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# REVEIW ARTICLE

## IMPACT OF OBESITY ON CARDIOVASCULAR FITNESS: A STUDY ON STRESS TEST PARAMETERS AND VO2MAX IMPROVEMENT

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**ABSTRACT**

**Background:** Obesity and cardiovascular fitness are interrelated, with lifestyle management playing a crucial role in improving cardiopulmonary function. This study examines the correlation between stress test results and obesity, emphasizing lifestyle interventions. **Methods:** A retrospective, multi-centric, observational study was conducted from January 2024 to September 2024. A total of 24 patients(Males: 87.5%, Females: 12.5%) aged30-75 years diagnosed with IHD (positive stress test) with Obesity (BMI) >25regardless of underlying comorbidities were included in this study. The primary endpoint was improvement in Vo2max and BMI from baseline to the 90-day follow-up. Secondary endpoints were improvement in weight, ABG (Abdominal girth), systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR)and reduction in dependency on allopathic medication from baseline to the 90-day follow-up. **Results:** Mean age of the study population was 58.00±10.24 years. The primary endpoint of Vo2maximproved from 12.71±3.20 to 17.36±6.96, $p=0.00$ and BMI 29.00±3.46 to 27.92±3.24 at the 90-day follow-up. Secondary endpoints of Met value (day 1: 3.61±0.89and day 90: 4.96±1.99, $p=0.02$), weight (day 1: 76.97±10.08kgand day 90: 73.73±10.19kg, $p=0.00$), ABG (day 1: 104.04±9.24 and day 90: 99.96±8.59, $p=0.00$), and SBP (day 1: 136.83±21.16 and day 90: 131.67±16.76; $p=0.04$) , DBP (day 1: 79.46±12.36 and day 90: 76.63±12.56; $p=0.04$) also improved at the 90-day follow-up. Reduction in allopathic medication doses was also observed. **Conclusions:** The 90-day intervention had a positive impact on various health parameters, including improvements in VO2max and BMI, highlighting its effectiveness in addressing obesity.



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# INTRODUCTION

One key measure of cardiovascular fitness is maximal oxygen uptake (Vo2max), which is negatively influenced by increased body mass index (BMI)[1]. Furthermore, high BMI is associated with increased systemic inflammation, leading to vascular dysfunction and impaired metabolic pathways[2]. Lifestyle modifications, including physical activity and dietary interventions, have been shown to improve metabolic health, thereby positively influencing cardiovascular fitness[3]. Regular aerobic exercise can significantly enhance cardiovascular efficiency, reduce hypertension, and improve metabolic health, which may be reflected in stress test outcomes[4]. The correlation between obesity and stress test performance is a crucial aspect of understanding how weight management can positively influence cardiovascular fitness[5]. Cardiopulmonary exercise testing (CPET), including stress testing, provides critical insights into aerobic capacity and cardiovascular efficiency[6]. Studies indicate that individuals with obesity tend to have reduced Vo2max, signifying impaired cardiorespiratory fitness, which increases the risk of cardiovascular complications[7].Obesity is a significant public health issue and a major risk factor for cardiovascular diseases, metabolic disorders, and reduced functional capacity[8]. Weight loss interventions, including exercise and lifestyle modifications, have been shown to improve Vo2max and other cardiometabolic parameters[9].The prevalence of obesity has been rising globally, contributing to increased morbidity and mortality due to its association with hypertension, diabetes, and heart disease[10].Thus, study aims to assess the relationship between stress test parameters and obesity by analyzing changes in Vo2max, BMI, and other cardiometabolic parameters over time. Ayurveda is a traditional medicine system used to treat a range of disease. Panchakarma, an ancient Ayurvedic therapeutic approach, is being explored as a potential adjunct treatment for IHD. This study investigates the correlation between stress test parameters and obesity and evaluates the impact of lifestyle interventions on cardiopulmonary health. However, evidence is still scarce.By understanding this correlation, healthcare providers can design interventions to improve cardiovascular health in obese individuals.

# MATERIALS AND METHODS

**Study design& patient population:** This was a retrospective, observational study conducted at Madhavbaug Clinics, Maharashtra between January 2024 and September 2024. Patients aged 30-75 years diagnosed with IHD (positive stress test) with Obesity (BMI) >25 regardless of underlying comorbidities were included in this study. Patients with (i) Negative Stress Test, (ii) Low BMI and (iii) incomplete treatment of 90 days were not included in this study. All patients provided written informed consent. The study was conducted as in accordance with the Declaration of Helsinki, Good Clinical Practice, and applicable regulatory requirements.

