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Study on Resting Blood Pressure and Heart rate in Individuals with Normal and High Body Mass Index

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Abstract: *Body mass index (BMI) is an established parameter to assess overweight and obesity in adults. Different studies have reported adverse effects of increased body mass index on cardiac health. Heart rate and blood pressure are largely regulated by the autonomic nervous system, and reflects the state of balance that exists between the sympathetic and parasympathetic nervous systems. The aim of this study was to search for any significant relationship between resting heart rate and resting blood pressure of different individuals with respect to their body mass index. 200 subjects (all adult males only) belonging to age groups between 20 years to 50 years were selected after informed consent of the participants. The total study sample included 100 overweight / obese subjects and 100 subjects within normal Body Mass Index (BMI). The participants were required to attain a calm and quiet posture for 10 minutes before the procedure. Thereafter, their blood pressures were measured using a mercury sphygmomanometer from the left arm in a sitting position. The heart rate as calculated by examination of the radial artery pulse, and confirmed by resting electrocardiograph. In our study, the resting blood pressures (both systolic and diastolic) were greater in overweight / obese individuals compared to normal-weight individuals. The difference was statistically significant ($p < 0.001$). Body mass index had a strong positive correlation with diastolic blood pressure [$R = 0.92$; $p < 0.00001$. This might be due to a raised sympathomotor or reduced vagal response in these subsets; consistent with higher prevalence of adverse cardiovascular outcomes in these subjects.*

Key Words: *Body mass index, blood pressure, resting heart rate.*

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I. Introduction:

Body mass index (BMI) is an established parameter to assess overweight and obesity in adults. In the recent years global prevalence of obesity has increased. This has been associated with a plethora of co-morbidities including hypertension, dyslipidemia, coronary heart disease and Type-2 diabetes mellitus [1-4].

Different studies have reported adverse effects of increased body mass index on cardiac health. Adverse cardiac events like malignant hypertension, acute coronary syndrome and sudden cardiac death are often attributed to raised sympathetic activity [5]. Heart rate and blood pressure are largely regulated by the autonomic nervous system, and reflects the state of balance that exists between the sympathetic and parasympathetic nervous systems [6]. Resting heart rates and resting blood pressures are simple yet useful parameters that can throw light on the autonomic activity of our body in health and disease.

II. Aims and Objectives:

The aim of this study was to search for any significant relationship between resting heart rate and resting blood pressure of different individuals with respect to their body mass index.

III. Materials and Methods

The subjects were taken from consenting staffs of KPC Medical College and Hospital. 200 subjects (all adult males only) belonging to age groups between 20 years to 50 years were selected after informed consent of the participants. The total study sample included 100 overweight / obese subjects and 100 subjects within normal Body Mass Index (BMI).

The subjects were distributed into two groups (A and B). The distribution of the participants was as follows:

- **Group A** consisted of 100 normotensive subjects with BMI < 25 kg/m^2.
- **Group B** consisted of 100 hypertensive subjects with BMI ≥ 25 kg/m^2.

Exclusion Criteria:

1. History of active sports training.
2. Known cardiac anomalies.
4. Any abnormalities in resting Electrocardiogram (ECG).
5. Patient on anti-hypertensive or anti-arrhythmic medications.
6. History of active medical illness such as recent acute coronary syndrome, tuberculosis, chronic lung disease like chronic obstructive pulmonary disease, interstitial lung disease, symptomatic ischemic heart disease.

Instruments Required:

1. Mercury Sphygmomanometer (Dynosure DOCTOR DT Mercurial Sphygmomanometer, MODEL DT 11, made in Japan, imported by Dynamic Tracom Private Limited).
2. Stethoscope (H. Mukherjee & Sons).
3. Weighing Machine (Virgo Manual Weighing Scale-V-9811Bblue2).
4. Stadiometer (Seca 213 Portable Stadiometer).

Procedure:

Each subject was separately explained about the study procedure and written consent was obtained from him. Weight and height of the subjects were recorded with subjects wearing light clothing and no shoes. Weight was measured using balance scale to within 100 grams. Height was measured to the nearest 0.5 cm using a Stadiometer. BMI was computed as weight (mass in kilograms) divided by the square of the subject's height in meter.

