Correlation Between Body Mass Index and Echocardiographic Findings in Overweight Patients Compared to Normal-Weight Patients

Mohammad Salehi1, Mehdi Latif2, Fatemeh Peighambari3, Mohammad Dehestani4*, Seyed Vahid Ahmadi-Hanzaei5
1Assistant Professor, Department of Internal Medicine, Islamic Azad University, Yazd Branch, Yazd, Iran
2Assistant Professor, Department of Cardiology, Islamic Azad University, Yazd Branch, Yazd, Iran
3Assistant Professor, Department of Anatomical Sciences, Islamic Azad University, Yazd Branch, Yazd, Iran
4Instructor, Department of Experimental Sciences, Islamic Azad University, Yazd Branch, Yazd, Iran
5General Practitioner, Islamic Azad University, Yazd Branch, Yazd, Iran
Corresponding Author: Mohammad Dehestani, E-mail: dr.dehestani@yahoo.com

ABSTRACT

Background: Being overweight is the main risk factor for many chronic disorders, especially cardiovascular diseases. Hypertension is the first reaction of the heart to overburdens imposed by obesity or overweightness. In this study, we evaluated the correlation between body mass index (BMI) and echocardiographic findings in overweight patients compared to normal-weight patients. Methods: This historical cohort study was conducted on 60 patients divided into two groups of 30 based on their measured weight: group 1 had a BMI of 20-25 kg/m² and was the control; group 2 had a BMI of >25-30 kg/m². Demographic and clinical data, as well as echocardiographic results, were recorded for all patients. Results: The mean age of patients in the control group (41.06 ± 12.82 years) and the overweight group (46.84 ± 12.61 years) was not significantly different (P = 0.067). Systolic blood pressure (P = 0.003) and pulse rate (P = 0.028) were significantly higher in the overweight group. Ejection fraction (P = 0.036); end-systolic (P < 0.001) and end-diastolic (P < 0.001) left ventricular dimensions; and left ventricular mass index (P = 0.005) were significantly higher in the control group. Conclusion: Overweightness due to anatomical remodeling can cause diastolic heart failure in the left ventricle. According to the relatively poor prognosis of treatment features in patients with probable risk factors for heart failure, such as diabetes, hypertension, and ischemic heart disease, we recommend considering overweightness as a strong prognostic factor for heart failure.

INTRODUCTION

Overweightness is a common condition and is a primary risk factor for many chronic disorders. The principal cause of death for people who are overweight and obese is cardiovascular disease; stroke and renal failure are also common in obese people (1-3).

When someone is overweight or obese, their ventricular wall can be overburdened with pressure, which can lead to hypertrophy as a compensatory mechanism. Hypertrophy, regardless of the cause, can lead to cardiac muscle stiffness and elevated metabolic requirements, resulting in cardiac output being limited in times of physical stress (4,5). The first heart reaction to obesity- or overweightness-related overburdening is hypertension, which is characterized by increased ventricular wall thickness. This can result in dysfunction of this cavity and symptoms of heart failure. Left ventricular hypertrophy (LVH) can be diagnosed most sensitively and accurately with chest X-ray (6). Diagnosis by echocardiography is based on direct observation of the heart and measurement of the parameters necessary for calculating the left ventricular mass and the index of left ventricular function (7).

LVH is an important risk factor for cardiovascular diseases. Given the increasing prevalence of cardiovascular diseases, current research in this area has been shifting away from treatment to prevention, and studies on preventive cardiology are much more significant than other types of studies. Accordingly, in our study we evaluated the correlation between body mass index (BMI) and echocardiographic findings in overweight patients compared to normal-weight patients.

METHODS

In this retrospective, historical cohort study, patients were divided into two groups based on the independent variable of
BMI: group 1 had a BMI of 20-25 kg/m² and was the control; group 2 had a BMI of >25-30 kg/m². Statistical consultation determined that the sample size should be at least 60 patients in two groups of 30 (normal weight and overweight).

Exclusion criteria were age over 60 years, BMI greater than 30 or less than 20 (5), diabetes (6), intermittent smoking and alcohol use (7), periodic or regular physical isometric exercise (8), history of antihypertensive drugs (9), congestive heart failure, kidney failure, pregnancy, abnormal echocardiogram at rest, positive exercise test, and heart valve lesions.

All echocardiograms were performed by a skilled technician using General Electric Vivid-3 echocardiography. Definitions of left ventricular echocardiography parameters, including ejection fraction, fractional shortening, and left ventricular relative wall thickness (10), were taken from the guidelines of the American Society of Echocardiography (11).

RESULTS

Demographic and hemodynamic variables in the two groups are presented in Table 1. We observed that heart rate and systolic blood pressure were significantly higher in overweight patients. The height of the patients was not significantly different between the two groups; weight was the only reason for differences in BMI.

Comparison of echocardiographic findings in the two groups showed that interventricular septum and posterior wall of the left ventricle in both end-systolic and end-diastolic dimensions were not significantly different between the two groups; however, ejection fraction, left ventricular thickness, and left ventricular mass index were significantly lower in the overweight group than in the control group (Table 2).

As shown in Table 3, no significant differences in Doppler echocardiographic findings were observed between the two groups.

DISCUSSION

Being overweight is the main risk factor for many chronic disorders, especially cardiovascular diseases (12). Obesity-related cardiovascular diseases often result in heart failure and become more common with increasing age (13). However, heart failure is mainly a diastolic disorder and has a strong association with anatomical remodeling of the left ventricle and its valves (12). Apart from age, history of diabetes mellitus, female sex, history of hypertension, and obesity are among the most common risk factors for left ventricular diastolic dysfunction (14). Although recent studies have identified obesity as the primary risk factor for left ventricular remodeling, preventive cardiology has an important role to play in reducing the risk of heart disease. From this perspective, overweightness, not obesity, is considered a warning for patients at risk (15,16). In this study, we examined overweight people in comparison to normal-weight people from this perspective.

