



## Evaluating the relation between maximum heart rate and resting heart rate in three groups of people (non-athletes, athletes, and people with type II diabetes)

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### ABSTRACT

Researches in the last decade have shown that heart rate in recovery period after exercise test is highly associated with mortality after cardiac events so that the amount of rest and exercise heart rate can indicate the severity of the risk of diabetes. But what is the connection between resting heart rate and activity in diabetics, athletes and healthy people has been neglected, so the aim of this study was to compare the resting heart rate and activity in three groups of athletes, diabetics and non-athletes. Dysfunction of the autonomic nervous system, especially the heart is that this disorder has a poor prognosis and is associated with increased risk of sudden death. For this purpose, 120 subjects were selected and resting heart rate and activity during and after exercise test were compared. All statistical analysis was performed using statistical software SPSS version 16 and charts were drawn using EXCEL, 2010 edition. Statistical significant level was considered less than  $\alpha \leq 0/5$ . Results of the research showed that in exercise test people with diabetes reach their maximum heart rate sooner and resting heart rate is also higher than the other two groups. This shows the positive effect of physical activity on vagal tone and heart rate autonomic nervous system of heart rate.

**Key words:** Type II diabetes, athlete, non-athlete, resting heart rate

### INTRODUCTION

Global statistics show the increasing trend of prevalence and incidence of type II diabetes. Many believe that type II diabetes is a preventable disease and can be done with appropriate interventions to prevent diabetes in people at risk. Therefore, primary prevention of diabetes in recent decades has been the subject of many studies. Due to the increase of diabetes in developing countries, primary prevention of diabetes in countries have particular importance. Identification of risk factors for type II diabetes and determine appropriate strategies to reduce the growing rate of diabetes in the population at risk, is the main point of interest. Genetic predisposition, insulin resistance, obesity, impaired glucose tolerance, physical inactivity and poor diet are the most important risk factors; however, other factors have been considered in the development of diabetes. Most available researches studied the effects of behavioral interventions or lifestyle through increased physical activity and educating suitable nutritional in primary prevention of diabetes, it seems that over the coming decades diabetes has been treated as a preventable disease [1]. But of course, according to the rapid advances in human knowledge, in addition to modifying behavior and improving lifestyle habits in the future, achieving more effective and definite ways to prevent diabetes does not seem out of reach. In addition, regular physical activity, by acting on blood lipids gives rise to the reduction of coronary artery disease and diabetes. In recent years, growing evidence show that delayed return of heart rate to normal after exercise heart by increasing cardiac arrhythmia and mortality in patients with diabetes mellitus and cardiovascular disease are linked [2]. Moreover, recent epidemiological data confirmed resting heart rate as an

independent factor in predicting mortality from cardiovascular disease in men and women with and without known heart diseases [3]. In fact, some studies have reported an increased risk of diseases with increasing resting heart rate in more than 60 bpm. However, lowered resting heart rate and endurance in trained subjects and increase in Parasympathetic tone is seen. These findings suggest that exercise may affect HRR, however, there are limited data on the effects of exercise. Lgramnth and his colleagues (2007) examined the effects of exercise in heart rate parameters involved in coronary artery disease. The results showed that the experimental group significantly decreased resting heart rate by 6% [4]. Tsai and his colleagues (2005) investigate the effect of cardiac rehabilitation on resting heart rate and recovery of diabetic patients. The results of this study showed that resting heart rate of physical activity compared to without exercises groups significantly decreased, While the heart rate recovery in without exercise group increased to a greater extent [5].

### Research methodology

Method of studying was clinical trial which were selected through simple random sampling of 40 type II diabetic patients, 40 healthy subjects and 40 athletes over 50 years old of general staff of Ardabil. Diabetic patients were confirmed by specialist and according to test results existed in files. In none of the healthy and athlete groups have no obvious symptoms of type II diabetes including hyperphagia, polydipsia and polyuria according to the American Diabetes Association and the World Health Organization and considering there is no specialist in clinical supervision, suspicious people were excluded. Studied individuals were from three groups older than 50 and living in the city of Ardabil, both genders, in age group of 60-50 years old. Data collection tool was a questionnaire about basic variables as age, sex, occupation, education, number of children, weight, height, marital status, smoking rate. This study involved 40 male diabetes patients that three of them withdrew from the test due to personal reasons.

