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Heart Rate Recovery in Sedentary and Physically Active Individuals

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Abstract

Introduction: Slow heart recovery after an exercise test is associated with an increased risk of all-cause mortality. An abnormal value for the recovery of heart rate (HR) was defined as a reduction of 12 beats per minute or less from the HR at peak exercise. The following study was taken up to assess the HR and blood pressure of the individuals with physically active lifestyle versus sedentary lifestyle. This research study was aimed to study the difference in HR recovery in response to 3-min step test between sedentary group and physically active group within age group of 18–24 years. **Methodology:** Forty-five healthy subjects were divided into two groups sedentary and physically active. Each participant was subjected to YMCA 3-min step test, and their pre- and post-readings for HR were noted. Heart rate recovery in 1 min (HRR1) and in 2 min (HRR2) after step test was noted. These parameters were, thus, compared in two groups statistically. **Results:** Significant difference in HRR1 and HRR2 was found in between physically active group and sedentary group. It was also found that time taken for the HR to recover to resting HR was delayed in sedentary group than physically active group. **Conclusion:** On the basis of the results found in present study, there is a significant difference between physically active and sedentary individuals, for HR recovery.

Keywords: 3-min step test, Heart rate recovery, Physically active, Sedentary

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Introduction

Physical activities can boost your health and lower your risk of developing a variety of diseases.[1] According to ACSM, Children and adolescents should engage in at least 60 min of physical activity per day as a component of transportation, physical training, sport, playtime, and planned exercise. The activities should be a mix of moderate and vigorous intensity. Moderate intensity is described as activity that intensifies breathing, sweating, and heart rate (HR), whereas vigorous intensity dramatically increases breathing, sweating, and HR.[2] Sedentary behavior is a term that describes behaviors associated with low-energy expenditure. This includes long periods of sitting at work, home, business centers, long periods of screen time, driving, and leisure time.[3]

The value for HR recovery was defined as the decrease in HR from peak exercise to 1 min after exercise cessation. An abnormal value for HR recovery was defined as a decrease of 12 beats per minute or less from peak exercise HR. The increase in HR that occurs with exercise is caused by a decrease in vagal tone. The increase in HR during exercise is thought to be caused by a combination of parasympathetic withdrawal and sympathetic activation. The drop-in HR immediately following exercise is thought to be a result of parasympathetic nervous system reactivation. Because increased vagal activity has been linked to a lower risk of death. Physical exercise has been shown to increase cardiac vagal tone.[4,5] Since physical activity influences the parameters; thus, the following study was initiated to assess the HR and blood pressure of the individuals with physically active lifestyle versus sedentary lifestyle.

Methodology

This is a cross-sectional interventional study done on subjects 18–24 years of age. This study was conducted on students of one of the reputed physiotherapy college of Delhi in the year of 2018-19. Subjects who were non-smokers and non-alcoholics1 included and who were diagnosed with musculoskeletal impairment, deficit in cognitive function and with any history of diabetes, cardiovascular problems, peripheral vascular and respiratory disease, and exercise limiting arthritis were excluded from this study.

Outcome Measures

HR and blood pressure.

Procedure

Forty-five healthy subjects were pre-assessed and each subject was subjected to YMCA 3-min step test, and his/her pre- and post-readings for HR were noted. Heart rate recovery in 1 min (HRR1) and in 2 min (HRR2) after step test was noted. These parameters were, thus, compared by dividing subjects in two groups statistically, as sedentary and physically active.

Results

Continuous data were summarized as mean ± SD while discrete data (categorical) in numbers. The age, height, weight, and BMI of two groups were compared by t-test. The pre- and post-HR parameters of two groups were compared [Table 1]. A two-tailed $p < 0.01$ ($P < 0.01$) was considered statistically significant. Comparing

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the basic characteristics of two groups, all the characteristics were taken and matched graphically and thus comparable.

Outcome Measures

HR

The pre (RHR) and post (peak HR, HR1, and HR2) exercise HR of two groups (Sedentary and Active) are summarized in Table 2 and also shown in Figures 1 and 2, that the mean HR in both groups was higher at all post periods (peak HR, HR1, and HR2) as compared to pre-exercise (RHR) and at all post periods, it was higher in sedentary group as compared to physically active group.

