker, 2018).

Cardiorespiratory stamina is an indicator of the general physical health of a person. Though cardiorespiratory endurance enhances the absorption of oxygen in the lungs and heart, which can assist a person to perform physical activity for prolonged period of time (Billingsley et al., 2019). Any other possible health benefits from enhanced cardiorespiratory endurance are also indicated by clinical studies. A study indicates that individuals with greater cardiorespiratory endurance are less likely than those with lower cardiorespiratory endurance to experience high blood pressure (Domínguez et al., 2017). A strong correlation between cardiorespiratory endurance levels and multitask performance in adults between the age group of 59 and 80 years was identified by researchers (Wong et al., 2015). According to a 2015 report, improving cardiorespiratory endurance can reduce the chances of coronary heart disease morbidity even mortality from causes (Laukkanen et al., 2015).

Circuit training refers to a set of drills in which the trainee goes through training. Circuit resistance training is done by completing one workout after another in a cycle. Exercise is performed in this method of preparation with little or no pause among multi nature exercise protocol. It will, therefore, differ depending on the type of circuit being implemented. Circuit resistance training is a technique in which people switch between several exercise stations. Where they do at least part of the time, or do multiple re-doing things, until the circuit is over. There are several ways to construct a circuit, but different exercise protocol, including body weight, weight and dynamic workouts, are usually used.

In the game of soccer, an athlete has to continuously be engaged, which in turn would hold the heart rate up. The athlete’s heart has to work harder to pump blood, especially into lungs, when he/she is constantly moving. Challenging soccer games will significantly strengthen athlete’s stamina and endurance, and at the same time, the competitive nature of the sport will boost motivation (Jemni, Prince & Baker, 2018). The game of soccer is considered as activity of elevated severity that needs high levels of aerobic and anaerobic fitness on part of the players. A soccer player is required to cover a typical distance of 10-13 km either by walk or at low intensity (Bangsbo & Mohr, 2006).

This aerobic activity is intermixed with activity of elevated severity indices consisted acceleration of the player, sprinting, agility, jumping, tackling, inside & outside stepping (Ekblom, 1986; Reilly, 1976). The aforementioned changes in moments can gracefully be performed if the players have muscle strength, flexibility and agility (Ekblom, 1986; Sheppard & Young, 2006). These moments not only help in making the play interesting but also most decisive (Wisloeff, 1998).

However, all the while a game betwixt sole players, there are marked variations in physical and physiological performance, related to place and playing style, as well as team strategy (Ekblom, 1986; Bangsbo, 1994; Bangsbo, 1994b; Sporis et al., 2009). Therefore, it is essential that players and trainers have approach to impartial player's physical status data for selection and training purposes during the season (Datson et al., 2014). This type of knowledge can also be used as feedback and player encouragement (Ekblom, 1986, Bangsbo, 1994).

Many developed nations have national projects aimed at encouraging athletes to improve their physical health. There is, however, a lack of adequate exercise protocol that could improve and promote the cardio-respiratory endurance of soccer players, especially in our country's higher education institutions. In order to fill this void, the current research aimed to incorporate appropriate circuit resistant training protocol in the current literature and device that could help improve cardio-respiratory endurance of soccer players.

Objectives

1. To evaluate the effects of CRT on important indices of cardio endurance such as cardiac output and stroke volume.
2. To evaluate the effects of CRT on important indices of respiratory endurance such as inspiratory reserve volume (IRV) and expiratory reserve volume (ERV).

Hypotheses

The subsequent hypotheses have been used to quantify some information on the effects of CRT on various parameters of cardiorespiratory endurance.

H 1 There are positive effects of Circuit resistant training on important indices of cardio endurance such as cardiac output and stroke volume.

H 2 There are positive effects of Circuit resistant training on important indices of respiratory endurance such as inspiratory reserve volume (IRV) and expiratory reserve volume (ERV).

