

Compare Heart Rate Recovery and Cardiopulmonary Endurance of Badminton and Squash Player

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ABSTRACT

Background: Cardiopulmonary endurance is the ability to pump blood rich with oxygen to working muscles and this oxygen during exercise works and enhance period of activity. Regular aerobic exercises and sports can enhance cardiovascular endurance. Previous work in the field of physical science reveals that physical activity manage to advance and sustain higher levels of physical as well as cardiovascular fitness.

Objectives: The main objectives of study were to compare heart rate recovery in badminton and squash healthy young adult players and to compare cardiopulmonary endurance among badminton and squash players.

Methodology: 20 players with the age of 20-40 years playing badminton and squash for more than a year from Liaquat Bagh Sports Complex, Rawalpindi were selected for this study. Subjects performed two tests for cardiopulmonary fitness testing i.e. Rockport walk test and 3 minutes step test. Subjects then played their regular game for 10 minutes. Heart rate, blood pressure, SpO₂ were measured before the start of game, immediately after play and 5 minutes after cessation of game and heart rate recovery was calculated. Independent T test and Chi square test were applied to analyze the data.

Results: When comparing heart rate recovery, results showed that people who were playing regular badminton showed faster heart rate recovery as compared to those individuals who were playing squash regularly. According to results of cardiopulmonary fitness test badminton players showed better result than squash players.

Conclusion: Playing regular badminton for fitness purposes showed better results in cardiovascular health and heart rate recovery than playing squash

Keywords: Badminton, Body Mass Index, Blood Pressure, Cardiopulmonary, Endurance, Heart Rate, Heart Rate Recovery, Rate Perceived Exertion.

INTRODUCTION

Regular physical activity is considered as an essential factor of a healthy routine for a long time. Many individuals are seeking sports as an alternate way to exercise and maintain their fitness especially cardiopulmonary fitness. Several investigators have examined the effect of sports on cardiovascular health and others have compared the heart rate recovery of regular playing individuals with those having sedentary lifestyle. However, no studies have examined comparable effects during two different sports such as badminton and squash. Cardiovascular system has main role in distributing oxygen and blood rich with glucose and other nutrients to each and every cell and also to remove carbon dioxide and other cellular wastes (1). A lot of energy is consumed during exercise and physical activities, which is derived by cell from oxidizing glucose. Both glucose and oxygen have to be elated by the blood. It means that the heart has to work harder to pump supplementary blood through the body (2).

However, long-term exercise will increase the size of your heart and thickens its walls also, especially during moderately to vigorously intense exercise (3). The time pulse takes to return to individual's resting heart rate is known as heart rate recovery. First minute is the most crucial time for heart rate to drop after exercise (4). Elevated HR during exercise is related to left ventricular oxygen uptake (5), vagal reactivation after physical activity may be a biological function to prevent an extreme cardiac workload (5). With the cessation of exercise, the decrease in HR immediately after exercise is mainly thought to be a function of vagal reactivation (5). Sympathetic system further reduces the heart rate after exercise. So immediately after exercise the heart rate is reduced by vagal reactivation and sympathetic system (5).

Endurance is basically the ability for something to last without any damage for longer period of times (6). Cardiopulmonary endurance is the ability of heart to pump blood rich with oxygen to working muscles and capacity of these muscles to use, this oxygen during exercise and work and periods of activity. Cardiorespiratory endurance tells us about synchronization

of our heart, lungs, and muscles to keep your body active for long intervals of activity. Regular aerobic exercises and sports can enhance your cardiovascular endurance. One must train at different level of heart rate zone in order to improve fitness there are total of six heart rate zone which determine the level of fitness if you train in them for a longer period of time. All the subjects who participated in this study were working in 70-80 or 80-90% of training zones as badminton and squash both are considered high impact sports. Zone 3 is called the aerobic zone and zone 4 is the threshold zone.

MATERIAL & METHODS

This observational study was conducted in Liaquat Bagh sports complex, Rawalpindi from August 2018 to October 2018. Sample size 40 was calculated through open epitool and randomly divided into badminton and squash players i.e; 20 players in each group. Healthy, young males and females, age between 20-40 years, playing badminton and squash (single or double), 3 days a week, from at least 12 months were included while players having any cardiac disease or surgery, any respiratory condition, diabetic and smokers were excluded from the study. All Badminton, squash players and coaches who participated were regular member of that club. Permission was taken from each and every participant.

Subjects performed two tests for cardiopulmonary fitness testing i.e. Rockport walk test and 3 minutes step test. Subjects then played their regular game for 10 minutes. Heart rate, blood pressure, SpO₂ were measured before the start of game (resting), immediately after play and 5 minutes after cessation of game (after game) and heart rate recovery was calculated. Next day, we performed 3 minutes step test and Rockport walk test. Heart rate was taken before step test and we guided the participants up and down throughout 3 minutes. Heart rate was taken after 3 minutes and difference was calculated and written on table given in our Questionnaire.

