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Effect of different body positions on heart rate recovery after a sub-maximal test in obese individuals

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Abstract

Background: Obesity as well as cardiorespiratory fitness is considered to be independent predictors of cardiovascular mortality and all acute mortality rates. Overweight and obesity is associated with cardiovascular diseases. The autonomic nervous system plays an important role in genesis, maintenance and interruption of ventricular arrhythmias. In most instances, especially during post exercise period, the sympathetic activation enhances ventricular arrhythmias and higher vagal activity suppresses the occurrence. As such, means of acutely improving post exercise parasympathetic reactivation, as assessed non-invasively through analysis of heart rate and heart rate recovery. Exercises are characterised by a decrease in the parasympathetic tone and increase sympathetic tone, this in turn causes increased heart rate. Heart rate is a good and an immediate measure of general health. A delay in reduction of a heart rate or delay in heart rate recovery during the first minute after submaximal test or after an exercise has been told to be strongly associated with all-cause mortality and is used to predict the mortality rate Changes in positions have been used since decades to challenge the autonomic nervous system and produce acute and immediate effects on parasympathetic activity. Thus, the present study aims at finding the effect of position that causes a faster heart rate recovery in obese individuals after a submaximal test.**Objectives**: To find the effect of different body positions including supine, 70 degree leg raise in supine with support and 90 degree leg raise in supine with wall support on heart rate recovery after a submaximal test in obese individuals and to find the most effective position among all three. **Materials and methods:** In this study 30 obese individuals were selected according to the inclusion and exclusion criteria, the heart rates were measured noninvasively pre-test followed by a submaximal incremental shuttle walk test. The heart rate recovery was measured in each minute for 5 minutes post-test continuously while the subject was lying in the testing position and a subject perception scale was filled. The procedure was repeated another two days for evaluating heart rate in other two positions.**Results**: All the parameters showed statistically significant faster recovery of heart rate in 70 degree leg raise position with least minimum difference as compared to 90 degree leg raise and supine positions. **Conclusion**: Supine with supported 70 degree leg raise position is most effective and is the most comfortable position for faster recovery of heart rate in obese individuals after a submaximal test.

Keyword: Heart rate recoveries, leg raise, sub maximal test, obese, subject perception scale.

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Introduction:

Overweight and obesity is associated with cardiovascular diseases. Obesity is an excessive fat accumulation which may impair health. A study done in 2016 shows that more than 1.9 billion adults and 18 years and older population were overweight. Amongst these over 650 million were significantly obese.39% of adults aged 18 years and above were overweight on 2016 and 13% were obese. A simple index used to calculate the obesity in a person by measuring weight-for-height is Body Mass Index (BMI) that is commonly used to classify overweight and obesity in humans. Body mass index is defined as a person's weight measured in kilograms divided by the square of his height in metres (kg/m^2) according to the WHO fact sheet.

Civilization makes our lives pleasant, luxuriant and jubilant. But, automation and other technologies have contributed to lessen the physical activities at work place and home and this sedentary life that is the lack of exercise is contributing to reduce cardio respiratory fitness. Obesity as well as cardiorespiratory fitness is considered to be independent predictors of cardiovascular mortality and all acute mortality rate. Previous studies have researched that decrease in cardiorespiratory fitness and increased adiposity was to be associated directly with reduced AC. Interventional studies have predicted that exercise training can improve compliance of larger capacitance arteries either independently or in association with improvements in cardiorespiratory fitness. Though, it is not proven if the protective effects of cardiorespiratory fitness in relation with reduced cardiovascular mortality risk might be in some way mediated by increased arterial compliance. Exercise is a great method to maintain and improve cardiovascular fitness hence, the assessment of cardiorespiratory fitness is extremely necessary which can be performed with various types of exercise testing.