Key Terms

i. Cardiorespiratory endurance

Cardiorespiratory endurance is an ability of the heart, lungs, and related muscles to work for an extended period of time during work/exercise/sport.

ii. Cardiac Output

Cardiac output is the ability in which the heart can pump blood into the circulatory system within a minute time.

iii. Stroke Volume

Stroke volume is the ability of left ventricle to expel bold in a single contraction.

iv. Inspiratory Reserve Volume (IRV)

It is the excess amount of air that can be inhaled after a normal inhalation (tidal volume).

v. Expiratory Reserve Volume (ERV)

The additional amount of air that can be expelled from the lungs with determined effort after normal tidal volume expiration.

Research Methodology

Research Design

There were several research designs that were not appropriate for testing the suggested variables of cardiorespiratory endurance, and that is why a pre-test and post-test randomized experimental research design was applied in the current study (Chang et al., 2014). In a pre- and post-test experimental design, the measurements are taken before and after a treatment. A detailed overview of the research design has been presented in the following diagram.

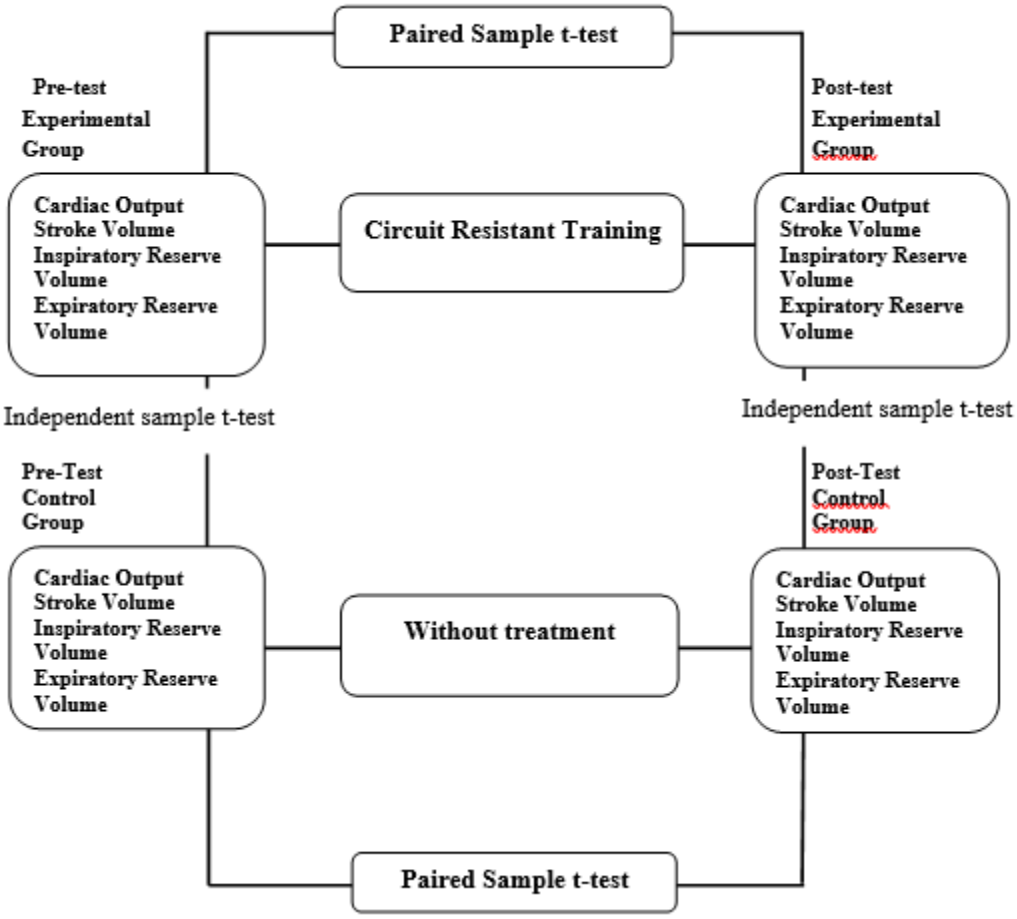

Figure 1: Viewing research design.

