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EFFECT OF AEROBIC TRAINING PROGRAM ON INSULIN SENSITIVITY IN ADULT ATHLETES

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ABSTRACT

The purpose of this study was to determine the effect of the aerobic training program on the insulin sensitivity in adult athletes. To work on the purpose, thirty (30) male active athletes, age ranged from 21 to 24, were recruited from New Delhi (India). Further, these athletes were randomly divided into two homogenous groups (control and treatment groups) at random basis depending on their blood sugar levels. The control group was kept under rigorous supervision and do not indulge in any special physical activities, whereas the treatment group was instructed to participate assigned training program and performed solely the experimental procedure for a period of twelve (12) weeks under the researcher's supervision. Data on the pre-decided variables from all participants were recorded before and after the treatment to determine the impact of the aerobic training program. Insulin sensitivity was determined using the IG Index, calculated with the formula - IG Index = glucose AUC x insulin AUC. A paired sample t-test was used to compare the mean differences in blood glucose estimation up to 2 hours after the administration of 75 gm of glucose orally (mg/dL) among the adult athletes' pre-and post-aerobic training programs. Results documented that there were no significant changes in fasting glucose or insulin levels; however, insulin sensitivity changed 4.7% dramatically after 12 weeks of aerobic training among the adult athletes, as measured by an oral glucose tolerance test.
***Keywords**: Insulin sensitivity, aerobic training, blood glucose estimation.*

1. INTRODUCTION

The degree to which your cells respond to insulin is known as insulin sensitivity. It might be improved to decrease insulin resistance and the risk of developing several diseases, including diabetes (AbouAssi et al., 2015). In his renowned Banting speech from 1988, Gerald Reaven asserted that the root cause of cardiovascular illness is insulin resistance (Reaven, 1988). He had observed the metabolic syndrome, a group of risk factors for cardiovascular disease that included obesity, hypertension, high triglyceride levels, low HDL levels, and glucose intolerance (Report of the National Cholesterol Education Program, 2002). According to DeFronzo (1997), insulin can directly affect blood arteries by stimulating the growth of smooth muscle cells (Stout, Bierman, & Ross, 1975). Based on previous suggested reducing body weight to address insulin resistance and cutting back on carbohydrates to lower insulin levels (Tuomilehto et al., 2001; Wilcox, 2005; Yaffe, 2010).

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Impaired insulin sensitivity (insulin resistance) and insufficient insulin secretion cause type 2 diabetes (Kosaka, Noda, & Kuzuya, 2005). On a population basis, insulin sensitivity decreases with increasing weight (DeFronzo, 1997). Through exercise training, insulin sensitivity can change within a few days. If insulin sensitivity deteriorates, insulin secretion needs to increase to prevent blood glucose levels from rising. If insulin secretion cannot be increased further, blood glucose rises, developing type 2 diabetes. The level of insulin sensitivity at which type 2 diabetes arises depends on the individual's ability to increase insulin secretion (Kosaka, Noda, & Kuzuya, 2005; Ramachandran et al., 2006). Thus, individuals without diabetes can have poor insulin sensitivity if they have sufficient capacity to secrete insulin. Insulin acts on many different tissues in the human body. Before discussing insulin sensitivity in various organs, it is essential to note that not all tissues have the same level of insulin sensitivity. If impaired insulin sensitivity of one organ causes insulin levels to rise, other insulin-sensitive tissues may experience high insulin levels and react pathologically (Wilcox, 2005; Diabetes Prevention Program Research Group et al., 2009).

The study's main goal was to determine the impact of an aerobic training regimen on the insulin sensitivity of healthy adult athletes. Aerobic activities include walking, running, jumping, cycling, swimming, and dancing. Aerobic exercise is defined as any physical activity that lasts thirty minutes or more and engages the main muscle groups. Sunde (2009) suggests that aerobics should be done at least five days a week for thirty minutes per session for physiological changes.

2. METHODS AND MATERIALS

2.1 Participants

Thirty (N = 30) healthy male athletes of the age range 21 to 24 years were chosen based on the random sampling method from New Delhi (India) as the participants of the study. These, 30 participants were parted into two groups based on their mean fasting blood sugar (<100 mg/Dl). The first group was called as 'treatment group', whereas the second group was termed as 'control group'. As the Treatment as well as Control both groups included 15 participants, and the study was conducted using an equal groups design.

2.2 Experimentation

As the participants were randomly allocated into two homogenous groups depending on their blood sugar levels. The control group was kept under rigorous supervision and don't participate in any activities.

The experiment group was assigned pre-designed training program and they were asked to perform solely the experimental procedure for a period of twelve (12) weeks under the researcher's supervision.

