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Survey of "Obesity Paradox" in Patients With Chronic Cardiac Symptoms Candidate for Elective Coronary Angiography

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Abstract

Objectives: Obesity is a major risk factor for cardiovascular diseases (CVDs) and increases morbidity. However, recent studies have shown that obesity improves the prognosis of patients with CVDs, which is named as "obesity paradox". The current study aimed to investigate the risk factors of coronary artery disease (CAD) and its severity based on angiographic findings according to the syntax score system and their association with obesity severity based on patients' body mass index (BMI) and to respond to this discrepancy.

Materials and Methods: This cross-sectional-analytical study analyzed the documents of 260 patients who were diagnosed with stable angina and hospitalized at the Shahid Madani CVDs Center in Tabriz from January 2016 to December 2017 and underwent elective coronary angiography.

Results: The mean age of patients was 59.5 years, and 171 (65.8%) and 89 (34.2%) of them were males and females, respectively. CVD was more prevalent in males than females (65.8% vs. 34.2%), and systemic hypertension (HTN) was the most common risk factor in patients (55.4%), followed by diabetes (26.5%). The mean BMI of patients was 28.24 kg/m2 and there was no association between obesity grading and the other risk factors of CAD. In addition, no significant associations were observed between BMI and the values of syntax score I and clinical SYNTAX score (CSS) ($P=0.254$ and 0.101, respectively), as well as obesity grading and syntax score II treatment recommendation based on the syntax score II (Chi-square value = 7.67, $P=0.661$).

Conclusion: In patients with stable angina who are candidates for angiography, the severity of coronary artery involvement was not different according to syntax scores I and II and the clinical syntax score in different BMI groups under the same conditions in terms of other risk factors for CAD.

Keywords: Coronary artery diseases, Stable angina, Body mass index, Obesity, Coronary angiography

Introduction

Cardiovascular diseases (CVDs), including stroke and coronary artery diseases (CADs), are common causes of mortality in both developed and developing societies (1). According to the World Health Organization (WHO) statistics, CVDs are the most prevalent cause of death worldwide, and about half of the estimated 36 million per year deaths of non-communicable diseases are due to CVDs (2). These diseases cause 10% of the total disability-adjusted life year, 735 000 annual heart attacks, and 375 000 deaths in the United States, making CVDs the most common cause of mortality in the United States (3,4). CVDs are the most widespread cause of death in people aged over 45 years and the second cause of years of lost life in Iran (5).

Major risk factors for CAD include diabetes mellitus (DM), systemic hypertension (HTN), hypercholesterolemia, smoking, overweight and obesity, sedentary lifestyle, stress, poor nutrition, age, gender, and race (6). Currently, most epidemiological studies, including the Framingham study, reported that considering its effect on other risk factors, obesity is still an independent risk factor for CVDs (7,8) so that the American Heart Association mentioned obesity as an important risk factor for coronary heart diseases (9).

Meanwhile, the prevalence of obesity is rapidly increasing in Western societies due to lifestyle changes, and it has become an epidemic in the United States (10,11). According to the WHO statistics, the global prevalence of obesity has tripled since 1975 (12). A meta-analysis conducted on 30 million participants found that overweight and obesity were associated with an increased risk of all causes of mortality (13). However, recent studies have shown that obesity improves the prognosis of patients with CVDs, which is named as "obesity paradox". Several studies have been published since the publication of the first articles on this subject (about 20 years ago), which confirmed or rejected this issue (14), but its role in the severity and extent of coronary artery involvement has received less attention.

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Key Messages

- This report evaluated another piece of the puzzle of "obesity paradox" in patients with stable angina and revealed that the severity of coronary artery involvement was not different according to the syntax score in different BMI groups under the same conditions in terms of other risk factors for CAD.

Accordingly, this study aimed to evaluate the severity of obesity as an indicator of the severity of CAD and respond to these discrepancies. The results can help reduce the risk of morbidity and mortality in patients by improving epidemiological knowledge and planning.