**TreadmillStress Test:** A Treadmill Stress Test using a GE Healthcare machine is a diagnostic procedure designed to evaluate heart function under physical exertion. The system typically consists of a high-quality medical treadmill, such as the GE T2100, integrated with an ECG monitoring system like the GE CASE™ or CardioSoft™. The test begins with the placement of electrodes on the patient's chest to record a baseline 12-lead ECG while monitoring blood pressure. As the treadmill gradually increases in speed and incline, the patient's heart activity, rhythm, and blood pressure are continuously tracked to detect any abnormalities, such as ischemia or arrhythmias. The test continues until the patient reaches their target heart rate, experiences symptoms, or meets stopping criteria. Afterward, a recovery phase ensures that vital signs return to baseline while data is analyzed through GE's advanced software, which generates a comprehensive diagnostic report. This system is widely used in hospitals and clinics for assessing coronary artery disease, exercise tolerance, and overall cardiovascular health.

**Study endpoints anddata collection:** The primary endpoint was improvement in Vo2max and BMI from baseline to the 90-day follow-up. Secondary endpoints were improvement in Weight, abdominal girth (ABG), systolic blood pressure (SBP), diastolic blood pressure (DBP) and reduction in dependency on allopathic medication from baseline to the 90-day follow-up.Data for patient demographics, anthropometrics, echocardiographic findings, and medications were collected and analysed from patient medical records. On day1, a detailed patient history, anthropometric measurements, and echocardiographic measurements were documented. Details of concomitant standard anti-ischemic medication was also recorded. This activity was repeated on day 90 of the program. Data of day 1 was compared with data of day 90. Data of only those patients who had completed a total of 14 sessions was collected and analysed.

**Statistical analysis:** Categorical data are expressed as number (percentage) andcontinuous data are expressed as mean ± standard deviation.Paired t test was used to determine the difference betweenbaseline and follow-up at 90 days. P value ≤0.05 wasconsidered as statistically significant. R Version 3.4.1software was used to analyse the data.

# RESULTS

**Demographics of study patients:** A total of 24 patients were included in this study. The mean age of the study population was 58.00±10.24years and there were 21 (87.5%) males in the study population. Vo2maximproved from 12.71±3.20 to 17.36±6.96, p=0.02 and BMI 29.00±3.46 to 27.92±3.24, p=0.02 at the 90-day follow-up. Secondary endpoints of Met value (day 1: 3.61±0.89 and day 90:4.96±1.99, p=0.02), weight (day 1: 76.97±10.08kg and day 90: 73.73±10.19kg, p=0.00), ABG (day 1: 104.04±9.24 and day 90: 99.96±8.59, p=0.00), and SBP (day 1: 136.83±21.16 and day 90: 131.67±16.76; p=0.04), DBP (day 1: 79.46±12.36 and day 90: 76.63±12.56; p=0.04) improved at the 90-day follow-up. The demographics of the study population are detailed in Table 1.EF and GLS changes at baseline and 90-day follow-up according to underlying comorbidities of the study population are given in Table 2.

**Table 1. Demographics of the study population**

| Variable | Day 1 | Day 90 | p value |
|---|---|---|---|
| Age, years | 58.00±10.24 | | |
| Male, | 21 (87.5%) | | |
| Vo2max | 12.71±3.20 | 17.36±6.96 | 0.02 |
| Body mass index | 29.00±3.46 | 27.92±3.24 | 0.02 |
| Weight, kg | 76.97±10.08 | 73.73±10.19 | 0.00 |
| Abdominal girth, cm | 104.04±9.24 | 99.96±8.59 | 0.00 |
| SBP | 136.83±21.16 | 131.67±16.76 | 0.04 |
| DBP | 79.46±12.36 | 76.63±12.56 | 0.04 |

All data are expressed as number (percentage) or mean± standard deviation. p value ≤0.05 was considered statistically significant. SBP – systolic blood pressure, DBP – diastolic blood pressure

**Demographic and anthropometric measurements according to age, ejection fraction, and global longitudinal strain of the study population:** Weight improved for the of 35-60 year age group (day 1: 83.04±8.23 kg and day 90: 79.50±8.48 kg, change: -4.26%), 61-80 year age group (day 1: 69.80±6.84 kg and 66.90±7.44 kg, change: -4.15%), at the 90 day follow-up. BMI improved for the of 35-60year age group (day 1: 30.15±3.48 and day 90: 28.92±3.65, change: -4.08%), 61-80 year age group (day 1: 27.64±2.90 and day 90: 26.73±2.14, change: -3.29%)at the 90 day follow-up. ABG improved for the of 35-60year age group (day 1: 109.23±8.94 and day 90: 102.85±9.02, change: -5.85%), 61-80 year age group (day 1: 97.91±4.72and day 90: 96.55±6.57, change: -1.39%) at the 90 day follow-up.Vo2max improved for the of 35-60 year age group (day 1:12.98±3.52% and day 90: 18.99±8.16%, change: 46.38%), 61-80 year age group (day 1: 12.20±2.52and day 90: 15.42±4.48%, change: 26.46) at the 90 day follow-up. Met value improved for the of 35-60 year age group (day 1:3.71±1.01and day 90: 5.43±2.33, change: 46.38%), 61-80 year age group (day 1: 3.48±0.72and day 90: 4.41±1.28, change: 26.46%)at the 90 day follow-up. The demographic and anthropometric measurements according to age at baseline and the 90-day follow-up are demonstrated in Table 2.

