Effect of exercise on pulse rate in young college students: An observational study

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ABSTRACT:

Introduction: Pulse rate is the count of heartbeats per minute. It varies due to varied factors and conditions like obesity, diabetes, and other diseases. Normal adult pulse rate varies from 60-100 beats per minute. Pulse rate can be measured in various places of the body like a radial artery, carotid artery, and popliteal artery of the body. The throbbing effect is counted as beats that occur due to the pumping action of the left ventricle. **Aim:** The study aims to analyze the effect of exercise on pulse rate in young college students. **Methodology:** The study is done in the gym of the Dental College, Chennai. 20 individuals are selected and their pulse rates before and after workouts pulse rate is measured. They are compared with various parameters like gym duration per day and how long they are going to the gym. The analysis is done in SPSS software. The data were statistically analyzed using Chi-square and paired t-test systematically using SPSS V.106. The participants were selected based on inclusion criteria such as age (18-22 years) and gender (male); height, weight, and other qualities were considered to be independent variables. **Results:** There was no significant difference in the pulse rate of participants before and after the gym activity (P = 0.32). The participants who exercised for a longer duration had low pulse rates both resting (before) and after the workout as compared to the individuals who exercisedfor a shorter duration (P=0.679). **Conclusion:** Although there is no effect on the pulse rate of the gym-going persons, exercising for a longer duration may affect cardiac function. Exercising for a longer duration may reduce the stress on the heart which will be beneficial in the long term.

Keywords: Pulse rate, resting pulse rate, blood pressure, atherosclerosis, hyperbolic sympathetic activity, innovative technique.

INTRODUCTION:

Pulse rate is normally the count of heartbeats per minute. The normal pulse rate varies from 60 - 100 bpm (1). Pulse rate is influenced by various external and internal factors, variations are seen during specific conditions like diabetes mellitus, obesity, increase in altitude, and age (2). Resting pulse rate is always an easy method to assess neurological fitness(3). Decreased RPR

(bradycardia) is found in regularly practicing adults and other healthy people(4). Pulse rate is counted by measuring the number of beats (throbbing effect) of the heart (left ventricle) and is felt in the middle finger while measuring in the radial artery by the palpatory method. Pulse rate is usually increased for the persons who are obese this is because the saturated fat gets deposited in the walls of the arteries and blood vessels so that the blood flows through it in high pressure and the pulse rate tends to be increased(5).

Most of the studies are done in establishing the relationship between the pulse rate and other parameters(6). Resting pulse rate sometimes shows the degree of how healthy an individual is. Endurance athletes and regularly working individuals tested for pulse rate. The results showed that the subjects had a low pulse rate when compared to others with illness and other conditions(7). Sinus bradycardia is commonly observed in case persons (8–10) who undergo regular and vigorous workouts, this is because the heart gets adapted to various kinds of physical stress it is put into in a regular period. In the early stages, changes occurring in the neural input (vagal tone) were thought to lead to bradycardia (decreased pulse rate) in athletes(11). The strong cardiac muscular tensility makes the conduction potential stronger for regular athletes. However, several studies have demonstrated that even after blocking these inputs (autonomic blockade), athletes continue to have lower pulse rates than non-athletes(12). Recent research done using rats of Wistar strain suggests the bradycardia is due to intrinsic changes within the heart by down-regulation of the HCN4 gene (13). In the test rats ivabradine, (which is a drug given to treat heart failure) helped to equalize the pulse rates in athlete and non-athlete mice(14,15). Athlete's hearts often develop odd electrical changes that sometimes can trigger heart problems (16). An athlete's electrocardiogram might show abnormal arrhythmia, heart block and other symptoms that signals heart disease if spotted in a nonathlete, says heart surgeon and tri-athlete, Lawrence L. Creswell. Adrenaline-based studies are also important in determining the pulse rate of an individual as it acts by increasing the pulse rate(17). An increase in pulse rate can lead to various risk factors like heart failure. Resting pulse rate each contributes and reflects internal organ pathology. An abnormal increase in pulse rate, because of imbalances of the involuntary systema nervosum with hyperbolic sympathetic activity or reduced pneumogastric tone, has an impression on perfusion-contraction matching, which is the process that regulates heart muscle blood and performance(18–20). Within the healthy heart, an abnormal increase in metabolism as a result of exaggerated contracted performance ends up in elevated heart muscle blood flow and, to a lesser degree. In the presence of arterial blood vessel ailment, perfusion-contraction mismatching is localized to areas of inadequate care. Once arterial blood vessel flow is insufficient to satisfy demands, contracted and pulsation functions within the affected space area unit are correspondingly reduced. A rise in rate results not solely in a rise in heart muscle atomic number 8 demands, however conjointly a possible impairment of providing ensuing from a discount of collateral insertion pressure and collateral flow. This imbalance could promote anemia, arrhythmias, and other pathophysiological conditions. Our team has extensive knowledge and research experience that has translated into high quality publications (21)[-(22–26)].