Materials and Methods

Recently, the syntax scoring system has been introduced as a tool for estimating the severity and extent of coronary artery involvement based on the angiographic evaluation of coronary lesions, their functional effects, areas of involvement, and the complexity of the lesions (15). In this regard, several variables were examined, including coronary dominance, location at bifurcation/trifurcation or the osteal lesion, vessel tortuosity, presence of calcification, the content of a thrombus, presence of diffuse disease and, the elongated lesion (16).

In the current study, the documents of patients diagnosed with stable angina at the Shahid Madani Cardiovascular Diseases Center in Tabriz from January 2016 to December 2017 and undergoing elective coronary angiography were obtained, and the required data were extracted accordingly. The transfemoral approach was used for selective coronary angiography according to the modified Seldinger technique (17). In this approach, a flexible metallic J-shaped guidewire is inserted through a valved sheath in the femoral artery and advanced slowly to the aortic root under a fluoroscopic view. A fluid-filled catheter is leaded under the angiographic guidewire, then the wire is extracted completely. The coronary ostium is engaged under fluoroscopic imaging with small injections of the contrast. Finally, angiographic images are obtained while directly injecting the contrast into the cannulated coronary artery. People with a history of heart failure, percutaneous coronary intervention (PCI) and coronary artery bypass graft (CABG), and congenital heart diseases were excluded from the study. Moreover, patients were excluded if the required information was not fully available.

Angiography files were reported by a medical specialist who was blind to study objectives. The severity of coronary artery involvement was calculated quantitatively and numerically based on the syntax score.

Patients' weight and height were measured using a hand gauge scale calibrated in kilograms and a wall gauge, respectively. Next, their body mass index (BMI) was calculated as the ratio of individuals' weight per kilogram to height squared in meters (kg/m^2). Then, the severity of obesity was assessed so that a BMI <20, 20-24, 29-25, 34-30, 39-35, and ≥40 was considered as underweight, normal, overweight, first-degree obesity, second-degree obesity, and third-degree obesity, respectively.

Other extracted data included age, gender, vascular HTN status, DM, smoking, and family history. In cases where complete information was unavailable, the patient was contacted and the fields were completed, otherwise, the patient was excluded from the study.

Finally, the data were analyzed using SPSS software (version 13) and presented by descriptive statistical methods (i.e., mean, standard deviation, frequency, and percentage). The normality of data was tested using the Kolmogorov-Smirnov test, and the ANOVA test was used to compare the data. A P value <0.05 was considered statistically significant.

Results

In total, the data of 260 patients were extracted, of whom 171 (65.8%) were males and 89 (34.2%) of them were females. The mean age of patients was 59.5 years and the age of the youngest and oldest patients was 27 and 91 years, respectively. In addition, 144 (55.4%), 69 (26.5%), 42 (16.2%), 21 (8.1%), 58 (22.3%), 3 (1.2%), and 2 (0.8%) of patients had a history of systolic HTN, DM, hyperlipidemia, a family history of ischemic heart disease, a history of smoking, obstructive pulmonary disease, and peripheral vascular disease, respectively. Therefore, the incidence of CVDs was more common in males than females, and systemic HTN was the most common risk factor in patients, followed by diabetes (Table 1).

As regards gender, the mean age of male and female

Table 1. Demographic Pattern and the Prevalence of Cardiovascular Risk Factors in the Study Patients

Risk Factors	Status	Number (%)
Patient gender	Male	171 (65.8)
	Female	89 (34.2)
History of IHD	Negative	158 (60.8)
	Positive	102 (39.2)
Diabetes mellitus	Negative	191 (73.5)
	Positive	69 (26.5)
Systemic hypertension	Negative	116 (44.6)
	Positive	144 (55.4)
Hyper-lipidemia	Negative	218 (83.8)
	Positive	42 (16.2)
Family history of IHD	Negative	239 (91.9)
	Positive	21 (8.1)
Smoking	Negative	202 (77.7)
	Positive	58 (22.3)
Peripheral vascular disease	Negative	258 (99.2)
	Positive	2 (0.8)
Chronic obstructive pulmonary disease	Negative	257 (98.8)
	Positive	3 (1.2)

Note. IHD: Ischemic heart disease.

patients was 58.9 and 60.7, respectively, which was not statistically significant ($P=0.159$). According to analyses, the prevalence of HTN, hyperlipidemia, and smoking was significantly higher in males although the distribution of other risk factors for CVDs was the same in both genders.