Data on selected variable of both the groups were recorded before and after experiment to determine the impact of aerobic training program. Following procedure was adopted for experimentation-

Insulin Sensitivity (OGTT and IG Index) and Blood Glucose Estimation up to 2 hours after administration of 75 gm of glucose orally

a) The participants were given a postprandial blood glucose test to examine their blood glucose levels two hours after their first good meal. A glucometer was used to complete this test. The blood glucose level was measured in milligrams per deciliter; the typical range for postprandial glucose in human blood is <140 mg/dl. After a fasting glucose sample was collected in the morning, the individuals were instructed to have a typical meal and come to the testing between 8:00 and 9:00 a.m. for a sample of blood (Mondon, Dolkas, & Reaven, 1983).

b) Subjects drank a drink containing 75 g of glucose combined with 300 ml of water. To eliminate any residual NaCl solution from the cannula, 1 mL of blood was collected before each blood sample, and 5 mL of blood was obtained 00 and 120 minutes after the drink was consumed (Mondon, Dolkas, & Reaven, 1983). Insulin sensitivity was determined using the IG Index, calculated with the following formula:

IG Index= glucose AUC x **insulin AUC**

The IG Index is a method of measuring insulin sensitivity. It examines how glucose and insulin respond to a glucose load given by orally. By lowering the reaction of glucose and/or insulin to an oral glucose load, a decrease in the IG Index indicates that the body is more sensitive to insulin (Mondon, Dolkas, & Reaven, 1983).

2.3 Training Program

The aerobic exercise program which was given to the treatment group was a series of treadmill exercises, including slow, medium, and fast walking; walking with a 30 degrees incline (uphill); walking with a 30 degrees declination (downhill); jogging with a 30 degrees incline (uphill); running with a 30 degrees declination (downhill); and cycling. The training frequency and intensity were never maximized. The identical load, which varied in volume, intensity, and frequency, was applied to every participant. By periodically tracking heart rate, the researcher was able to keep an eye on how intense the training intensity was using this technique.

2.4 Analysis of Data

Insulin sensitivity was analyzed for both pre-test and post-test of all the participants. For a period of twelve weeks, the experimental groups did their assigned activities, which were designed as an aerobic training program. After a period of twelve weeks, post tests on the dependent variables mentioned above were administered to the participants, resulting in final scores. The impact of the aerobic training program on selected variable was determined by the difference between the initial and final scores. A paired sample t-test and Cohen’s d were used to investigate statistical significance with impact size. To test the hypothesis of this study, 0.05 levels were used.

3. RESULTS

Description of the participants and results of this study is presented in the followings tables.

Table 1: Description of the participants

Participants	n	Age (Years)		Height (cm)		Weight (Kg.)	
		Mean	SD	Mean	SD	Mean	SD
Group-I (Treatment)	15	22.47	1.13	173.33	4.79	74.47 (Pre) 73.87 (Post)	5.83 5.54
Group-II (Control)	15	22.20	1.15	170.67	3.66	73.27 (Pre) 73.47 (Post)	8.03 8.29

Table 1 displays descriptive statistics of the age, height, and weight of adult athletes who were recorded before and after a specifically designed aerobic training program. The mean value of Group-I (Treatment group) age was 22.47 years (SD 1.13), the height was 173.33 cm (SD 4.79) and the weight were 74.47±05.83 kg (Pre) and 73.87 ±5.54 kg (Post), and

Group-II (Control group) age was 22.20 years (SD 1.15), the height was 170.67 cm (SD 3.66) and the weight were 73.27 ± 8.03 kg (Pre) and 73.47±8.29 kg (post), respectively.

Table 2: Paired samples statistics of blood glucose estimation up to 2 hours after the administration of 75 gm of glucose orally (mg/dL)

		Mean	n	Std. Deviation	Std. Error Mean
Group-I	Pre	124.40	15	9.86	2.54
(Treatment)	Post	118.53	15	9.01	2.32
Group-II	Pre	128.40	15	7.01	1.81
(Control)	Post	129.47	15	8.96	2.31

Table 2 shows descriptive data for adult athletes' blood glucose estimation up to 2 hours after the administration of 75 gm of glucose orally (mg/dL) before and after participating in a specifically designed aerobic training program. Blood Glucose Estimation up to 2 hours after administration of 75 gm of glucose orally (mg/dL) in Group-I (Treatment group) was 124.40±09.86 (pre) and 118.53±9.01 (post), whereas Group-II (Control group) Blood Glucose Estimation up to 2 hours after administration of 75 gm of glucose orally (mg/dL) was 128.40 ±7.01 (pre) and 129.47±8.96.

