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***Research Article***

# BLOOD PRESSURE RESPONSE TO ISOMETRIC EXERCISE IN YOUNG OBESE MALES AND FEMALES USING HAND GRIP DYNAMOMETER TEST

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**ABSTRACT:**
In obesity, as excessive adipose tissue accumulates, an altered metabolic profile occurs along with a variety of adaptations/alterations in cardiovascular structure and function even in the absence of co-morbidities. To assess Blood pressure response to isometric exercise in obese young male and female subjects and compare the results with controls. Hand grip dynamometer test was performed to elicit Blood pressure response during the isometric exercise. The blood pressure response to an isometric exercise were reduced in obese group compared with the controls. Our data indicate that in obese subjects Blood pressure response to an isometric exercise is impaired due to a lower Sympathetic activation in obese group when compared with controls.

***Keywords:*** *Hand Grip Dynamometer; Obese; Blood Pressure, Isometric Exercise.*

## INTRODUCTION:

Laederach-Hofmann *et al.,* (2000) reveals that Obesity causes a whole spectrum of subsequent health problems. The major ones are cardiovascular, pulmonary, metabolic, orthopedic, gastroenterological and psychosocial disorders. Obese persons suffer from an increased mortality risk supposedly due to cardiovascular disorders related to either continuously lowered
parasympathetic or altered sympathetic activation.

Hotamisligil *et al.,* (1995) suggests that the adipose tissue is not simply a passive storehouse for fat but an endocrine organ that is capable of synthesizing and releasing into the blood stream an important variety of peptides and non-peptide compounds that may play a role in cardiovascular homeostasis. Adipose tissue is a significant source of Tumor Necrosis Factor-alpha (TNF- α), interleukin-6, plasminogen activator inhibitor-1, leptin, angiotensinogen and insulin like growth factor – 1 (IGF-1).

Poirier *et al.,* (2005) observed that Weight gain in young people is a potent risk factor for subsequent development of hypertension. The increase in blood pressure is greatest when the obesity is of abdominal distribution. Factors linking obesity to increase in Blood Pressure (BP) include 1) direct effects of obesity on hemodynamics and 2) mechanisms linking obesity and an increase in peripheral vascular resistance; endothelial dysfunction, insulin resistance, sympathetic nervous system over activity, substances released from adipocytes (IL-6, TNF and so forth) and sleep apnea.

Valensi *et al.,* (1999) investigated that that BP response to an isometric contraction is impaired in obese patients due to a lower sympathetic activation. Systolic BP and diastolic BP also increased from the first to the fifth minute with a maximum increase at the fifth minute (15.8 ± 3.0mmHg and 11.9 ± 1.6 mmHg, respectively). Haemodynamic response did not differ significantly in men and women

Stamler *et al.,* (1978) suggests that the hypertension is about 6 times more frequent in obese subjects than in lean men and women. Weight gain in young people is a potent risk factor for subsequent development of hypertension. The increase in blood pressure is greatest when the obesity is of abdominal distribution.

Jonge *et al.,* (2010) reveals a general decrease of the sympathetic nervous system (SNS) component in all groups while the parasympathetic nervous system (PNS) component increased, indicating an improvement of the SNS/PNS balance

Akhter *et al.,* (2010) studied the relationship between sympathetic nerve function and obesity and concluded that mean values of resting heart rate, resting systolic and diastolic blood pressure were significantly ($p < 0.05$) higher and both the sympathetic nerve function parameters (BP response to hand grip and BP response to standing) were significantly ($p > 0.05$) lower in obese compared to those of non obese control subjects. Again, BP response to hand grip were negatively and BP response to standing were positively correlated with BMI in all subjects. These correlations are statistically significant ($p < 0.05$).

## MATERIALS AND METHODS

60 obese and 60 non-obese young males and females of the age group 18-25 years were selected randomly from the general population.

***Inclusion* criteria:**

- Young obese males and female aged 18-25 years.
- Young non obese males and females aged 18-25 years.

***Exclusion criteria:***

- Age below 18 years and above 25 years.
- Subjects with history of Asthma, Diabetes, Mellitus, Hypertension, other cardiovascular diseases, endocrine disease or surgery.
- Subjects on chronic medication.
- Smokers
- Alcoholics
- Subjects with noticeable weight loss over the preceding 3 month
- Subjects having any neuro-muscular disorders.

The benchmark for obesity was taken on the basis of body mass index as per the standard protocol.
Height (m) and weight (kg) of the subjects will be recorded and BMI calculated as per Quetelet's index

$$\text{Body mass index} = \frac{\text{Weight (kilogram)}}{\text{Height}^2 \text{ (meter)}}$$

Subjects are classified into 2 groups based on BMI as follows:
Normal weight – BMI – 18.5 – 24.99 kg/m²
And / obese – BMI > 30 kg/ m²
A pretested structured proforma is used to collect the relevant information. All subjects were explained about the procedures to be undertaken and written informed consent was obtained from them. Following tests are performed in sitting 2-3 hours after light breakfast in sequence after familiarizing the subjects with the testing procedure.
Handgrip dynamometer test was performed to elicit sympathetic cardiovascular functions during the isometric exercise. The baseline systolic and diastolic blood pressure values were recorded. The subjects were asked to perform maximal voluntary contraction (MVC) by gripping the handgrip dynamometer, as hard as possible for few seconds and the maximum force exerted was noted down. After giving rest for a few minutes, the subjects were made to perform isometric exercise at 30% of the maximal voluntary contraction to the point of fatigue. Systolic and diastolic blood pressure recordings were taken at intervals of each minute during the period of exercise. The mean systolic and diastolic blood pressure, the increase in systolic and diastolic blood pressure during the isometric exercise were calculated and the maximal values of systolic and diastolic BP achieved during exercise were noted down.