The submaximal exercise testing or submaximal clinical exercise tolerance testing (SXTT) gives a clinical data that is an important foundation for an effective exercise prescription. The exercise prescription will identify the at risk patients who should undergo further medical evaluation and treatments. ACSM Guidelines for Exercise Testing and Prescriptiondescribes the standard submaximal exercise tests by Noonan et al to estimate the amount of maximal oxygen uptake are based on assumptions and the important and primary assumption is that the maximal heart rate of a person going through the submaximal exercise testing is similar to a predicted maximal heart arte based on a formula such as "220-AGE"

The autonomic nervous system plays an important role in genesis, maintenance and interruption of ventricular arrhythmias. In most instances, especially during post exercise period, the sympathetic activation enhances ventricular arrhythmias and higher vagal activity suppresses the occurrence. As such, means of acutely improving post exercise parasympathetic reactivation, as assessed non-invasively through analysis of heart rate and heart rate recovery.
During exercise there is increase in release of neurohumoral agents by the sympathetic nervous system which will activate the enzyme adenylcyclase present in the cell membrane of each cell of the body. The adenylcyclase activates 3-5 cyclic- AMP which converts ATP to ADP and releases energy.The energy thus released stimulates the functioning of each cell, so the

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heart beats more rapidly and the endocrine glands release more hormones and a vasoconstriction occues due to stimulation of smooth muscles of blood vessels. Exercises are characterised by a decrease in the parasympathetic tone and increase sympathetic tone, this in turn causes increased heart rate. Heart rate is a good and an immediate measure of general health .When a person performs any activity the heart rate and myocardial contractility rate increases to meet the energy required by the active muscles during that activity. With cessation of that exercise the decrease in heart rate immediately is a main function of the reactivated parasympathetic nervous system and withdrawal of sympathetic nervous system.[2]
A delay in reduction of a heart rate or delay in heart rate recovery during the first minute after submaximal test or after an exercise has been told to be strongly associated with all-cause mortality and is used to predict the mortalityrate.[3] It has been found that higher rates of heart lead to an increased arterial stress and therefore an increased prevalence of arteriosclerosis and other cardiovascular disorders and diseases.

The active parasympathetic system causes the heart rate to return to baseline after an exercise is theorised to be due to high vagal tone associated with cardiorespiratory fitness and good health. When there is a delay in decreasing the heart rate it is a independent predictor of all-cause mortality.

Evaluation of parasympathetic system is important because various researchers have documented that a delay in parasympathetic reactivation is an indicator of future risk of cardiovascular diseases.[5]Recovery in heart rate is defined as the reduction in heart rate from the rate at peak exercise to the heart rate after one minute cessation of the exercise.[2]

Changes in positions have been used since decades to challenge the autonomic nervous system and produce acute and immediate effects on parasympathetic activity. At rest compared with upright standing position, lying can rapidly trigger parasympathetic system at a faster rate by vagal stimulation and thus decreasing the heart rate complexity. The effect of different body positions on heart rate have been partly described in studies. Compared with an upright posture the supine elicits increased cardiac output lower peripheral resistance and higher stroke volume which leads to a faster recovery of heart rate.

Heart rate recovery can be measured in different body positions previous studies have been conducted in order to search for the favourable positions for heart rate recovery some determined that the supine is the best position for the recovery some suggest supine with 90 degree leg raise is favourable, but there is a lack of evidence and literature regarding the favourable position for the heart rate recovery among obese individuals.[1] Also no evidence of calculating the heart rate at each minute starting from 1 to 5. Thus, the present study aims at finding the effect of position that causes a faster heart rate recovery in obese individuals after a submaximal test.

Methodology

The study was approved by the ethical, scientific and research committees. The study was conducted in Dr. D.Y. Patil College of Physiotherapy, Pimpri, Pune. The target population were obese individuals selected on the basis of inclusion criteria which was Age : 18-40 yrs individual,

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BMI : (30.0-34.9) (35.0-39.9), Gender : males and females and exclusion criteria which was Subjects undergoing physical training, Subjects having any respiratory and cardiovascular condition, Recent fracture, Neurological impairments,Subjects unwilling to continue with the procedure . The heart rate was measured noninvasively pre-test with help of pulse oximetre followed by a submaximal incremental shuttle walk test where the subject was asked to walk in between two cones at the sound of a beep, the gap time between the beeps was getting reduced after every lap with incrementation of the speed of the subject, subject was asked to stop when he was too breathless to run anymore. The heart rate recovery was measured in each minute for 5 minutes post-test continuously while the subject was lying in the testing position that were body positions including supine, 70 degree leg raise in supine with support and 90 degree leg raise in supine with wall support. Heart rate recovery was measured in one position on the first day with consecutive gap of two to 3 days in between was given as a washout phase.At the end of each day session a subject perception questionnaire was filled by the samples. The procedure was repeated another two days for evaluating heart rate in other two positions. Hence, a total number of three days of procedure was included in the study.