Participants

The participants of the present research consisted of the male soccer's players having uniformity in the age, gender and exercise schedule. A total of 40 male soccer's players aging 20-25 who have consented were randomly selected. Only male soccer's players having no health impairment and those participated in the exercise schedule on a regular basis were included in the study. The participants were accordingly distributed into two different groups such as (EG=20) and (CG=20). The following diagram shows the details.

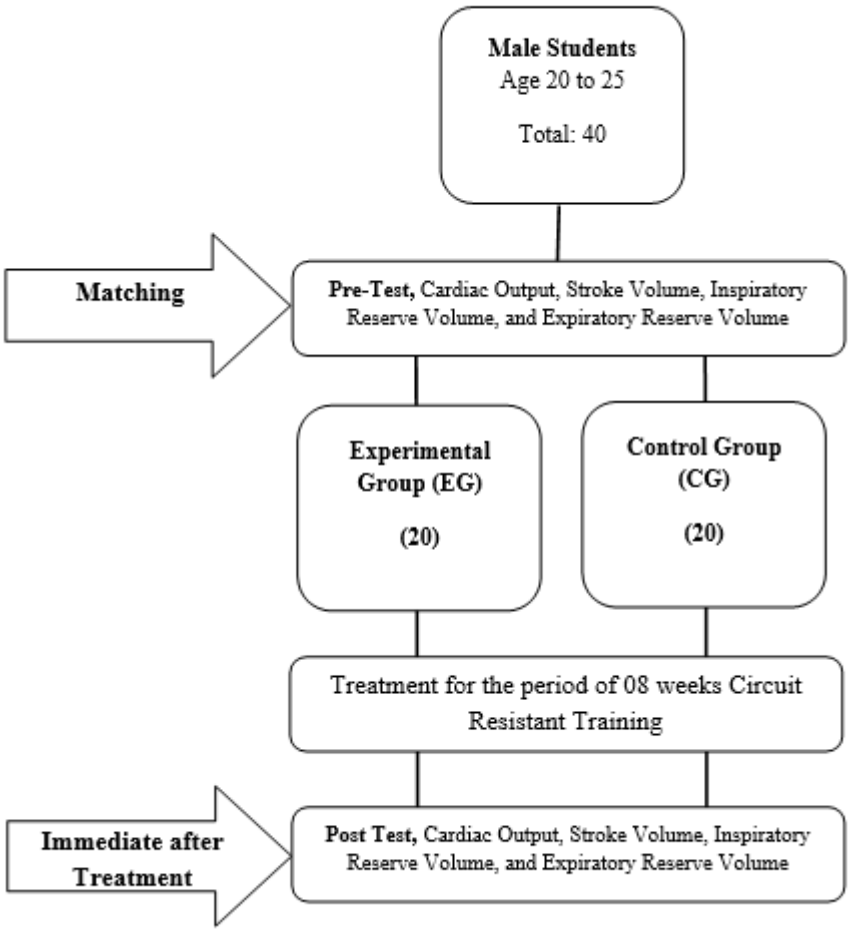

Figure 2: Showing Experimental Group (EG) and Control Group (CG).

Proposed (CRT) Exercise Protocol

Various studies used multiple fitness protocols to determine the impact of workout on multiple body systems. The observers established the (CRT) exercise technique in this study and then administered it for a fixed period of time to the chosen participants. Before the beginning of the circuit resistance training, a 5-minute warm up exercise was performed. A 5-minute cool down workout followed the circuit resistance exercise. The circuit resistant training 3 times per week with intensity, repetition, set and rest period as specified in the table 1 continued for 06 weeks. The circuit resistant training program comprised different exercises including Jumping Jacks, Burpees, Hand release push-ups, Mountain Climbers (running planks), vertical/ sergeant Jump, skipping. The Hip Circumference, Waist-hip ratio, Body mass index, Cardiac Output, Stroke Volume, Inspiratory Reserve Volume, and Expiratory Reserve Volume was assessed at the start and the end of the 6-week period.

