Benha Journal of Applied Sciences (BJAS) print: ISSN 2356–9751
Vol.(8) Issue(9) (2023), (49-52) online : ISSN 2356–976x
http://bjas.bu.edu.eg

Impact of Early Adulthood Obesity on Left and Right Ventricular Function (An Echocardiographic Study)

Ahmed.O.Abdallah, Basant.S.Mohamed, Shymaa.S. Mohamed and Hesham.K.Rasheed
cardiovascular medicine Dept., Benha faculty of medicine, Benha University
E-mail: aoab19942020@gmail.com

Abstract

The Worldwide rates of obesity, particularly among children and young adults, are Increasing. Heart failure, coronary disease, and peripheral vascular disease have all been linked to obesity, and the incidence of their consequences has also been found to fluctuate accordingly. Obese patients often exhibit early signs of heart failure, including subclinical left ventricular dysfunction.The aim of this study was to determine the effect of early age obesity on left and right ventricular functions using echocardiography. 75 healthy volunteers were included in our study who presented to Department of cardiovascular medicine at benha university hospitals in the period between July 2022 to May 2023. All volunteers were evaluated using Echocardiography at Benha University Hospital's Cardiology department and divided into two groups. Group I (control) consisted of participants with a body mass index (BMI) of 25 or less (non-obese), while Group 2 (Case) consisted of participants with a BMI of 30 or more (Obese). Heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) showed no statistically significant differences between the groups. There were no statistically significant variations in PWTd across the groups. Mitral E wave velocity, Mitral A wave velocity, and the E/A ratio showed no statistically significant differences between groups. Obese group had a greater IVSd than the control group.

Keywords: Early adulthood obesity, pulsed wave doppler, left ventricular dysfunction.

1. Introduction

The worldwide rates of obesity are rising, particularly among children and youth. Obesity has been linked to an increased risk of cardiovascular disease, including heart failure, coronary artery disease, and peripheral vascular disease [1, 2]. Risk factors that associate obesity such as hypertension, dyslipidemia, and diabetes have a major role in the association between obesity and cardiac dysfunction [2]. Obese individuals with coronary artery disease and HF have been shown to have a favourable prognosis in some literature, leading to the concept of the obesity paradox. [3]

Existing data on the effects of obesity on cardiac dysfunction comes mostly from studies of middle-aged and elderly individuals, the vast majority of whom also suffer from metabolic syndrome. [4]

There is a lack of information on how obesity affects heart function in young obese individuals who do not have metabolic syndrome. However, some research has examined how childhood obesity affects the ventricular function. [5]

Subclinical left ventricular dysfunction is often seen in morbidly obese individuals. Those effects shown in several research have been shown to be reversible when it comes to weight loss. [6]

2. Patients and methods

This is a non-randomized, single-center, cross-sectional study of 75 healthy adults between the ages of 18 and 30, who presented to the Cardiology department at Benha University Hospitals for an Echocardiography evaluation, divided as: Obese group of 50 individuals with BMI>30 kg/m^2 and Control group of 25 individuals with BMI of 19-24.9 kg/m^2.

Patients were ruled out of the study if they had any of the following:

1- Evidence or history of systolic heart failure.

2- Evidence of Pericardial disease.

3- Poor Image quality for transthoracic echocardiography.

4- Pregnancy.

The following data were collected:

Age, gender, and other sociodemographic information, as well as risk factors such as (smoking, hypertension, diabetes mellitus, dyslipidemia).

Fasting blood glucose, blood pressure, lipid profile (including high-density lipoprotein and triglyceride levels), and waist circumference which are the diagnostic criteria for metabolic syndrome. To be diagnosed with metabolic syndrome, at least three of the five criteria have to be satisfied. [7]

Thorough physical examination. Systolic and diastolic BP as well as heart rate were measured.

A platform scale was used to determine the patient's weight in kg. A measuring tape was used to take the patient's height and waist circumference.