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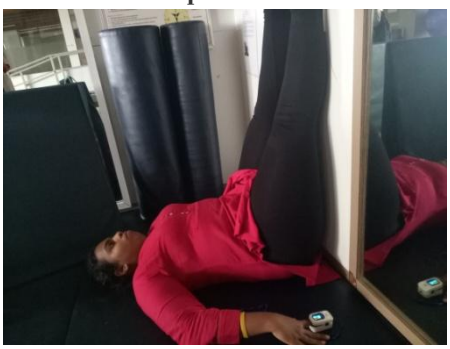

Results

Tables: Description of samples based on their personal characteristics

Demographic Variable	Frequency	%
Age		
18-24	26	86.7%
25-30	3	10.0%
Above 30	1	3.3%

Demographic Variable	Frequency	%
GENDER		
MALE	7	23.3%
FEMALE	23	76.7%

Demographic Variable	Frequency	%
BMI		
Class 1 (BMI 30.0-34.9)	20	66.7%
Class 2 (BMI 35.0-39.9)	8	26.7%
Class 3 (BMI 40 and above)	2	6.7%

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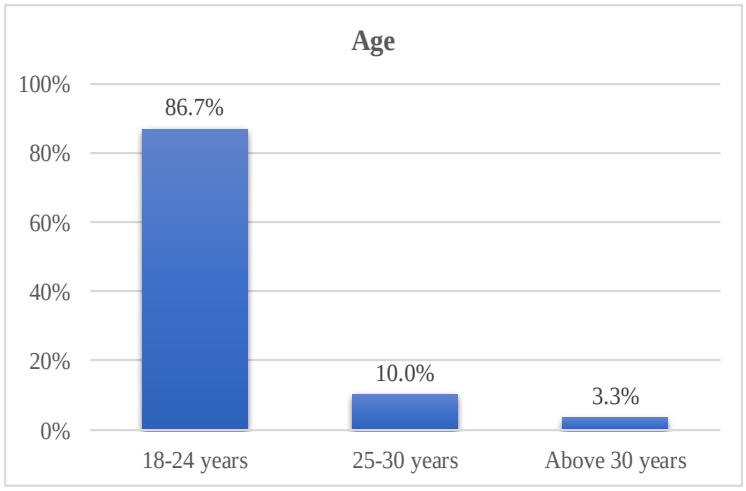
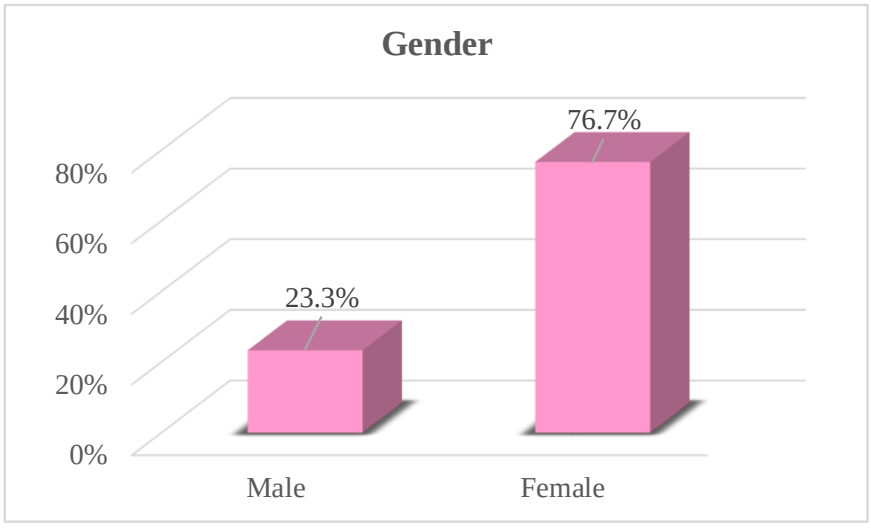
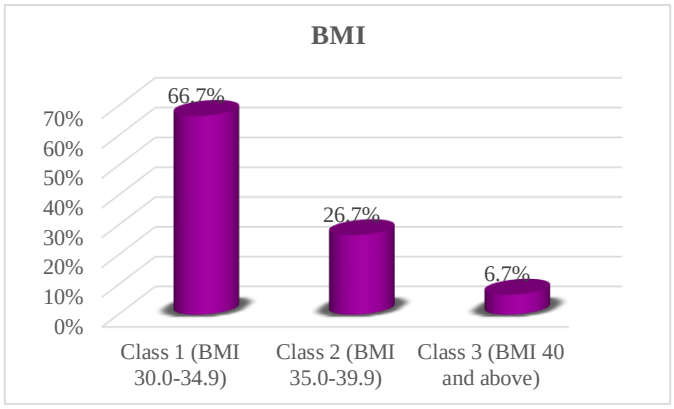