**Table 2. Demographicand anthropometric measurements according to age of the study population**

| Variable | Vo2max Day 1 | Vo2max Day 90 | Change % | Met Value Day 1 | Met Value Day 90 | Change % | Weight Day 1 | Weight Day 90 | Change % | BMI Day 1 | BMI Day 90 | Change % | ABG Day 1 | ABG Day 90 | Change % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Age, years** | | | | | | | | | | | | | | | |
| 35-60 | 12.98±3.52 | 18.99±8.16 | 46.38 | 3.71±1.01 | 5.43±2.33 | 46.38 | 83.04±8.23 | 79.50±8.48 | -4.26 | 30.15±3.48 | 28.92±3.65 | -4.08 | 109.23±8.94 | 102.85±9.02 | -5.85 |
| 61-80 | 12.20±2.52 | 15.42±4.48 | 26.46 | 3.48±0.72 | 4.41±1.28 | 26.46 | 69.80±6.84 | 66.90±7.44 | -4.15 | 27.64±2.90 | 26.73±2.14 | -3.29 | 97.91±4.72 | 96.55±6.57 | -1.39 |

All data are expressed as mean ± standard deviation. ABG – abdominal girth; BMI – body mass index

**Table 3. Demographicand anthropometric measurements according to BMI of the study population**

| Variable | Vo2max Day 1 | Vo2max Day 90 | Change % | Met Value Day 1 | Met Value Day 90 | Change % | Weight Day 1 | Weight Day 90 | Change % | BMI Day 1 | BMI Day 90 | Change % | ABG Day 1 | ABG Day 90 | Change % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Obess | 10.85±3.55 | 19.70±9.43 | 81.62 | 3.10±1.01 | 5.63±2.69 | 81.62 | 82.12±11.95 | 77.76±12.68 | -5.32 | 33.11±1.29 | 31.11±2.33 | -6.04 | 111.67±9.21 | 106.11±8.03 | -4.98 |
| Overweight | 13.68±2.26 | 15.95±4.35 | 16.59 | 3.91±0.65 | 4.56±1.24 | 16.59 | 73.88±7.18 | 71.31±7.35 | -3.48 | 26.53±1.41 | 26.00±1.93 | -2.01 | 99.47±5.45 | 96.27±6.55 | -3.22 |

All data are expressed as mean ± standard deviation. ABG – abdominal girth; BMI – body mass index

# DISCUSSION

The concurrent reduction in BMI and weight supports previous findings that excess adiposity negatively impacts oxygen utilization and cardiovascular efficiency[7]. Furthermore, improvements in systolic and diastolic blood pressure indicate better vascular function and reduced cardiovascular strain, aligning with evidence that weight loss interventions can positively influence hemodynamic parameters[9]. The reduction in heart rate signifies improved autonomic function and cardiac efficiency, reflecting the benefits of enhanced aerobic conditioning[6]. Additionally, the decline in allopathic medication usage suggests that non-pharmacological interventions, such as structured exercise and lifestyle modifications, can play a crucial role in managing obesity-related cardiovascular complications[10].Despite the findings, limitations such as the small sample size and retrospective study design should be considered, further research with larger cohorts and longer follow-up durations. Future studies should explore the long-term impact of weight management strategies on cardiovascular health and stress test performance. Nevertheless, this study underscores the importance of integrating stress testing as a routine assessment tool to guide weight management interventions and improve cardiovascular outcomes in obese individuals. Patients with IHD typically rely on traditional allopathic medications, contributing significantly to the escalating healthcare expenses in resource-limited countries such as India. Moreover, the adverse effects associated with these allopathic medications often result in reduced patient adherence and heightened morbidity. In our research, a 90-day treatment witha Lifestyle Management demonstrated a noteworthy decrease in the dependence on nearly all categories of anti-ischemic drugs.

# LIMITATIONS

The single armdesign of the study are some limitations of the current study. Also, a larger sample size might have allowed generalization of these study findings to a larger population.

# CONCLUSION

The results of this study highlight a significant association between obesity and stress test parameters, reinforcing the importance of weight management in improving cardiopulmonary fitness. The observed increase in Vo2max suggests enhanced aerobic capacity, which is crucial in reducing cardiovascular disease risk and improving overall health outcomes.

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