Table 1: Showing the details of (CRT) protocols.

Exercise Name	Intensity	Repetitions	Set	Rest period
Jumping Jacks, Burpees, Hand release push-ups, Mountain Climbers (running planks), vertical/ sergeant Jump, skipping	60%	10 times	5	30 seconds (each set)
	70%	8 times	6	
	80%	6 times	7	

Variables and Equipment

In the case of laboratory experiments, there might be various instruments involved. Is it necessary, therefore, to decide if the facilities and equipment needed for the research are appropriate? This research is experimental in nature focusing on determining the results of adult Circuit Resistant Training (CRT) among adults. To perform the proposed research analysis successfully, the available facilities and equipment were available. In the table below, a complete overview of the suggested parameters and equipment are given:

Table 2: Showing the variables and equipment applied

S. No	Variables	Apparatus/Equipment applied
1	Cardiac output	Stethoscope/sphygmomanometer
2	Stroke volume	Stethoscope/sphygmomanometer
3	Inspiratory Reserve Volume	Spirometer
4	Inspiratory Reserve Volume	Spirometer

Statistical Analysis

The approach by which quantitative tools are routinely used to analyze and understand data is called statistical analysis. The commonly used statistical instrument SPSS, version 26, was used in this study to analyses the measurements obtained. Various statistical tests such as mean, standard deviation, an independent sample t-Test and Paired sample t-Test were applied to obtain the required results.

Analysis and Interpretation

In the current study forty (40) healthy volunteers equally divided into two different groups namely, experimental group (EG) and a control group (CG) were selected for the study. According to the analyzed data, the participants of an experimental group shown a statistical significant differences in Hip Circumference (HP), Waist-hip ratio (WHR) and Body mass index (BMI) (Table 3 and 4). Furthermore, results of the t-test revealed a significant increase in the cardiorespiratory indices (CO, SV, IRV, ERV) among the participants of experimental group (Table 5). Based on the analysis, it can be interpreted that the Circuit Resistant Training (CRT) continued for 6-week proposal was very productive in enhancing the cardiorespiratory categories examined (CO, SV, IRV, ERV).

Table 3: ***Means± SD (pre intervention)***

Variable	Control (n=20)x ± SD	Experimental (n=20)x ± SD
HC (cm)	100.02±1.833	100.02±2.917
WHR (cm)	0.771±0.074	0.773±.003
BMI (kg/m^2)	21.47±0.600	21.42±0.167
CO (l)	5.544±0.3712	5.558±0.049
SV (ml)	74.259±2.246	74.249±1.707
IRV (lit)	2.442±0.0055	2.448±0.2124
ERV (lit)	.693±0.1491	.698±0.1344

Key: X: Mean, SD: Standard Deviation, HC: Hip Circumference, WHR: Waist-hip ratio, BMI: Body mass index, CO: Cardiac Output, SV: Stroke Volume, IRV: Inspiratory Reserve Volume, ERV: Expiratory Reserve Volume

Table 4 ***Means± SD (Post intervention)***

Variable	Control (n=20)x ± SD	Experimental (n=20)x ± SD
HC (cm)	99.97±1.945	98.01±2.450
WHR (cm)	0.776±0.263	0.769±.010
BMI (kg/m^2)	21.67±0.593	21.17±0.516
CO (l)	5.546±0.4544	5.933±0.184
SV (ml)	74.326±4.241	78.223±2.716
IRV (lit)	2.445±0.0081	2.874±0.3140
ERV (lit)	.690±0.0025	.825±0.1829

Key: X: Mean, SD: Standard Deviation, HC: Hip Circumference, WHR: Waist-hip ratio, BMI: Body mass index, CO: Cardiac Output, SV: Stroke Volume, IRV: Inspiratory Reserve Volume, ERV: Expiratory Reserve Volume