Weight in kilogrammes was divided by the square of height in metres to get body mass index (BMI). [8]

According to the Mosteller formula, body surface area (BSA) was determined by taking the square root of the result of (weight in kilogrammes multiplied by height in centimetres divided by 3600). [9]

Participants divided into a control group with a BMI of 19-24.9 kg/m2 and an obese group with a BMI 30 kg/m2 based on World Health Organization guidelines. [10]

Conventional 2D echocardiography with Doppler studies: the patients were checked in the cardiology department at Benha university hospital.

All patients were examined using a Philips epic 7c ultrasound system and the conventional supine and left lateral decubitus were used during echocardiographic assessment.

Conventional 2D echocardiography was used to assess The left ventricle. It was measured linearly in the PLAX image, with the ventricular chamber positioned such as central as possible, and as perpendicular as possible to the long axis, so that it was just beyond the leaflet tips of the MV. [12]

The A4C view was used for estimating TAPSE. The M-mode cursor was positioned along the RV free wall perpendicular to the lateral tricuspid annulus (and parallel to TV annulus movement as possible). The distance moved by the annulus's leading edge from end-diastole to the apex at end-systole was measured. [12]

Pulsed wave Doppler echocardiography was used to evaluate mitral inflow from the apical 4-chamber view. A 1- to 2-mm sample volume was positioned between the tips of the mitral leaflets during diastole, and the Doppler beam was oriented parallel to the flow direction. The E- and A-wave velocities were calculated from the mitral inflow profile. [13]

3. Results and discussion

The primary aim of our study was to use echocardiography to detect the effects of obesity on left and right ventricular functions in young adults. Fifty individuals were classified as the case group (BMI > 30 m2/kg) and 25 volunteers were used as the control group (BMI 25 m2/kg), for a total of 75 participants.

Age (P-value= 0.75), sex (P-value= 0.615), height (P-value= 0.315), and smoking status (P-value= 0.314) were not statistically different across the groups (Table 1)

Sixty-five percent of the participants in the research were men. The percentage of female patients was 35%. The fact that women in low-income populations, like our own, get less attention and have less access to health care facilities may help to explain this phenomenon.

There was a statistically significant difference in weight (P 0.005) between the groups. The obese group had a considerably higher value (100±9) than the control group (72±6).

Body mass index significantly differed between the studied groups (P < 0.005). It was significantly higher in the obese group (33.4 ±1.9) compared to the control group (21.9 ±1.6). (Table 1)

Body surface area significantly differed between the studied groups (P < 0.05). It was significantly higher in the obese group (2.31 ±0.29) compared to the control group (1.75 ±0.22). (Table 1)

Waist circumference significantly differed between the studied groups (P < 0.05). It was significantly higher in the obese group (101 ±9) compared to the control group (83 ±8). (Table 1*)*

No significant differences were detected between the studied groups regarding diastolic blood pressure (P-value= 0.301) being (75 ±7) mmHg in obese group and (74 ±9) mmHg in control group. (Table 1)

No significant differences were found between the studied groups regarding systolic blood pressure (p-value=0.796) being (113 ±10) mmHg in obese group and (112 ±9) mmHg in control group. (Table 1)

No significant differences were detected regarding heart rate (p-value=0.319) being (73 ±7) mmHg in obese group and (74 ±8) mmHg in control group. (Table 1)

This result agrees with that of Ünlü et al. 2021, who studied the effects of obesity in young adults on left and right ventricular functioning in 117 people aged 18 to 30 and classified into control, overweight, and obese groups according on their body mass index. Systolic blood pressure, diastolic blood pressure, and heart rate were all measured, and researchers found no statistically significant changes among the groups. [14]

Our study demonstrated that there were statistically significant differences (P<0.05) in IVSd measurements across the groups. Obese people had a 1±0.2 cm IVSd compared to the control group's 0.9±0.1 cm.

As can be seen in Table 2, there was no statistically significant difference between the groups in terms of PWTd (P-value= 0.391), with the obese group having a PWTd of 1±0.1 and the control group having a PWTd of 0.9±0.1. (Table 2)

Di Bello et al. 2013 found comparable outcomes in their study of the association between obesity and echocardiographic parameters in 108 subjects classified as either obese or control based on their body mass index. The researchers discovered that IVSd was substantially greater among the obese group (P= 0.001). [15]

No significant differences were observed between the studied groups regarding TAPSE (P = 0.131). (Table 2)

Pulsed wave Doppler results showed no significant differences between the groups, including mitral E wave velocity (P = 0.542) and mitral A wave velocity (P = 0.36). (Table 2).