Time to HR Recovery

The time to HR recovery of two groups is summarized in Table 3 and also shown in Figure 3. The mean (± SD) time to HR recovery of sedentary group was 2.86±0.65 min, while, in physically active group, it was 2.18 ± 0.66 min. Comparing the mean time to HR recovery of two groups, t-test revealed significantly different ($P > 0.001$) and higher time to HR recovery in sedentary group as compared to physically active group.

Borg Scale

Borg scale score is noted in sedentary group and physically active group after 3 min step test. It is found that mean (±SD) for sedentary group and physically active group is 2.66 ± 1.07 and 1.1 ± 0, respectively [Table 4 and Figure 4].

Table 1: Basic characteristics (mean±SD) of two groups

Demographic characteristics	*Sedentary (n=23) (%)*	*Physically active (n=22) (%)*
Age (years)	20.52±1.47	21.45±1.63
Height (m)	1.64±1.82	1.69±0.69
Weight (kg)	61.04±9.49	60.59±9.49
BMI (kg/m^2)	22.42±2.60	20.94±2.62

Table 2: Pre- and post-exercise heart rate (mean±SD and *P* value) of two groups

Periods	*Heart rate (beats/min)*	*Sedentary (n=23)*	*Active (n=22)*	*P-value*
Pre-exercise	RHR	72.78±5.61	75.27±10.52	0.34
Post-exercise	Peak HR	103.40±14.25	102.54±15.29	0.84
	HRR1	91.39±10.53	90.18±11.95	0.72
	HRR2	82.60±10.48	80±10.54	0.41

HR: Heart rate, RHR: Resting heart rate, HRR1: Post-exercise heart rate after 1 min, HRR2: Post-exercise heart rate after 2 min

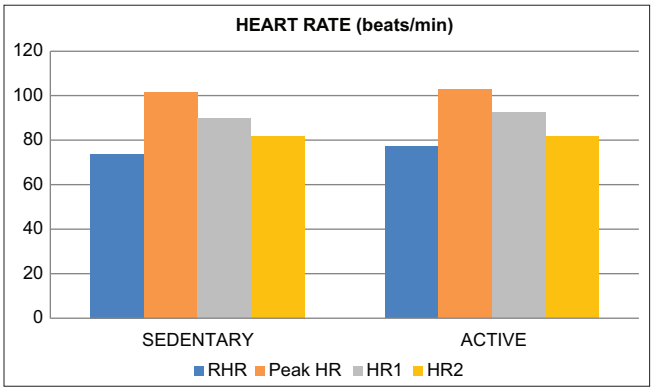

Figure 1: For each group, bar graphs showing mean HR within the groups (between periods)

Discussion

In our study, it was found that the heart recovery was slower in sedentary subjects as compared to physically active subjects. Nowadays, people are becoming more sedentary and reducing the leisure time physical activities, which lead to increasing stress in individuals and increases mortality. Many studies have shown that pre-exercise HR in physically active subjects is significantly lower than in sedentary subjects. Exercise-induced lower resting HR is thought to be due primarily to an increase in parasympathetic activity, with a minor decrease in sympathetic discharge. Hattiwale *et al*. discovered that the physically active group had a significantly faster return to pre-exercise HR than the age-matched sedentary controls. They stated that HR recovery after exercise is affected

Table 3: Time (mean±SD) to heart recovery of two groups

Sedentary (n=23)	*Active (n=22)*	*P-value*
2.86±0.65	2.18±0.66	0.001

Table 4: Borg scale score for two groups

Sedentary (n=23)	*Physically active (n=22)*	*P-value*
2.66±1.07	1.1±0.79	<0.001

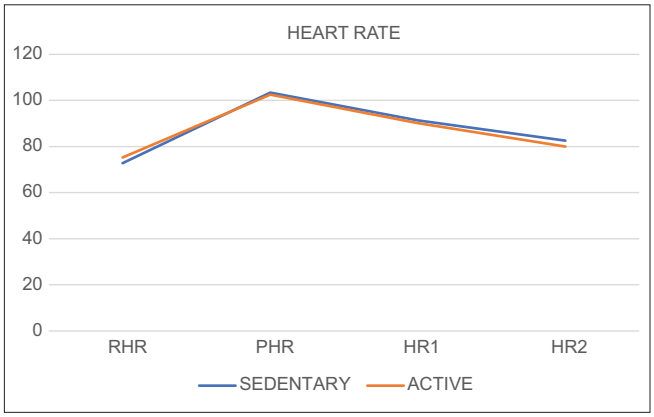

Figure 2: Pre- and post-exercise heart rate of two groups. Time to heart rate recovery (min)