Although many previous works were established in pulse rate and comparison, only meager studies were done based on comparison of pulse rate before and after a workout, Most of the previous research works include the only collection of data through forms circulated but the current study includes a collection of data such as the pulse rate and other criteria. The main aim of this study is to analyze the effect of exercise on pulse rate in young college students.

METHODOLOGY:

The cross-sectional study was conducted in February 2021 in the gym of Saveetha Dental College, Chennai. Permissions to undertake the study were obtained from the gym in charge and the gym attendees (participants) were clearly explained about the procedure of the study that is being done. The study was done only after receiving their written consent. The study was done in a single day which was in-contact with the participants. 20 male participants of age groups between 18-22 years were selected on inclusion criteria like age, attending gym and males and exclusion criteria like height and weight. The pros of the study were standard sampling, properly assessed methods of measuring the pulse rate, participants without any ailment were selected and proper safety measures required for the COVID-‘19 pandemic were taken. Methods (palpatory method) to find the pulse rate was taught on a two-day training basis by the staff of Saveetha Dental College and an expert in the subject, Chennai. The pulse rate was measured in beats per second (bpm).

Pulse rate estimation

The pulse rate was estimated using palpatory method. The ring and the index fingers were used to palpate the radial artery, whereas the middle finger was indulged in measuring the pulse rate by feeling the rate of throbbing which is due to the contraction and relaxation of the left ventricle of the heart. Resting pulse rate was measured as soon as the participant arrived at the gym, taken ten minutes later after he arrived in the gym. Then all the gym participants were asked to perform basic exercises of the gym like treadmill, lat (Latissimus dorsi) pull, and pull-push-ups. Then after the workout including a standing time for two minutes the pulse rate was again measured and the data were recorded in an excel sheet.

Essential details like age, height, weight, their duration in the gym, and how long they are in the gym were collected manually. The BMI was calculated using weight(Kg)/(height in M)^2. Then the measured pulse rate was recorded manually and entered into the excel sheet. The data collected were tabulated, retrieved, and imported to SPSS analytical software. The data were statistically analyzed using Chi-square and paired t-test systematically using SPSS V.106. The participants were selected based on inclusion criteria such as age (18-22 years) and gender (male); height, weight, and other qualities were considered to be independent variables.

RESULTS:

The graphs demonstrated the associations for BMI correlation for the number of participants attending the gym and the time from when they attend the gym and the pulse rate difference correlation compared with the participants’ gym duration per day and the number of the participants in percentage. From the graph, it is clear that most of the participants who are attending the gym for about three weeks have a BMI of about 28 Kg/m²**.** Some (10.53%) of the participants of three months have a BMI of about (10.53%) 29.3 Kg/m² followed by participants (5.26%)with BMI of 25.5, 27.2, 28 Kg/m² and the same in case of persons with a year in the gym. But in the case of gym-going individuals for about 2 and 3 years they have less BMI when compared to other group individuals. Most of the participants from the 2-year group have a BMI of about 27.2 Kg/m² and 25.5 and 26.6 Kg/m² were the BMI in the case of three years **[Table 1]**. The participants who attended the gym for about 1.5 hours had a pulse rate difference of 9 bpm (10.53%), 10 (15.79%) bpm, and 16 (10.53%). The gym participants who attended the gym for about 2 hours per day had a pulse rate difference of about 9 (15.79%) bpm, 10 (21.05%) bpm, 13 (5.26%) bpm, 15 (10.53%) bpm, and 16 (6.26%) bpm. And a pulse rate difference of 13(5.26%) bpm who was attending the gym for about three hours **[Figure 1]**. The pulse rate was analysed statistically with a paired sample

t test in SPSS version 23, and obtained a p value of .32 which was more than 0.05. This shows that the difference between pulse rate before and after the gym activity was not significantly different.