The participants were required to attain a calm and quiet posture for 10 minutes before the procedure. Thereafter, their blood pressures were measured using a mercury sphygmomanometer from the left arm in a sitting position. The first phase of Korotkoff sounds was recognised as systolic blood pressure and the fifth phase as diastolic blood pressure.

The heart rate as calculated by examination of the radial artery pulse, and confirmed by resting electrocardiograph.

Source of finance:

The study was funded by researchers.

Statistical Methods:

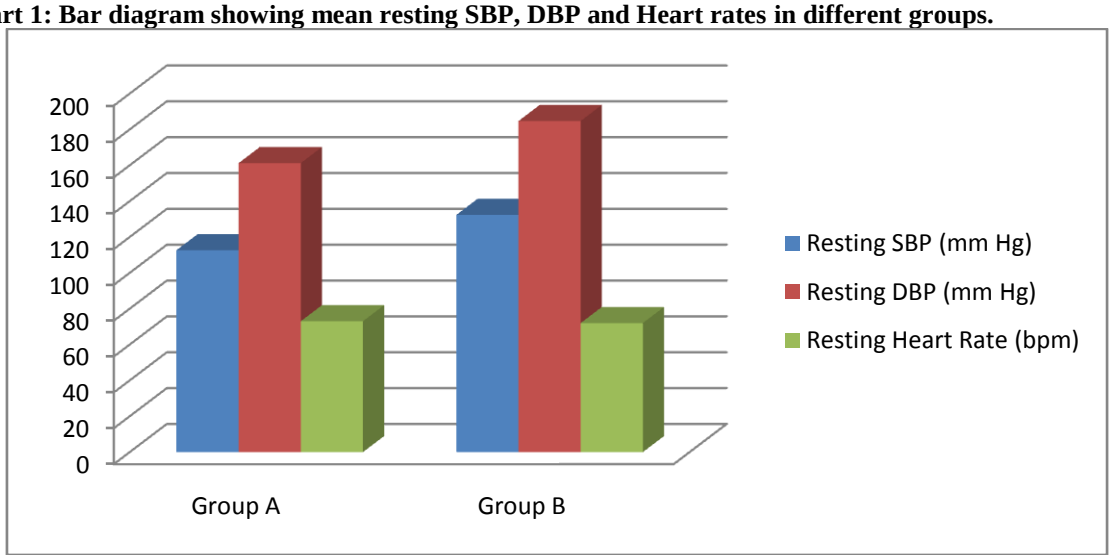
For each group, the Mean ± SD of different parameters like age, height, weight, body mass index (BMI), resting systolic blood pressure (SBP), resting diastolic blood pressure (DBP) and resting heart rate (HR) were calculated. The mean values of systolic and diastolic blood pressures, and heart rates of each study group were compared using bar-diagram. Correlations between body mass index and blood pressure or heart rate ere studied using Pearson's Correlation Coefficient. The data were analyzed using Microsoft excel 2007 and SPSS-20.

IV. Observations and Results:

Table 1: Mean ± SD of different study parameters in individuals of Groups A-B.

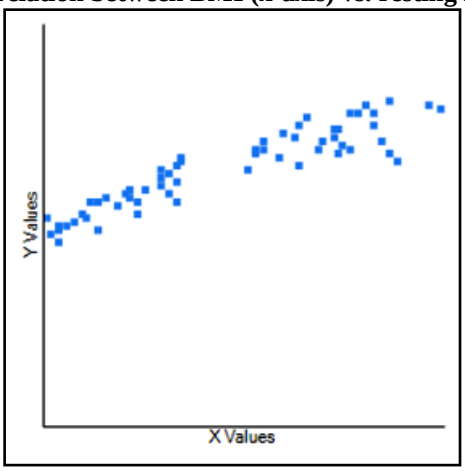
Group	Age (years)	Height (m)	Weight (kg)	BMI (kg/m^2)	Resting SBP (mm Hg)	Resting DBP (mm Hg)	Resting Heart Rate (bpm)
A [n = 100]	34.6 ± 7.4	1.60 ± 0.3	58.8 ± 3.7	22.7 ± 1.6	112.6 ± 3.5	73.7 ± 3.1	73 ± 5.4
B [n = 100]	35.2 ± 6.9	1.62 ± 0.4	64.2 ± 7.4	29.8 ± 3.6	134.6 ± 8.2	78.1 ± 7.7	72 ± 4.5