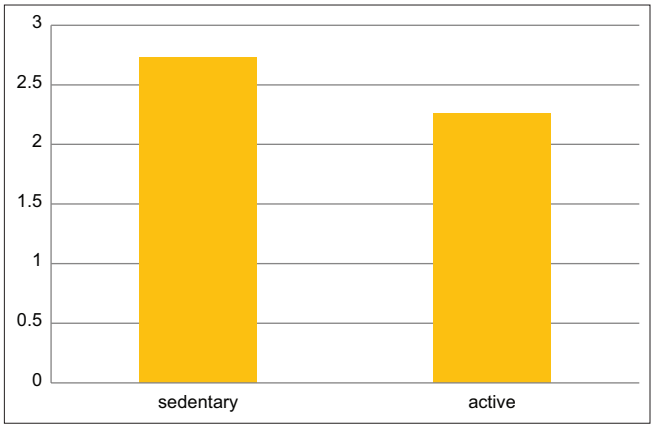

Figure 3: Bar graph showing mean time to heart rate recovery of two groups

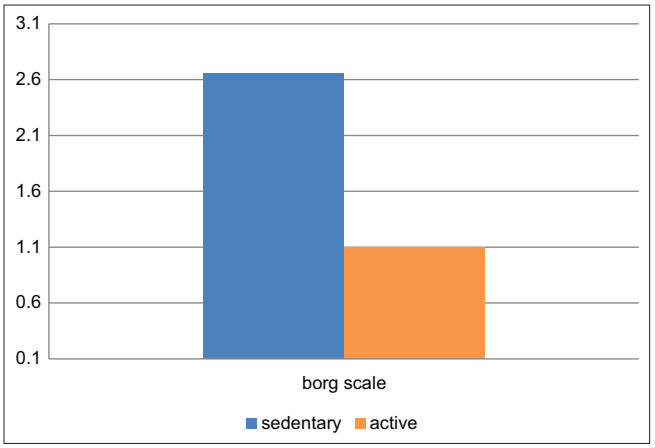

Figure 4: Bar graph showing mean Borg scale score of two groups

by several factors, including exercise intensity, cardiorespiratory fitness, cardiac ANS modulation, hormone changes, and baroreflex sensitivity. Physical activity has been shown to increase cardiac vagal tone and hasten HR recovery after exercise. The recovery of the HR immediately following exercise is a result of vagal reactivation.[1]

Comparing the mean HR between the groups, the HR at pre-exercise levels was comparable for each period. However, it was significantly different and higher ($P = 0.01$ or $P = 0.001$) in the sedentary group compared to the physically active group at all post periods. However, RHR was found to be higher in the physically active group when compared to the sedentary group. The sympathetic and parasympathetic (vague) nerves, which abundantly supply the heart, also control the pumping effectiveness of the heart. Strong sympathetic stimulation can raise the HR of young adult humans from 70 beats per minute to 180–200, and in rare cases, 250 beats per minute. In contrast, strong vagal stimulation causes parasympathetic stimulation can reduce the strength of heart muscle contraction by 20 to 30%. Both of these mechanism works in balance together thus maintaining the HR to a normal level in a normal individual.[6]