We measured 1 mile that was 2 rounds of badminton court. Players who took part in this study were asked to walk as quick as possible and heart rate was taken after one mile and time was

noted for each player so it can be used for calculation of VO₂ max it took us a week to collect our data. Squash players also performed Rockport walk test on badminton court.

Data was analyzed using SPSS 21.0 and presented in the form of tables and graphs. Independent T test and Chi square test were applied to analyze the data. $P < 0.05$ is regarded as a significant difference.

RESULTS

40 players with the mean age of 26.1 ± 5.8 , height 172.4 ± 7.8 , weight 66.00 ± 11 , BMI was 22.6 ± 2.7 and targeted heart rate was $157.8-167.8 \pm 5.9$ in badminton while, in squash player mean age was 25.6 ± 6.9 , height 254.7 ± 12.3 , weight 65.5 ± 12 , BMI 22.1 ± 3.6 and targeted heart rate $134.4144.4 \pm 9.51$. P value was 0.000, so targeted heart rate of badminton players was significantly higher than squash group. Heart rate before game was 80.6 ± 12.75 in badminton and 89.90 ± 13.61 in squash. P value is 0.003 which showed significant difference among two groups. After 1 minute of game heart rate of both groups increased markedly, 131.5 ± 24.82 for badminton players and for squash players it is 136.10 ± 15.70 and the P value was 0.416 which showed no significant difference. After 5 minutes heart rate was higher for squash players and lower for badminton players. So, it was concluded that after 5 minutes heart rate of badminton players recovered faster as compared to squash players and the P value is 0.002 so there is a significant difference between both groups which means heart rate of badminton players recover at significantly faster than squash players (Table 1).

Table 1: Targeted Heart Rate (THR)

Players	Targeted Heart Rate		HR Before Play	HR 1 min After Play	HR 5 min After Play
	Min.	Max.			
Badminton	157.8 ± 5.91	167.8 ± 5.91	80.6 ± 12.75	131.5 ± 24.82	98.1 ± 15.00
Squash	134.4 ± 9.51	144.4 ± 9.51	89.9 ± 13.6	136.10 ± 15.7	101.6 ± 15.47
P value	0.000		0.003	0.416	0.002

Similarly, SPO₂ was before game was 97.6 ± 0.68 in badminton and 97.35 ± 1.03 in squash players and P value is 0.37 which shows no significant difference. After 1 minute of game SPO₂ was 96.7 ± 1.03 in badminton and 97.50 ± 0.760 in squash players and the P value is 0.28 which indicate no significant difference. 5 minutes post game SPO₂ was 96.95 ± 1.7 in badminton and 97.50 ± 0.56 in squash players and the P value is 0.211 which showed no significant difference. There was no significant change in blood pressure before and after game but blood pressure of squash players was higher 1 minute after game as compared to badminton group. Rate of perceived exertion RPE in badminton players is 6.85 ± 1.08 in badminton and 6.9 ± 1.09 in squash players. P value is 0.77 which indicate that there is no significant difference in the RPE of both badminton and squash groups.

Table 2: Rockport walk test

Parameters	Time taken to complete Test	Vo ₂ max	Spo ₂ before test	Spo ₂ After test	Hr before Test	Hr after test
Badminton	11.1 ± 3.2	53.5 ± 12.6	97.6 ± 0.68	95.4 ± 2.0	89.0 ± 13.6	170.0 ± 14.3
Squash	15.9 ± 5.4	41.7 ± 18.2	97.4 ± 1.03	97.1 ± 1.7	89.9 ± 13.6	142.6 ± 28.0
P Value	0.001	0.023	0.375	0.006	0.033	0.001

Meanwhile in Rockport walk test, time taken to complete one mile was 11.21 ± 3.18 in badminton and 15.9 ± 5.39 in squash players. The P value is 0.001 showed significant difference. VO₂ max was 53.49 ± 12.5 in badminton and 41.96 ± 18.22 in squash. The p value is 0.023. SPO₂ before start was 97.6 ± 0.68 in badminton and 97.35 ± 1.03 in squash. P value is 0.375. SPO₂

after completion of test was 95.40 ± 2.01 in badminton and 97.10 ± 1.65 in squash. P value is 0.006. Heart rate before start of Rockport test was 89.0 ± 13.59 in badminton and 89.9 ± 14.31 in squash players. P value is 0.033. HR after completion of test was 170 ± 14.32 in badminton and 142.6 ± 28 in squash players. P value is 0.001 (Table 2).

Chi Square was applied to find the association and between game a player plays and results of 3 minutes step test was 0.001 which shows results of badminton players are significantly better than those of squash and Rockport walk test was 0.001 (Table 3).