GRAPH 1



GRAPH 2



GRAPH 3

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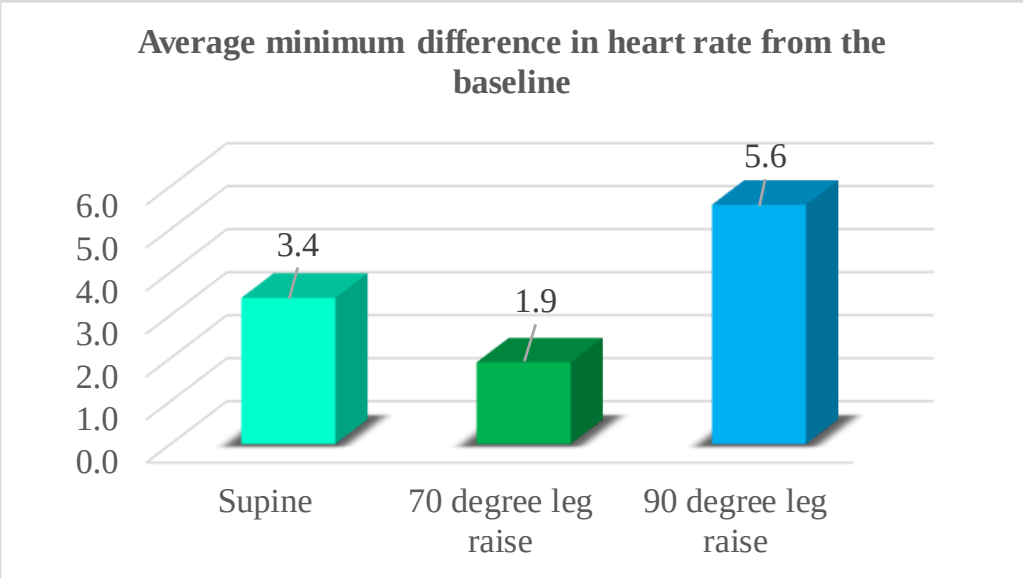
Analysis of data related to the effect of different body positions on heart rate recovery after a submaximal test in obese individuals

Table 2: The effect of different body positions on heart rate recovery after a submaximal test in obese individuals

N=30

Positions	Mean	SD	t	Df	p-value
Supine	3.4	4.1	4.1	29	0.000
70 degree leg raise	1.9	2.1	5.0	29	0.000
90 degree leg raise	5.6	6.1	5.0	29	0.000