Table 1. Evaluation of the demographic factors affecting the left ventricular parameters in the two groups

<table>
<thead>
<tr>
<th>Demographic variables</th>
<th>Normal-weight group (BMI = 20-25 kg/m²)</th>
<th>Overweight group (BMI = &gt;25-30 kg/m²)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>41.06±12.82</td>
<td>46.84±16.21</td>
<td>0.067</td>
</tr>
<tr>
<td>Heart rate (bpm)</td>
<td>79.34±9.25</td>
<td>84.13±7.93</td>
<td>0.028</td>
</tr>
<tr>
<td>Systolic blood pressure (mmHg)</td>
<td>125.66±16.75</td>
<td>137.10±14.31</td>
<td>0.003</td>
</tr>
<tr>
<td>Diastolic blood pressure (mmHg)</td>
<td>83.00±14.41</td>
<td>87.36±9.77</td>
<td>0.142</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>162.96±8.51</td>
<td>161.18±11.33</td>
<td>0.476</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>61.60±7.23</td>
<td>73.76±11.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.14±1.43</td>
<td>28.28±2.14</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

BMI: Body mass index

Table 2. Evaluation of the left ventricular echocardiographic findings in the two groups

<table>
<thead>
<tr>
<th>Demographic variables</th>
<th>Stages</th>
<th>Normal-weight group (BMI = 20-25 kg/m²)</th>
<th>Overweight group (BMI = &gt;25-30 kg/m²)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interventricular septum thickness (mm)</td>
<td>End-diastolic</td>
<td>16.01±3.23</td>
<td>15.86±3.86</td>
<td>0.865</td>
</tr>
<tr>
<td></td>
<td>End-systolic</td>
<td>10.79±2.24</td>
<td>10.37±2.38</td>
<td>0.520</td>
</tr>
<tr>
<td>Posterior wall thickness (mm)</td>
<td>End-diastolic</td>
<td>15.58±2.56</td>
<td>15.89±2.84</td>
<td>0.635</td>
</tr>
<tr>
<td></td>
<td>End-systolic</td>
<td>11.43±2.1</td>
<td>11.69±3.03</td>
<td>0.690</td>
</tr>
<tr>
<td>Ejection fraction</td>
<td></td>
<td>61.50±5.43</td>
<td>57.63±8.66</td>
<td>0.036</td>
</tr>
<tr>
<td>Fractional shortening</td>
<td></td>
<td>32.17±9.75</td>
<td>29.68±9.13</td>
<td>0.282</td>
</tr>
<tr>
<td></td>
<td>End-diastolic</td>
<td>38.84±6.08</td>
<td>32.13±5.78</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>End-systolic</td>
<td>32.47±6.66</td>
<td>26.3±5.31</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mass index (g/m²)</td>
<td></td>
<td>53.25±8.64</td>
<td>49.45±8.88</td>
<td>0.005</td>
</tr>
</tbody>
</table>
We found that end-systolic and end-diastolic left ventricular dimensions were significantly lower in overweight patients than in normal-weight patients. Redfield et al. (17) found significant effects of overweightness on the left ventricular size. However, in their study, only patients with a BMI greater than 30 kg/m² were selected, and overweight and obese patients were not included.

Decreased left ventricular size, except for the reduction of end-systolic and end-diastolic dimensions, is also measured using a more precise indicator called the left ventricular mass index. In our study, the left ventricular mass index in overweight patients was lower than the left ventricular mass index in normal-weight patients. Considering the significant difference in systolic blood pressure between the two groups and regarding the interval between the incidence of blood pressure in patients, the difference in left ventricular mass index between the two groups can be interpreted well. In a similar study, Yu et al. (18) reported that the left ventricular mass index and the ejection fraction in obese patients were lower than in normal-weight patients, which is completely in line with the results of our study. This finding suggests the need for preventive cardiologic strategies in overweight patients.

CONCLUSION
A significant correlation exists between overweightness and left ventricular anatomical remodeling, which can accelerate the onset of left ventricular diastolic dysfunction. Considering the relatively poor prognosis of patients with left ventricular diastolic dysfunction, and that these patients are often treated only symptomatically, we recommend that, to prevent heart failure, further complications, and subsequent disabilities, overweightness factors—such as diabetes, high blood pressure, and ischemic heart disease—be regarded seriously in patients with possible risk factors for cardiovascular diseases. Therefore, not only patients at risk, but also middle-aged populations, should undergo necessary diet and lifestyle modifications and get regular physical isometric exercises to lose weight and prevent possible complications of heart failure. Additional comprehensive studies with larger sample sizes and that consider other potential risk factors are needed to verify or modify the findings of this and similar studies.

Study Limitations
Since the exclusion criteria of our study included a wide range of cardiac and non-cardiac diseases, the sampling time was longer than expected. Moreover, echocardiography required a longer duration than is normal for other patients. In addition to requiring more time, this raised the cost of echocardiography for each patient beyond the cost of a typical echocardiography.

ACKNOWLEDGMENTS
We thank and appreciate the staff of the Department of Echocardiography at Yazd Social Security Hospital, especially Mr. Ahmadi, for their cooperation.

AUTHORS CONTRIBUTION
All authors contribute in this study equally

REFERENCES
8. Kasner M, Westermann D, Steendijk P, Gaub R,