Wong et al. (2004), evaluated the association between BMI and echocardiographic parameters in 142 individuals classified into 4 groups based on BMI. He found similar results. There was no statistically significant difference in mitral E wave velocity, mitral A wave velocity, or TAPSE between the two groups. [16]

Table (1) Demographics of the studied groups

		Obese (n = 50)	**Control (n = 25)**	**P-value**
Age (years)	**Mean ±SD**	**23 ±5**	**23 ±5**	**0.75**
Sex				
Males	**n (%)**	**32 (64)**	**17 (68)**	**0.615**
Females	**n (%)**	**18 (36)**	**8 (32)**	
Weight (Kg)	**Mean ±SD**	**100 ±9**	**72 ±6**	**<0.005***
Height (cm)	**Mean ±SD**	**173 ±5**	**174 ±7**	**0.305**
BMI (kg/m^2)	**Mean ±SD**	**33.4 ±1.9**	**21.9 ±1.6**	**<0.005***
BSA (m^2)	**Mean ±SD**	**2.31 ±0.29**	**1.75 ±0.22**	**<0.05***
Waist circumference (cm)	**Mean ±SD**	**101 ±9**	**83 ±8**	**<0.05***
Smoking	**n (%)**	**18 (36)**	**10 (40)**	**0.314**
SBP (mmHg)	**Mean ±SD**	**113 ±10**	**112 ±9**	**0.796**
DBP (mmHg)	**Mean ±SD**	**75 ±7**	**74 ±9**	**0.301**
HR (BPM)	**Mean ±SD**	**73 ±7**	**74 ±8**	**0.319**

BMI: Body mass index; BSA: Body surface area; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; HR: Heart rate

Table (2) Echocardiographic findings in the studied groups

		Obese (n = 50)	**Control (n = 25)**	**P-value**
IVSd (cm)	Mean ±SD	1 ±0.2	0.9 ±0.1	<0.05
PWTd (cm)	Mean ±SD	1 ±0.1	0.9 ±0.1	0.164
TAPSE (mm)	Mean ±SD	22 ±5	23 ±4	0.131
Mitral E velocity (cm/s)	Mean ±SD	79 ±9	80±8	0.761
Mitral A velocity (cm/s)	Mean ±SD	55 ±7	54 ±9	0.465

IVSd: Interventricular septum thickness in diastole; PWTd: Posterior wall thickness in diastole;

4. Conclusion

Obesity has been linked to subclinical changes in LV measurements such as IVSd even in healthy young people. Obesity-related LV function impairment should be taken into account when risk stratifying young individuals.

References

[1] Ampofo,A.G.,&Boateng,E.B.(2020). Beyond 2020: Modelling obesity and diabetes prevalence. *Diabetes research and clinical practice*, *167*,108362.https://doi.org/10.1016/j.diabres.2020.108362

[2] Russo, C., Sera, F., Jin, Z., Palmieri, V., Homma, S., Rundek, T., Elkind, M. S., Sacco, R. L., & Di Tullio, M. R. (2016). Abdominal adiposity, general obesity, and subclinical systolic dysfunction in the elderly: A population-based cohort study. *European journal of heart failure*, *18*(5), 537–544. https://doi.org/10.1002/ejhf.521

[3] Elagizi, A., Kachur, S., Lavie, C. J., Carbone, S., Pandey, A., Ortega, F. B., & Milani, R. V. (2018). An Overview and Update on Obesity and the Obesity Paradox in Cardiovascular Diseases. *Progress in cardiovascular diseases*, *61*(2), 142–150. https://doi.org/10.1016/j.pcad.2018.07.003