Chart 1: Bar diagram showing mean resting SBP, DBP and Heart rates in different groups.



In our study, the resting blood pressures (both systolic and diastolic) were greater in overweight / obese individuals compared to normal-weight individuals. The difference was statistically significant ($p < 0.001$). The Diastolic BP correlated more significantly with BMI than SBP.

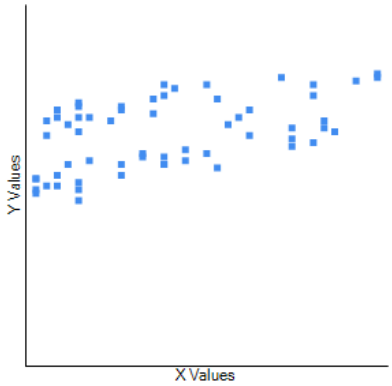
Chart 2: Correlation between BMI (x-axis) vs. resting DBP (y-axis):



The value of R is 0.9233. This is a strong positive correlation, which means that high X variable scores go with high Y variable scores (and vice versa).

The value of R^2, the coefficient of determination, is 0.8525. The P-Value is < 0.00001. The result is highly significant.

Chart 3: Correlation between BMI (x-axis) vs. resting SBP (y-axis):



The value of R is 0.5118. This is a moderate positive correlation, which means there is a tendency for high X variable scores go with high Y variable scores (and vice versa).
The value of R^2, the coefficient of determination, is 0.2619. The P-Value is <0.05. The result is statistically **significant**.

V. Discussion:

Body Mass Index (B.M.I) is the most widely used anthropometric tool for the clinical assessment of obesity [7]. It is defined as weight in kilogram divided by the square of the height in meters (W/H^2) [7]. In this study, BMI < 18.5 kg/m^2 was considered underweight, BMI within 18.5 - 24.9 kg/m^2 was considered healthy weight, BMI within 25 - 29.9 kg/m^2 was considered overweight and BMI ≥ 30 kg/m^2 was categorised as obesity, in accordance to international standards [7]. However, for Asian countries, lower cut-off values have been suggested by a WHO expert consultation for the purpose of public health action. The proposed values were 23 kg/m^2 for overweight and 27.5 kg/m^2 for obese [7].

Although, a BMI of 25 has generally been considered as the upper limit of normal, individuals with BMI at around 20, which is within normal range, have been found to have increased morbidity and mortality risks [7].

Various studies done in India from 2002-2012 indicate a rising trend in the prevalence of overweight and obesity in children and adolescents [8-13]. This may have major implications towards increasing prevalence of non-communicable disease (NCD) like diabetes, hypertension and cardiovascular disease in early adulthood [8-13].

We found a greater value of systolic and diatolic blood pressures in subjects with BMI ≥ 25 kg/m^2 (Group B) compared to the subjects with BMI < 25 kg/m^2 (Group A). Paired Student's T-tests were performed with the SBP and DBP values for each group. In all groups, the differences were *statistically significant* ($p < 0.001$). Body mass index had a strong positive correlation with diastolic blood pressure [$R = 0.92$; $p < 0.00001$]. The resting heart rate however did not have significant correlation with BMI ($p < 0.05$).

VI. Conclusion:

Blood pressure is an important predictor of cardiovascular disorders [11-15]. In this study, we found a higher value of systolic and diastolic blood pressures in overweight / obese individuals. This might be due to a raised sympathomotor or reduced vagal response in these subsets; consistent with higher prevalence of adverse cardiovascular outcomes in these subjects.

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