Table 5 ***Results of Paired t-test (pre and post interventions)***

Variable	Control (n=20)		Experimental (n=20)	
	t-value	p-value	t-value	p-value
PRE HC- POST HC	0.095	0.925	2.917	.007
PRE WHR- POST WHR	-1.233	0.228	2.342	.026
PRE BMI- POST BMI	-1.499	0.145	2.728	.011
PRE CO- POST CO	-0.017	0.987	-11.149	.000
PRE SV- POST SV	-0.084	0.934	-7.139	.000
PRE IRV- POST IRV	-1.356	0.186	-6.135	.000
PRE ERV-POST ERV	0.113	0.911	-3.415	.002

Key: X: Mean, SD: Standard Deviation, HC: Hip Circumference, WHR: Waist-hip ratio, BMI: Body mass index, CO: Cardiac Output, SV: Stroke Volume, IRV: Inspiratory Reserve Volume, ERV: Expiratory Reserve Volume

Discussion

The present research was conducted to evaluate the influence of 06-week circuit resistant training (CRT) on soccer's players among higher education institution of Khyber Pakhtunkhwa (KP), Pakistan. The experimental group indicated a statistical significant difference in Hip Circumference (HP), Waist-hip ratio (WHR) and Body mass index (BMI). Likewise, results of the analyzed data revealed a significant increase in the cardiorespiratory indices (CO, SV, IRV, ERV) among the participants of experimental

group. These results tend to interpret that cardiorespiratory fitness of soccer's players can be improved with the help of 06 week (CRT) program. These results are substantiated by previous research that studied the effects of circuit training systems on people with different health conditions (Takeshima et al., 2004; Brentano et al., 2008; Romero-Arenas et al., 2013), but little have investigated the effect of circuit resistant training (CRT) among soccer's players 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; Camargo et al., 2008). Research studies using CT have also revealed same results of improvement in various indices of cardiorespiratory fitness among other populace (Ignico et al., 19954; Ignico et al., 2005; Wong et al., 2008). One study indicated that a least duration CT program helps in enhancing VO_2 max (Romero-Arenas et al., 2013). Circuit resistant training that lasted six weeks was one of the most significant findings of the current research, which could be effective for improving and maintaining cardiorespiratory endurance among players. Despite the fact that further research is required to validate these findings, the detraining and followed 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.

Conclusion

Physical fitness is the prerequisite for a successful sport as well as practical life. With increase in levels of fitness components, more and more strength is achieved. This strength in various organs of the body has contributed to massive achievements in sport career and other important aspects of life. Sport's trainers, coaches and physical educationists are continuing to measure various components of fitness, and researchers are continuing to find ways to develop and maintain physical fitness. The findings of the current study suggest that CRT can contribute to the development of cardiorespiratory indices of soccer's players. In the future, it is hoped that this research will lead to develop a test model for soccer players of higher education institutions. If we use the CRT programs used in the study, our athletes will achieve optimal cardiorespiratory endurance. More research and innovation are needed to achieve high standard in cardiorespiratory while still supporting the fitness needs of our athletes.

Consent Form

An inform consent was duly signed by the participants those who willingly to contribute in the program over the duration of the fitness program; test participants should not be vulnerable to injury in any way. A prior consideration was paid to the dignity of the participants.

Approval

Before conducting the study, we obtained formal approval from the Department Supervisory Committee (DSC), Department of Sport Sciences and Physical Education, Gomal University, Dera Ismail Khan.

Acknowledgement

We appreciate all of the participants who volunteered to take part in this research. We are grateful to the DSC, Department of Sports Sciences and Physical Education, Gomal University, Dera Ismail Khan, Khyber Pakhtunkhwa (KP), Pakistan, for supporting the study with the requisite facilities and assistance.

Conflicting Interests

No conflicting interest has been found.

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