GRAPH 4

Section 2

Analysis of data related to the Subject Perception Scale

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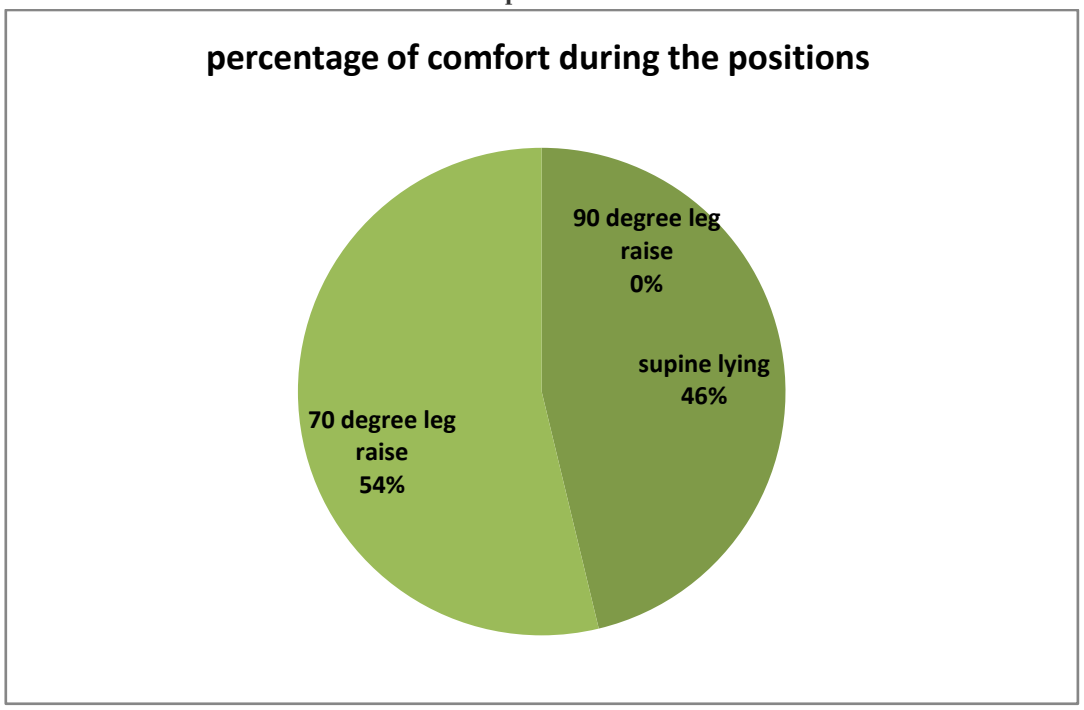
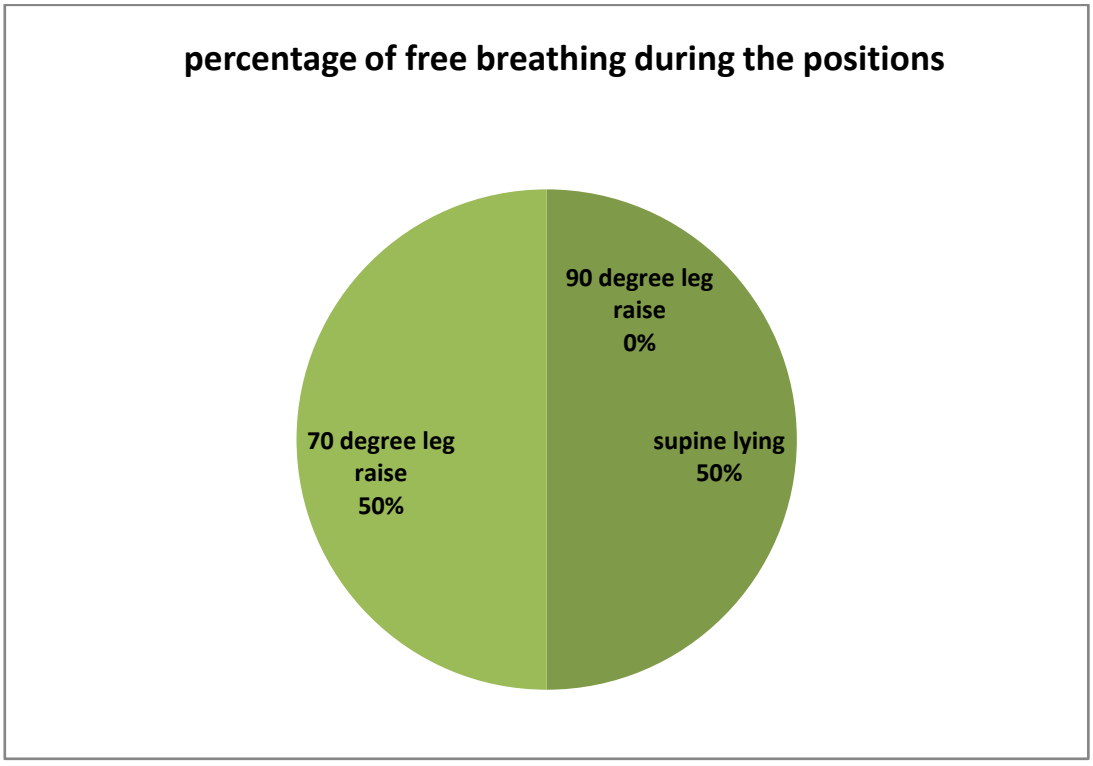