The participants' BMI was analyzed with the duration of the gym activity. The gym participants' BMI was calculated. It was found that the participants who were attending the gym for three weeks had a BMI of about 27.2 Kg/m^2 (1 participant) and 28 Kg/m^2 (3 participants). They have increased BMI because their body has exceeded the prescribed body weight, and are almost in the obesity margin. Obese persons have increased BMI when compared to normal individuals as their body weight is too heavy due to the presence of fat deposits in the body(27). Regular and strenuous exercises are essential for them to get into a healthy state and normal adult BMI (25 Kg). Then on analysis of the participants who were attending a gym for about three months, and their BMI was found to be 25.5 Kg/m^2 (1 participant), 27.2 Kg/m^2 (1 participant), 28 Kg/m^2 (1 participant), and 29.3 Kg/m^2 (2 participants). In another similar study which was done on the participants of strength and endurance training, attendees were analyzed with BMI which is normal even in increased muscle fibrillar mass. As height and weight play an important role in the analysis of the BMI of a person(28). In theOn the analysis, the BMI of attendees who attended the gym for about six months were analyzed. Their BMI was found to be 25.5 Kg/m^2 (1 participant). They had a normal BMI at an average of 24.75 Kg/m^2, as his height and weight were intact. In a similar study on analysis of high school female students and the study their pulse rate was also estimated and was found to be at an average of 60 bpm. (29). Then on analysis of the gym attendees who were attending for some time of one, two, and three years; their BMI was in respect to height as some were involved with extensive enlargement of muscles [**Table 1]**.
The participants' pulse rate difference correlation was analyzed with their gym duration per day. On analysis of gym duration of about 1.5 hours, the before and after workout pulse rate difference was 9 bpm (10.53% - 2 participants), 10 bpm (15.79% - 3 participants), and 16 bpm (10.53% - 2 participants). Then the analysis of gym attendees of about 2 hours and the difference was observed to be 9 bpm (15.79% - 3 participants), 10 bpm (21.05% - 4 participants), 13 bpm (5.26% - 1 participant), 15 bpm (10.53% - participants) and 16 bpm (5.26% - 1 participant). And then analysis of gym participants who were in the gym for about 3 hours, the pulse rate difference was found to be 13 bpm (5.26% - 1 participant)(30) **[Figure 1]**.

Table 1: The above table represents the BMI correlation for the number of participants attending the gym and the duration of the gym activity.

BMI (Kg/m^2)	Three weeks (No. of participants)	Three months (No. of participants)	Six months (No. of participants)	One year (No. of participants)	Two years (No. of participants)	Three years (No. of participants)
25.5	-	1	1	1	1	1
26.6	-	-	-	-	-	1
27.2	1	1	-	1	2	-
28	3	1	-	1	-	-