### Exercise test

Before the grouping from each participant standard test of modified Bruce was taken on a treadmill. Heart response of subjects was monitored continuously during the test using an electrocardiogram 12 – derivative. Also, blood pressure was measured manually at the end of each stage of the test and was recorded. The test continued until autonomic exhaustion and helplessness. Heart rate before the test, during the test, and after the exercise test were measured and recorded in a sitting position. To describe the basic features of the subjects, descriptive statistics (mean, standard deviation) and to assess the normal distribution of variables, the test Kolmogorov - Smirnov test was used, and to evaluate and compare the groups the independent one-way ANOVA test was used. Analysis of the results of all statistical calculations were performed using SPSS software version 16 and graphs were drawn with the help of EXCEL, 2010 edition. Significant level of the test was considered  $\alpha \leq 0/5$ .

### Research findings

Average of maximum and resting heart rate in athletes was lower than the other two groups and this difference was statistically significant, maximum heart rate during a maximal aerobic activity as well as the rest period is higher in people with diabetes. According to table 1-1 and graph 1-1 it was observed that the average resting heart rate and maximum heart rate is higher in people with diabetes and this difference was statistically significant.

Maximum heart rate and resting heart rate after a maximum activity and the time to reach maximum heart rate (in beats / min)

**Tale 1. Chart comparing three groups of subjects having resting heart rate (beats / min)**

Athletes	Non-Athletes	Type 2 diabetes	Research variables
50±7	60±4	70±6	Resting heart rate
145±4.2	155±4.50	160±2.22	Maximum heart rate
15.21±4.33	12.25±5.54	10.45±2.33	Time to reach HR <sub>max</sub> based on minute

## DISCUSSION AND CONCLUSION

Regarding resting heart rate decrease, the results of this research are in accordance with the results of Kaneslman's research results which showed that breath control practice caused a significant reduction in the heart rate of a group of college men, and also with the results of Bernardi at al who showed that two weeks of hypoxia interval increases ventilatory response and decreases heart sympathetic nerve activity. Considering the acquired statistics from the current study, when we compare the average resting heart rate of the athlete group with the other two groups, we see that the number of beats in a minute among athletes is less than the other two groups which seems to be a considerable amount. The ability to recover heart rate after exercise depends on cardiovascular system capacity to reverse the stimulations of the nervous system and the adaptations of the Pressure receptors involved in exercise [9]. Heffernan et al (2007) concluded that heart rate recovery after exercise is regulated by both Sympathetic and parasympathetic branches. Initial reduction in heart rate is through parasympathetic nerves for reactivation, along

with delay reduction because of continuation of reactivation of parasympathetic nerves and the reduction of the effects of sympathetic nerves. Tark *et al* (2008) reported that reduction in the activities of the sympathetic nerves and improvement in pressure reflex after exercise is because of a constant decrease in the receptors of central nervous system angiotensin [5]. It is showed that early recovery after exercise is recognized after vagal reactivation while sympathetic stimulation reduction is clearer in next recovery stages. These findings with subsequent findings showed that plasma norepinephrine concentrations during the first minute of recovery remained constant or even increased immediately after the activity has been supported [12]. Of course, to support the findings of this study on the effects of exercise on HRR with the results of other studies, the results of Jolie and colleagues (2003), Tsai and colleagues (2005) that had positive impact of physical activity on heart rate at rest and activity that has been reported is consistent. Studies have shown that aerobic exercise reduced resting heart rate, which represents a decrease in sympathetic nervous system activity or increase in vagal tone [13]. However, some studies reported decreasing resting heart rate even in the absence of changes in the autonomic nervous system [14]. It was also suggested that decreasing resting heart rate due to exercise may be due to its consistency in sinoatrial node or an increase in venous return due to exercise and the result might be decreasing the heart rate. But some studies have shown that genetics have a significant effect on heart rate variability and resting heart rate, and the level of heart's response to exercise can affect the person [15]. Therefore, it seems that exercise through making some adaptations on autonomic nervous system and improve venous return and changes in the sinoatrial node improves heart rate recovery. Also, according to the literature that the role of intensity of exercise in the process of rehabilitation through exercise are very important, in this study, we tried to bring effect of exercise and diabetes on resting heart rate and activity that are examined, perhaps because of the significant differences between the three groups can be justified that increasing age, increasing arterial stiffness associated with increased systolic blood pressure that is concerned. Increased arterial stiffness may be due to the substitution elastic fibers by collagen and calcium. These changes in the arterial structure is hardly correction function by exercise, in a way that lack of improvement in arterial stiffness due to exercise showed older people resistance to exercise in reducing systolic blood pressure. Overall, the results show that having physical activity although irregular prevents metabolism and cardiovascular diseases, and doing aerobics and anaerobic of intermittent exercise prevents from early fatigue and possibly prevents the accumulation of lactic acid in the blood and strengthens the subject's power and capacity. And ultimately lowers the resting heart rate and maximum heart rate is in a similar maximal activity. Of course, definitive conclusion in this case, requires further researches and it is hoped that in the future, more research in this regard is done.

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