Table 3: Chi Square Association

		Value	Df	Asymp. Sig. (2 sided)
Rockport Walk Test	Pearson Chi Square	7.540 ^a	4	0.001
	Likelihood Ratio	8.354	4	0.079
	Linear by Linear	4.616	1	0.32
	Pearson Chi Square	13.486 ^a	4	0.009
	Likelihood Ratio	17.096	4	0.002
3-Minute Step Test	Linear by Linear	11.152	1	0.001
	Valid Cases		40	

DISCUSSION

Heart rate recovery can be used as a valid mean of predicting cardiac health. In our study our main focus was heart rate recovery. A methodical analysis on Relationships between resting heart rate, heart rate variability and sleep characteristics among female collegiate cross-country athletes was conducted by Sekiguchi Y, Adams W Met al in 2018(8). The authors came to a conclusion that HRR has the possibility to become a precious tool to note changes in training status in athletes. So, we took heart rate recovery as a mean to estimate the fitness of players among two games. People who engage regularly in physical activities or sports have a faster heart rate recovery than people participating in no such activity. In 2012 a research conducted by Haroonrashid M. et al compared RHR response in not so active and Physically Active Young Healthy Adults of Bijapur, Karnataka, India(9). Percent recovery heart rate and percent decrease of blood pressure were notably quicker in healthy adults than not so active individuals(9). This result supports our study whose result shows that including physical activity in everyday life has a substantial impact on cardiovascular fitness. TafurTascón LJet al in 2019 conducted a study on Colombian rugby player Autonomic modulation and association with the performance in a jump test. The result showed quicker HR recovery after exercise in the rugby players.(10). This study also supported our results which concluded faster heart rate recovery in Badminton playing individuals.

So, it has been an established fact now that physical activity such as any sports has an impact on heart rate recovery but we compared two forms of physical activities in our studies which were badminton and squash as both are considered to be important racquet games. According to our results on which we applied independent T test on heart rate recovery it was evident that badminton players have a faster heart rate recovery than squash players. Similar was the case with cardiopulmonary fitness that overall, with a slight margin badminton players showed better results than badminton players. We also compared blood pressure at different stages in game between both groups. Our study proved that blood pressure of both the groups was normal pre game. Hilde Mosby Berge and his colleagues conducted a study in 2013 on male football players in college which showed high ambulatory blood pressure in male footballers(11). This result contraindicated our study's result as blood pressure without playing in our study was normal.

In 2015 HM Berge et al conducted a systematic review to check relation between hypertrophy of left ventricle and hypertension and also checked BP and hypertension prevalence in various elite athletes, they concluded that BP and prevalence of hypertension in athletes differ considerably partly because of

variations in methodology, but type and intensity of training also play an important role higher BP. In this study they proved that blood pressure cannot strictly depend on one factor i.e. playing sports but it depends on intensity of exercise, age, gender and other factors. In this study some type of sports showed hypertension while others not but basically results of younger player showed no increase in blood pressure(12). So, result of this study supports our results because our study was also conducted on population of mean age 25 and there was no elevated blood pressure in them.

Braz J med conducted a research in which he compared blood pressure post exercise. He concluded that Systolic, mean, and diastolic BP after exercise were significantly lower than baseline, and there was no difference between the three exercise intensities(13).

This study contradicts our study in which post 10 minutes' game blood pressure remained same.

RPE was also compared between both groups post 10 minutes game. In 2007, Franco M Impellizeri examined the effect of field area, type of exercises, motivation by coach on the intensity and reproducibility of small-sided games of soccer. RPE was 4.8 in lower intensity soccer game and 7.2 in comparatively higher intensity game(14). In Our study RPE was 6.85 in badminton and 6.9 in squash players.

To check the cardiovascular endurance two tests were selected, Rockport one mile test was considered a valuable mean. A research on invention of 1-mile walk tests to reckon aerobic fitness in children was designed by Hoyong Sung et al in 2017(15). The study focused on the model that included 1-mile walk time, age, and gender. That were suitable for fitness testing of youth in physical education, particularly for less motivated or obese young children(16). Similarly in 2011 Laura Weiglein et al in which they proved. The 1 mile walk Test is a good predictor of VO2 max and is a reliable substitute fitness test to the 1.5 mile run in males U.S. Air Force(17). So, we tried this test on two sports badminton and squash. According to our results a badminton players showed more superior results than squash and more amount of squash players were in very poor category.

Second test was 3-minute step test which was taken into account also for cardiovascular fitness. In 2015, Hunter Bennett et al conducted a systemic review on submaximal step tests validity, to evaluate maximal oxygen consumption in fit adults. They concluded that step tests are safe and practical approach of evaluating cardiorespiratory fitness done in submaximal conditions and hence offer high potential to be used to evaluate health in the common adult population, and in a clinical or rehabilitation setting(18). So, we took 3 minute step test as a mean and as the results showed badminton players were better than squash players.

CONCLUSION

This study showed that people who were playing regular badminton from more than 6 months showed faster heart rate recovery as compared to those playing squash. According to results of cardiopulmonary fitness test badminton players showed better result than squash players. So, we conclude that playing

regular badminton for fitness purposes showed better results in cardiovascular health and heart rate recovery than playing squash.

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