GRAPH 5



GRAPH 6

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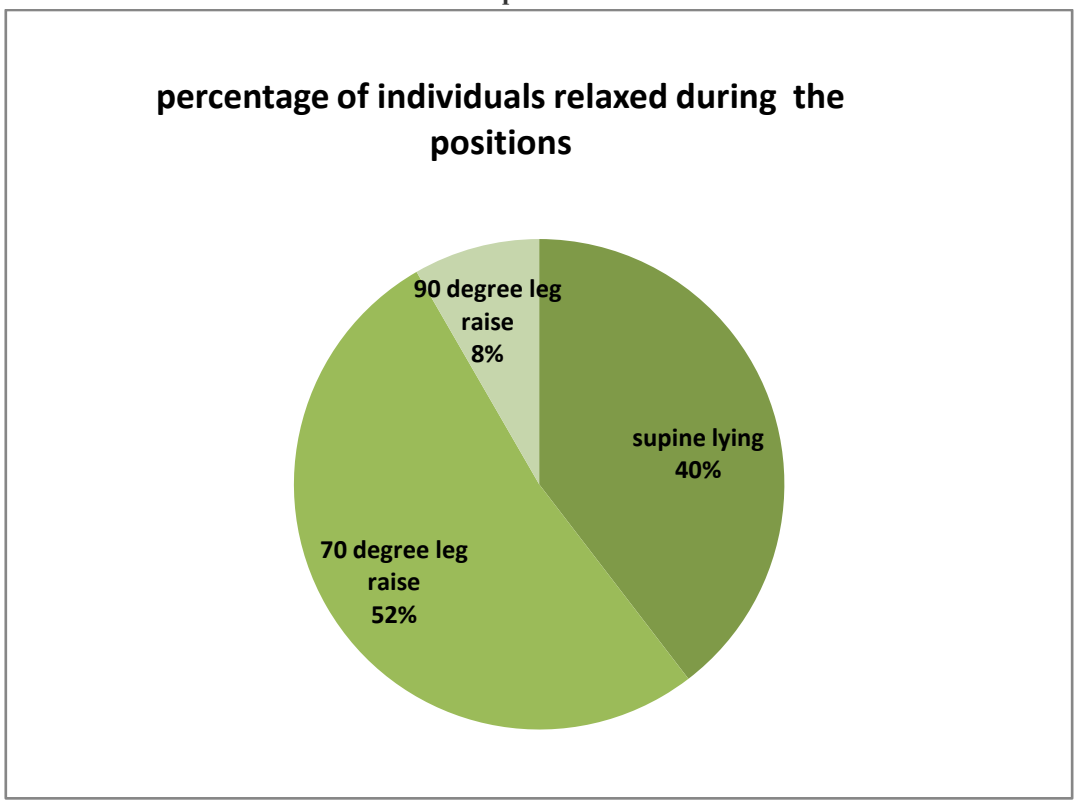

GRAPH 7

(Table 1.1, graph 1) shows 86.7% of the obese individuals had age 18-24 years, 10% of them had age 25-30 years and 3.3% of them had age above 30 years. (Table 1.2, graph 2) shows 23.3% of them were males and 76.7% of them were female. (Table 1.3, graph 3) shows 66.7% of them had class 1 BMI, 26.7% of them had class 2 BMI and 6.7% of them had class 3 BMI. (Table 2, graph 4) Researcher applied paired t-test for the effect of different body positions on heart rate recovery after a sub maximal test in obese individuals. Average minimum difference in heart rate in Supine position is 3.4, average minimum difference in heart rate in 70-degree leg rise position is 1.9 and average minimum difference in 90-degree leg rise position is 5.6. T-values for this test were 4.1, 5 and 5 with 29 degrees of freedom in supine, 70-degree leg rise and 90-degree leg rise. Corresponding p-values were 0.000, which are small (less than 0.05), null hypothesis is rejected.

Since the average minimum difference in 70-degree leg rise position is the least, 70-degree leg rise position is the best for heart rate recovery after a submaximal test in obese individuals.

(3, graph 5) Shows 54% of individuals were comfortable in 70 degree, 46% in supine and 0% in 90 degree leg raise respectively.(3, graph 6) Shows 50 % individuals during supine and 50% individuals during 70 degree leg raise were able to breathe freely during the positions.(3, graph 7) Shows 40% individuals in supine, 52% in 70 degree leg raise and 8% in 90 degree leg raise felt relaxed during the positions.