## RESULTS AND DISCUSSION

60 obese (30 males and 30 females) subjects and 60 non obese (30 males and 30 females) subjects were analysed for the results. The results obtained are expressed as mean ± standard deviation.

On analysis of the physical characteristics of the 30 non obese males, the mean age (years) is 21.0 ± 2.3; the mean weight (kg) is 60.80 ± 5.05; the mean height (m) is 1.67 ±0.05, the mean BMI (kg/m2) is 21.70 ± 1.73 (Table 1). On analysis of the physical characteristic of the 30 non obese females, the mean age (years) is 19.8 ± 2; the mean weight (kg) is 54.27 ± 6.33; the mean height (mt) is 1.59 ± 0.05; the mean BMI (kg/m²) is 21.43 ± 1.63.(Table 1)On analysis of the physical characteristics of the 30 obese male subjects, the mean age (years) is 21.2 ± 1.8; the mean weight (kg) is 80.90 ± 7.23; the mean height (mt)is 1.59 ± 0.08; the mean BMI (kg/m²)is 32.13 ± 1.71 (Table 1). On analysis of the physical characteristics of the 30 obese female subjects, the mean age (years) is 20.5 ± 2.0; the mean weight (kg) is 83.4 ± 5.82; the mean height (mt) is 1.61± 0.06; the mean BMI (kg/m²) is 32.33 ± 1.81 (Table 1).

**Table 1: Physical characteristics of the subjects**

| No. of Subjects | | Males Controls 30 | Obese 30 | Females Controls 30 | Obese 30 | Total Controls 60 | Obese 60 |
|---|---|---|---|---|---|---|---|
| Age (yrs) | Mean ± SD | 21.0 ± 2.3 | 21.2 ± 1.8 | 19.8 ± 2.0 | 20.5 ± 2.0 | 20.4 ± 2.2 | 20.9 ± 1.9 |
| | Range | 18-25 | 18-25 | 18-25 | 18-25 | 18-25 | 18-25 |
| Weight (kg) | Mean ± SD | 60.80 ± 5.05 | 80.90 ± 7.23 | 54.27 ± 6.33 | 83.40 ± 5.82 | 57.5 ± 6.6 | 82.2 ± 6.6 |
| Height (mt) | Mean ± SD | 1.67 ± 0.05 | 1.59 ± 0.08 | 1.59 ± 0.05 | 1.61 ± 0.06 | 1.63 ± 0.07 | 1.60 ± 0.07 |
| BMI | Mean ± SD | 21.70 ± 1.73 | 32.13 ± 1.71 | 21.43 ± 1.63 | 32.33 ± 1.81 | 21.67 ± 1.67 | 32.23 ± 1.75 |
| | Range | 18.4-24.5 | 30.1-36.6 | 18.5-24.9 | 30.1-36.4 | 18.4-25.0 | 30.1-36.6 |

***Blood pressure response to hand grip dynamometer test:***

The mean baseline systolic blood pressure (mm of Hg) in non-obese males was 117.0 ± 4.7. The mean baseline systolic blood pressure (mmHg) is obese male subjects was 124.3 ± 4.6. There was a statistically significant increase in baseline systolic blood pressure in obese males when compared to non-obese male controls ($p<0.001$) (Table 2).

**Table 2: Comparison of systolic blood pressure response to hand grip dynamometer test between non obese and obese males (n = 30 each)**

| Systolic blood pressure (mm Hg) | Non Obese | Obese | Significance t - value | p - value |
|---|---|---|---|---|
| Baseline Systolic BP (mean ± SD) | 117.0 ± 4.7 | 124.3 ± 4.6 | 6.08 | <0.001, HS |
| Maximum Systolic BP (mean ± SD) | 138.1 ± 2.7 | 143.8 ± 4.2 | 6.25 | <0.001, HS |
| Change in Systolic BP (Δ)(mean ± SD) | 21.1 ± 5.5 | 19.5 ± 4.6 | 1.22 | 0.23, NS |

**unpaired 't' test*
*NS – Not Significant*
*HS – Highly significant*

The mean baseline systolic blood pressure (mm of Hg) in non-obese females was 112.4 ± 7.2. Then mean baseline systolic blood pressure (mm of Hg) in obese female subjects was 123.3 ± 7.4. There was a statistically significant increase in baseline systolic blood pressure in obese female when compared to non-obese females ($p<0.001$) (Table 3).
The change in systolic blood pressure after isometric exercise in non-obese males was 21.1 ± 5.5 and in obese males was 19.5 ± 4.6. There was a statistically significant difference between obese males non-obese males (Table 2).
The change in systolic blood pressure after isometric exercise in non-obese females was 21.1 ± 5.8 and in obese females was 20.1 ± 7.9. There was o statistically significant difference between obese females and non-obese females (Table 3).