Assessment of HR recovery is an important clinical assessment tool for cardiovascular autonomic dysfunction. A delayed decrease in the HR after graded exercise during the 1st min (HRR1 ≤12 beats per minute and HRR2 ≤22 beats per minute) 12, may be a reflection of decreased vagal activity, which is a powerful predictor of overall mortality. Even after submaximal exercise, abnormal HR recovery predicts death.[6] In physically active group, the mean HR did not differ ($P > 0.05$) between RHR and HR2 suggesting that after 2 min of post-exercise, it reached at pre-exercise level (RHR), while, in sedentary group, it still remained significantly higher ($P < 0.01$) after 2 min of exercise. Normally, the increase in HR that accompanies exercise is partly due to a reduction in vagal tone. Recovery of the HR immediately after exercise is a function of vagal reactivation. Vagal reactivation plays an integral part in reducing HR after exercise, especially during the first 30 s. According to our results, comparison of the mean time to HR recovery of two groups by *t*-test revealed significantly different ($P < 0.05$) and higher time to HR recovery in sedentary group as compared to physically group. In our result, we have shown that active individuals recovered faster than sedentary individuals and it is significant.

During exercise, cardiovascular parameters change to supply oxygen to working muscles and maintain vital organ perfusion. During physical activity, the vascular resistance and HR are controlled differently. HR (and cardiac output) elevation is primarily mediated by central command signals through vagal withdrawal at the start of exercise. As work intensity increases and HR approaches 100 beats per minute, sympathetic activity increases, increasing HR, plasma norepinephrine concentration, and vasoconstriction of visceral organ vessels. With exercise cessation, loss of central command, baroreflex activation, and other mechanisms contribute to an increase in parasympathetic activity, resulting in a decrease in HR despite continued sympathetic activation. Later, after exercise, sympathetic withdrawal was also observed.[7] Other factors thought to contribute to HR recovery after physical activity include slower changes in stimuli to metaboreceptors and baroreceptors associated with metabolite clearance and delayed elimination of body heat and catecholamines. Nonetheless, parasympathetic activation is the primary mechanism underlying post-exercise cardio deceleration. The rate at which heart beat frequency decreases and the time required to recover after moderate-to-heavy exercise is commonly used as indicators of cardiovascular fitness. Recently, it has been proposed that a delayed decrease in HR during the 1st min after exercise is a powerful and independent predictor of all-cause mortality.[7] It has been observed in our study, even though HR at 1st min and 2nd min is not statistically significant in subjects of physically active and sedentary lifestyle ($P > 0.05$), the time taken to recovery, that is, HMR (HR minutes to recovery) has been found to be statistically highly significant where $P < 0.01$.

Clinical Implications

Physiotherapists may, thus, play an important role in the society in reducing the stress levels and increasing the physical activity level thus breaking the vicious cycle, by getting involved in the early diagnosis and preventive measures. Exercise training improves both autonomic function and exercise capacity.[6]

Conclusion

On the basis of the results found in present study, our experimental hypothesis (H1), "There is a significant difference between physically active and sedentary individuals, for HR recovery" was found true**.**

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References

1. Hattiwale HM, Hattiwale SH, Dhundasi SA, Das KK. Recovery heart rate response in sedentary and physically active young healthy adults of Bijapur, Karnataka, India. Basic Sci Med 2012;1:30-3.
2. American College of Sports Medicine's Guidelines for Exercise Testing and Prescription. 8th ed. Treasure Island, FL: StatPearls; 1993. p. 83.
3. Inyang MP, Stella OO. Sedentary lifestyle: Health implications. IOSR J Nurs Health Sci 2015;4:20-5.
4. Cole CR, Blackstone EH, Pashkow FJ, Snader CE, Lauer MS. Heart-rate recovery immediate after exercise as a predictor of mortality. N Engl J Med 1999;341:1351-7.
5. Yu Y, Liu T, Wu J, Zhu P, Zhang M, Zheng W, *et al*. heart rate recovery in hypertensive patients: Relationship with blood pressure control. J Hum Hypertension 2017;31:354-60.
6. Sikarwar A, Rai RH, Gupta VP, Priyanka S, Munjal YP, Negi MP. Comparison of non-diabetic young adults with and without parental history of diabetes mellitus for heart rate recovery. Indian J Physiother Occup Ther Int J 2017;11:187-91.
7. Javorka M, Zila I, Balhárek T, Javorka K. Heart rate recovery after exercise: Relations to heart rate variability and complexity. Braz J Med Biol Res 2002;35:991-1000.