Table 3: Comparison of mean score between pre and post aerobic training program of Blood Glucose Estimation up to 2 hours after the administration of 75 gm of glucose orally (mg/dL)

	Paired Differences			*t*	*p*-value	Cohen's *d*
	Mean	Std. Deviation	Std. Error Mean			
Group-I (Treatment)	5.86	8.40	2.17	2.70	0.01*	0.62
Group-II (Control)	-1.06	4.07	1.05	-1.01	0.32	0.13

df= 14 *$p<0.05$

A paired sample *t*-test was used to compare the mean differences in blood glucose estimation up to 2 hours after the administration of 75 gm of glucose orally (mg/dL) between adult athletes' pre- and post-aerobic training programs. Results of table 3 reveal that variables such as blood glucose estimation up to 2 hours after the administration of 75 gm of glucose orally (mg/dL) of the treatment group (t=2.70, p=0.01, $p<0.05$) show statistically significant mean differences exist between the pre-test and post-test of an aerobic training program; whereas, blood glucose estimation up to 2 hours after the administration of 75 gm of glucose orally (mg/dL) of the control group (t=-1.01, p=0.32, $p>0.05$) shows no significant mean differences exist between the pre-test and post-test of an aerobic training program. The value of the blood glucose estimation up to 2 hours after the administration of 75 gm of glucose orally mg/dL of the treatment group, Cohen's *d*, was 0.62 > 0.50, which indicated medium effect size, and the control groups, Cohen's *d*, was 0.13<0.20 which indicated no effect size, respectively.

Table 4: Plasma insulin concentration (pmol/L) in response to a 75-g oral glucose tolerance test before and after aerobic training program

	Time point (Min.)	Pre		Post	
		Mean	SD	Mean	SD
Group-I	0	7.60	2.99	10.13	2.26
(Treatment)	120	133.26	9.92	123.80	10.03
Group-II	0	7.80	2.14	7.93	1.33
(Control)	120	131.46	3.44	130.93	5.36

Table 4 shows descriptive data for adult athletes' plasma insulin concentration (pmol/L) before and after participating in a specifically designed aerobic training program. Plasma insulin concentration (pmol/L) in Group-I (Treatment group) was 7.60±02.99 (pre) and 10.13±2.26 (post) at 0 minutes and 133.26±9.92 (pre) and 123.80±10.03 (post) at 120 minutes time point; whereas, Plasma insulin concentration (pmol/L) in Group-II (Control group) was 7.80± 2.14 (pre) and 7.93±1.33 (post) at 0 minutes and 131.46±3.44 (pre) and 130.93±5.36 at 120 minutes time point.

4. DISCUSSION

This research investigated the effect of aerobic training program on insulin sensitivity among adult athletes. Based on the results this research observed that on a 75-g oral glucose tolerance test, the treatment group found a statistically significant mean difference between the pre-test and post-test of an aerobic training program at plasma insulin concentration (pmol/L) (Time point 0 minutes). The control groups, meanwhile, showed statistically small mean variations. The study's findings indicate that the experimental group had a rise of 33.52 percent with a large effect size; whereas, the control group had seen a decrease of 1.6 percent with no effect size. In response to a 75-g oral glucose tolerance test, the treatment group demonstrated a significant mean difference between the pre-test and post-test of an aerobic training program at plasma insulin concentration (pmol/L) (Time point 120 minutes). The control groups, meanwhile, showed statistically negligible mean variations. The study's findings suggest that the treatment group experienced a decline of 7.09 percent with a large impact size, compared to a fall of 0.4 percent with no effect size in the control group.

The results of the study also showed that the aerobic training program is one of the essential components that is associated with the changes in insulin sensitivity in adult athletes. It was indicated that aerobic training plays a significant role in managing insulin sensitivity. Previous scientific investigations showed that aerobic training program improve insulin sensitivity in individuals with type 2 diabetes (Umpierre et al., 2013), and although there have been very few studies on this topic in healthy adults (Conn et al., 2014; Flack et al., 2011), the information that is currently available supports this claim. Although aerobic exercise has been demonstrated to increase insulin action in people with diabetes and healthy adults (Colberg & Grieco, 2009), there is no agreement on the best degree of exercise intensity to do this (Hawley & Gibala, 2009). According to another source, the length of exercise, not the amount of energy used, is the most important component in increasing insulin sensitivity (Houmard et al., 2004). Although the present study showed that there were no significant changes in fasting glucose or insulin levels, insulin sensitivity changes 4.7 % dramatically after 12 weeks of aerobic training in a young healthy population, as measured by an oral glucose tolerance test. Numerous studies have shown that exercise helps to keep blood sugar levels normal, but little is known about how it could improve insulin sensitivity (Sénéchal, Slaght, Bharti, & Bouchard, 2014).

5. CONCLUSION

On the basis of the findings of the present investigation, it is concluded that there were no significant changes in fasting glucose or insulin levels; however, insulin sensitivity changed 4.7% dramatically after 12 weeks of aerobic training among the adult athletes, as measured by an oral glucose tolerance test.

Further, it was also recorded that on a 75-g oral glucose tolerance test, the treatment group found a statistically significant mean difference between the pre-test and post-test, which means an aerobic training program can help at plasma insulin concentration among healthy adult athletes. Here, researchers posit that physical activity could improve insulin sensitivity.

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