**Table 3: Comparison of systolic blood pressure response to hand grip dynamometer test between non obese and obese females (n = 30 each)**

| Systolic blood pressure (mm Hg) | Non Obese | Obese | Significance t - value | p - value |
|---|---|---|---|---|
| Baseline Systolic BP (mean ± SD) | 112.4 ± 7.2 | 123.3 ± 7.4 | 5.78 | <0.001, HS |
| Maximum Systolic BP (mean ± SD) | 133.5 ± 5.3 | 143.4 ± 7.2 | 4.84 | <0.001, HS |
| Change in Systolic BP (Δ)(mean ± SD) | 21.1 ± 5.8 | 20.01 ± 7.9 | 0.56 | 0.48, NS |

**unpaired 't' test*
*NS – Not Significant*
*HS – Highly significant*

The mean baseline diastolic blood pressure (mm Hg) in non-obese males was 79.3 ± 4.9. The mean baseline diastolic blood pressure (mm Hg) in obese male subjects was 84.4 ± 5.0. There was a statistically significant increase in baseline diastolic blood pressure in obese male when compared with non-obese males ($p<0.001$) (Table 4).

**Table 4: Comparison of diastolic blood pressure response to hand grip dynamometer test between non obese and obese males (n = 30 each)**

| Diastolic blood pressure (DBP) (mm Hg) | Non Obese | Obese | Significance | |
|---|---|---|---|---|
| | | | t - value | p - value |
| Baseline diastolic BP (mean ± SD) | 79.3 ± 4.9 | 84.4 ± 5.0 | 3.99 | <0.001, HS |
| Maximum Diastolic BP (mean ± SD) | 96.8 ± 3.5 | 94.3 ± 3.4 | 2.81 | <0.01, S |
| Change in Diastolic BP (Δ)(mean ± SD) | 17.5 ± 6.6 | 9.9 ± 6.0 | 4.60 | <0.001, HS |

**unpaired 't' test*
*NS – Not Significant*
*HS – Highly significant*

The mean baseline diastolic blood pressure (mm Hg) in non-obese females was 74.2 ± 4.5. The mean baseline diastolic blood pressure (mm Hg) in obese female subjects was 81.0 ± 2.6. There was a statistically significant increase in baseline diastolic blood pressure in obese female when compared with non-obese females ($p<0.001$) (Table 5).

The change in diastolic blood pressure after isometric exercise in non-obese males was 17.5 ± 6.6 and in obese males was 9.9 ± 6.0. There was a statistically significant decrease in obese male subjects compared with non-obese male controls ($p<0.001$) (Table 4).
The change in diastolic blood pressure after isometric exercise in non-obese females was 16.7 ± 1.6 and in obese females was 98.8 ± 1.9. There was a statistically significant decrease in obese female subjects compared with non-obese female controls ($p<0.001$) (Table 5).

**Table 5: Comparison of diastolic blood pressure response to hand grip dynamometer test between non obese and obese females (n = 30 each)**

| Diastolic blood pressure (DBP) (mm Hg) | Non Obese | Obese | Significance | |
|---|---|---|---|---|
| | | | t - value | p - value |
| Baseline diastolic BP (mean ± SD) | 74.2 ± 4.5 | 81.0 ± 2.6 | 7.17 | <0.001, HS |
| Maximum Diastolic BP (mean ± SD) | 90.9 ± 4.4 | 89.8 ± 3.1 | 1.12 | 0.27, NS |
| Change in Diastolic BP (Δ)(mean ± SD) | 16.7 ± 1.6 | 8.8 ± 1.9 | 17.42 | <0.001, HS |

**unpaired 't' test*
*NS – Not Significant*
*HS – Highly significant*

The differences in the mean values of each parameter between obese and non-obese males and females are analysed and discussed.
The result of the present study indicates high baseline systolic and diastolic blood pressure in the obese males and females when compared with non-obese males and females.
After the isometric exercise by using hand grip dynamometer the rise in the diastolic blood pressure in obese males and females were significantly lesser than non-obese males and females. A rise in the diastolic blood pressure of 1 mm Hg or more is considered as normal, 11-15 mm Hg as borderline and 10 mm Hg or less as abnormal response to handgrip dynamometer test.
It can be hypothesized that higher baseline blood pressure in obese group could be due to higher vasoconstrictor tone and increase in the cardiac output due to increased circulatory load on heart, as a consequence of increase in body mass index.

**The following conclusions can be drawn from the results of the present study.**

An increase in the body weight is associated with an increase in systolic and diastolic blood pressure in both males and females at resting condition. When compared with age and sex matched normal weight controls
Blood pressure response to isometric exercise using hand grip dynamometer is lowered in obese males and females when compared with controls indicating lower sympathetic activation in obese males and females to isometric exercise.

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