[4] Blomstrand, P., Sjöblom, P., Nilsson, M., Wijkman, M., Engvall, M., Länne, T., Nyström, F. H., Östgren, C. J., & Engvall, J. (2018). Overweight and obesity impair left ventricular systolic function as measured by left ventricular ejection fraction and global longitudinal strain. Cardiovascular diabetology, 17(1), 113. https://doi.org/10.1186/s12933-018-0756-2

[5] Kulkarni, A., Gulesserian, T., Lorenzo, J. M. M. D., Haroonian, Y., Ngyuyen, M., Lo, Y., Wang, D., Hsu, D., Kaskel, F., & Mahgerefteh, J. (2018). Left ventricular remodelling and vascular adaptive changes in adolescents with obesity. *Pediatric obesity*, *13*(9), 541–549. https://doi.org/10.1111/ijpo.12278

[6] Barbosa, J. A., Mota, C. C., Simões E Silva, A. C., Nunes, M.doC., & Barbosa, M. M. (2013). Assessing pre-clinical ventricular dysfunction in obese children and adolescents: the value of speckle tracking imaging. European heart journal. Cardiovascular Imaging, 14(9), 882–889. https://doi.org/10.1093/ehjci/jes294

[7] Grundy,S.M., Cleeman,J.I.,Daniels,S.R., Donato, K.A., Eckel, R. H., Franklin, B. A., Gordon, D.J., Krauss, R. M., Savage, P. J., Smith,S.C.,Jr, Spertus,J.A., Costa,F., American Heart Association, & National Heart, Lung, and Blood Institute (2005). Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood InstituteScientificStatement. Circulation, 112(17) ,2735.2752.https://doi.org/10.1161/CIRCULATIONAHA.105.169404

[8] Nuttall F. Q. (2015). Body Mass Index: Obesity, BMI, and Health: A Critical Review. Nutritiontoday, 50(3),117.128.https://doi.org/10.1097/NT.0000000000000092

[9] Mosteller R. D. (1987). Simplified calculation of body-surface area. The New England journal of medicine, 317(17),1098.https://doi.org/10.1056/NEJM198710223171717

[10] World Health Organization. 9 June 2021 "Obesity and overweight"fact sheet.

[11] Lang R, Badano L, Mor-Avi V, et al. Recommendations for Cardiac Chamber Quantification by Echocardiography in Adults: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. Eur Heart J Cardiovasc Imaging. 2015; 16(3): 233–271, doi: 10.1093/ehjci/ /jev014.

[12] Kronzon I, Aurigemma GP. M-mode echocardiography. In: Lang RM, Goldstein SA, Kronzon I, Khandheria BK, Mor-Avi V, editors. ASE's comprehensive echocardiography. 2nd ed. Philadelphia: Elsevier Saunders; 2016. pp. 30-8.

[13] Quinones MA, Otto CM, Stoddard M, Waggoner A, Zoghbi WA, Doppler ~ Quantification Task Force of the Nomenclature and Standards Committee of the American Society of Echocardiography. Recommendations for quantification of Doppler echocardiography: a report from the Doppler quantification task force of the nomenclature and standards committee of the American Society of Echocardiography. J Am Soc Echocardiogr 2002;15:167-84

[14] Ünlü, S., & Taçoy, G. (2021). Early adulthood obesity is associated with impaired left ventricular and right ventricular functions evaluated by speckle tracking and 3D echocardiography. Turk Kardiyoloji Dernegi arsivi : Turk Kardiyoloji Derneginin yayin organidir, 49(4), 312–320. https://doi.org/10.5543/tkda.2021.57336

[15] Di Bello, V., Fabiani, I., Conte, L., Barletta, V., Delle Donne, M.G., Cuono, C., Leo, L.A., Dini, F.L., Marzilli, M., Pinchera, A. and Santini, F. (2013), New echocardiographic techniques in the evaluation of left ventricular function in obesity. Obesity, 21: 881-892. https://doi.org/10.1002/oby.20071

[16] Wong, C. Y., O'Moore-Sullivan, T., Leano, R., Byrne, N., Beller, E., & Marwick, T. H. (2004). Alterations of left ventricular myocardial characteristics associated with obesity. *Circulation*, *110*(19), 3081–3087.https://doi.org/10.1161/01.CIR.0000147184. 13872.0F