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Discussion

In this study we have evaluated the effect of three different body positions on the recovery of heart rate among obese people . Here we measured and documented the heart rate of an individual at the baseline and then after the submaximal test which was incremental shuttle run test. There was an increase in the heart rate during and after the exercise which was considered to be due to activation of sympathetic system and withdrawal of parasympathetic system. The reduced heart rate after the exercise completion occurs when the parasympathetic nervous system is reactivated. It was suggested that the recovery of heart rate is an significant diagnostic tool and hence, the present study tried to find the optimal position of the body which will cause a faster and efficient heart rate recovery of obese subjects who were untrained and had a similar lifestyle thus, reducing the effect of different endurances on the study.

The study involved an evaluation of three body positions that were supine lying position in a relaxed manner on a yoga mat or onto the plinth, leg raise in 70 degree from hip where the legs were raised passively and were supported by pillows or vestibular ball according to the patient comfort and length of the legs of the subjects and the third position was raising the legs in 90 degrees which was achieved by placing the subject onto the yoga mats and supporting the legs straight on the wall .

The heart rate recovery was measured in all three positions in all the subjects which was measured from the 0 minute to 5th minute. There was a visible significant difference in the recovery of heart rates between all three positions. The recovery seen in the subjects who were in the 70 degree leg raise position were seventeen in number, nine subjects showed faster heart recovery in supine position and four subjects in 90 degree leg raise. The average minimum difference in 70 degree leg raise was the least amongst all three which was 1.9.

According to the findings in this study the 70 degree leg raise has an advantage over other two positions that is 90 degree leg raise and the supine position. During this study and the procedure it was seen that the subjects were uncomfortable in 90 degree position as all the subjects were obese and they found it difficult to lie in that position. When the subjects were in 90 degree leg raise with wall support there was an increased pressure on the abdomen when the hips were flexed. This position caused the stomach to push the viscera of the diaphgrm upwards. The viscera restricted the contraction of the diaphragrm during inspiration

Which resisted the lungs to expand fully .This in turn caused a shallow and shorter breathing by the subjects. To recover from the active sympathetic nervous system the person should be completely relaxed with no pressure on abdominal and thoracic walls so that the breathing is controlled and relaxed, however in this position it was not possible for most number of individuals due to heavy weights and more abdominal girth.

In supine position, the inference from findings may be that in this position gradual shift of autonomic equilibrium to a relative parasympatho-dominance leading to decrease in the heart rate in second highest number of individuals among study population. When lying in supine position the effect of gravity on your body is reduced, allowing more blood flow to the heart through the veins and because more blood returns to the heart the body is able to pump more

blood per beat, which means that less beats per minute are required to satisfy blood , nutrients and oxygen that the body demands after a vigorous activity. Lying in supine during recovery after an exercise may be an effective in transiently restoring the heart rate and vagal modulation with a safe position for prevention of syncope.

The findings in this study shows relatively rapid decrease in heart rate with supine position with legs elevated in 70 degrees. In this position the symptoms of rapid heart rate are seen to be resolved quickly. The purpose of elevating the legs above the heart was to improve the blood flow. The gravity pulls the blood from the lower extremities thus increasing te circulatory volume that is available to the heart called as cardiac preload by around 150 to 300 millilitres depending upon the venous reservoir.. Also according to the subject perception the 70 degree leg raise position followed by supine position proved to be most comfortable and relaxing as these positions gave the least resistance against the abdomen and chest during breathing and proved to be the positions where subjects could breathe freely and in relaxed manner. The subjects were uncomfortable in 90 degree position as all the subjects were obese and they found it difficult to lie in that position. This position caused the stomach to push the viscera of the diaphgrm upwards. The viscera restricted the contraction of the diaphragrm during inspiration which resisted the lungs to expand fully .This in turn caused a shallow and shorter breathing by the subjects.

Hence, based on the patient comfort, breathing, and relaxation in subject perception questionnaire and the average minimum calculated in the statistics for all the three positions the 70 degree supported leg raise position proved to be the most efficient for the faster heart rate recovery in obese individuals.

Conclusion

A significant difference was found between the heart rate recoveries in all the three positions according to the analysis and results of the data collected, the supine with 70 degree leg raise position proved to be more effective. In this position the heart rate recovery was significantly faster in a larger number of samples out of the study population.Also, the questionnaire which was based on patient comfort and relaxed breathing showed a positive outcome towards the 70 degree leg raise position.

Therefore, the supine with 70 degree leg raise position is effective in heart rate recovery after a submaximal test in obese individuals.

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