29.3	-	2	-	2	-	-

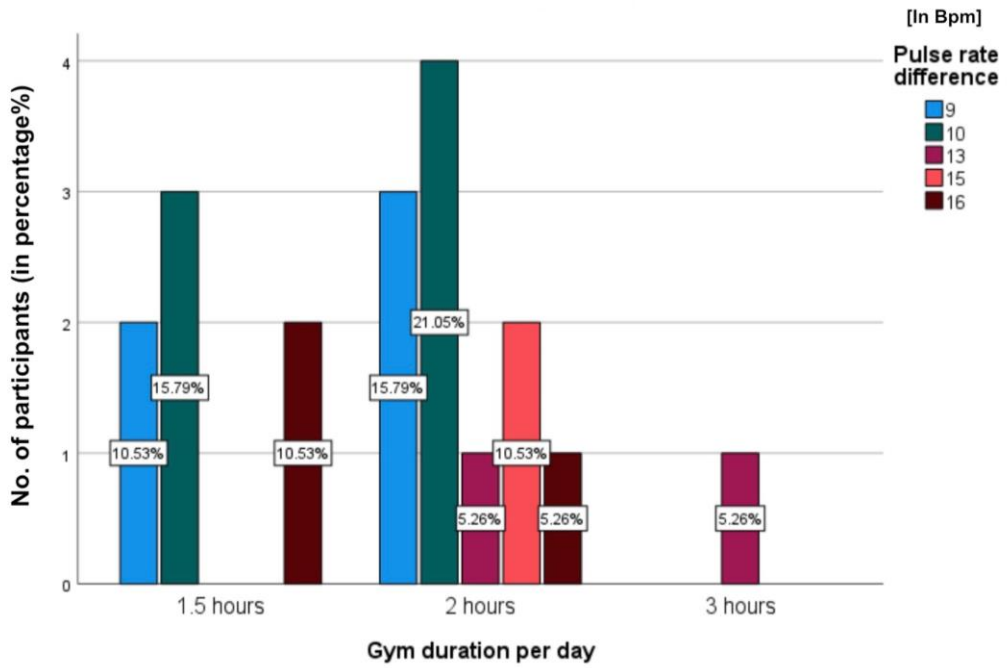

Figure 1: The above bar graph represents the pulse rate difference (before and after) correlation compared with the participants' gym duration per day and the number of the participants in percentage. The X axis represents the participants' gym duration per day and the Y axis represents the percentage of participants. Blue represents participants who had a pulse rate difference of 9 bpm, dark green represents the gym participants with pulse rate difference of 10 bpm, dark pink represents the pulse rate with a difference of 13 bpm, 15 bpm represented in orange and 16 bpm represented in dark brown colour. Participants who attended gym for about 1.5 hours had a pulse rate difference of 9 bpm [10.53%, blue] and 10 bpm [15.79%, dark green]. Participants who attended gym for about 2 hours had a pulse rate difference of 9 bpm [15.79%, blue], 10 bpm [21.05%, green], 13 bpm [5.26%, pink], 15 bpm [10.53%, orange], 16 bpm [5.26%, dark brown]. Participants who attended gym for about 3 hours had a pulse rate difference of about 13 bpm [5.26%, pink]. The results obtained are not significant statistically, as the P value obtained is 0.679 (>0.05, greater than 0.05 so it is not significant statistically).

DISCUSSION:

In a study where the pulse rate was compared with the athletes and normal people, it was found that the athletes were healthier when compared to normal persons, as their pulse rate was less when compared to the other individuals. pulse rate measured during the exercise acts as an accurate marker of performance and various other fitness-related activities. In a cross-sectional study, basketball players were monitored weekly, the after exercise pulse rate was measured at regular intervals after every game they played(31). Intense workouts for a regular period in a repetitive manner results in decreased pulse rate during exercise. Some similar studies include a comparison of various sports players but it is not recommended as a training scheme and the number of players

involved in a sport/game also plays an important role in the analysis of the pulse rate of an individual. Cardiac adaptations differ with each type of sport. Few sports like weight lifting, bodybuilding, and power throwing involve differential cardiac adaptability, whose pulse rate would be lower when compared to athletes performing activities like running and other fields involving sports events. In another long-term follow-up study, a badminton player was assessed for the examination of pulse rate; sequential changes were not observed as there were no patterned changes observed(32). This was observed in an analysis of players from an individual performance sport because the playing pattern is subjected only to the person, so that variation was observed. Although there was no particular trend the pulse rate followed the measure of resting pulse rate and after the game workout was less when compared to normal individuals. In a cross-sectional study, a total of 60 obese persons were analyzed for their resting pulse rate, the pulse rate was 89 bpm which is increased when compared to normal healthy individuals. Obese persons had an increased pulse rate, due to constricted blood vessels. In team sports, daily morning assessments could prove helpful, particularly in short- to mid-term periods of accumulated stress, like the analysis of pronounced travel hundreds or coaching camps(33). The pulse rate was measured in the current study with the palpatory method, in another study wearable, infra-red pulse oximeter sensors(34) were worn by the athletes for the physical fitness examination. In the analysis, it was found that some individuals who were not fit had an elevated pulse rate when compared to the trend of their previous reports. Training intensity is the measure of aerobic fitness and the key determinant factor for testing cardiac activity. Positions of the body during diagnosis of the pulse rate also act as a factor affecting the pulse count.

The limitations of the current study involve less sample size, increased sample size gives more variability in the results. Only males of the age group between 18-22 years were selected for the study, so for the study females can also be included and the pulse rate of females can be compared with the pulse rate of the males. So that we can get a comparative analysis for the current study. COVID-19 pandemic also played a role in undertaking the study, so large gym-going people were not assessed for their pulse rate. Dietary habits also play an important role in the fitness estimation of a person. So in future studies in the same field, dietary habits can also be analyzed for the betterment of the results.

CONCLUSION:

Although there is no effect on the pulse rate of the gym-going persons, exercising for a longer duration may affect the cardiac function. Exercising for a longer duration may reduce the stress on the heart which will be beneficial in the long term

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