The mean BMI was 28.24 kg/m^2 (the minimum and maximum values of the BMI were 19.6 and 44.6, respectively). One patient (0.4%) was categorized as underweight (BMI < 20), and 51 (19.6%), 128 (49.2%), 62 (23.8%), 11 (4.2%), and 3 (1.2%) of them were in the normal category (20 < BMI < 25), overweight (25 < BMI < 30), the first-degree obesity category (30 < BMI < 35), the second-degree obesity category (35 < BMI < 40), the third-degree obesity category (BMI < 40), respectively (Figure 1).

The results showed no association between obesity grading and other risk factors for CAD, including hyperlipidemia, DM, HTN, peripheral vascular disease, and smoking. Different BMI groups had a similar status in terms of the prevalence of risk factors for CVDs. Additionally, the statistical analysis did not indicate an association between BMI numerical levels and risk factors for CAD.

The results of the Pearson correlation test demonstrated no significant association between BMI and the values of the clinical SYNTAX score (CSS) and syntax score I. On the other hand, concerning the association between other risk factors for CVDs and syntax scores, the results revealed that the syntax score I in males was significantly higher compared to females although no significant association was found between gender and the CSS. Other risk factors such as DM, systemic HTN, hyperlipidemia, smoking, peripheral vascular disease, and a family history of ischemic heart disease were not associated with syntax score values (Table 2).

Finally, no significant association was found between obesity grading and syntax score II treatment recommendation (chi-square value = 7.67, $P=0.661$).

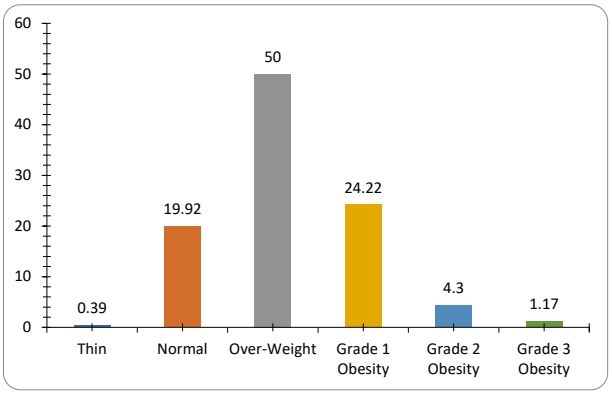

Figure 1. The Prevalence of Different BMI Groups in the Studied Patients. Note. BMI: Body mass index.

According to the results, the recommended treatment was significantly different for males and females. CABG was more recommended in females while PCI was more recommended for males ($P<0.000$). However, the scores of syntax I and the prevalence of HTN, hyperlipidemia, and smoking were significantly higher in males in comparison with females. However, the distribution of other risk factors was the same in both genders.

Discussion

Based on the results, no association was observed between obesity grading and BMI numerical values with other risk factors concerning the incidence of CAD. Furthermore, there was no significant association between BMI and the values of the CSS and syntax score I. Likewise, no significant association was found between obesity grading and the syntax score II treatment recommendation.

Stalls et al compared the association between BMI and CAD in white and black races and concluded that the BMI and risk factors for CAD were linearly correlated although BMI was not linearly correlated with CAD.

Table 2. The Relationship Between Obesity and the Most Common Risk Factors for the Cardiovascular Disease and the Correlation Coefficients With Syntax Scores I and II and the Clinical Syntax Score With a Statistically Significant Level

	Thin (BMI≤ 20)	Normal (20<BMI≤25)	Over-weight (25<BMI≤30)	Grade 1 Obesity (30<BMI≤35)	Grade 2 Obesity (35<BMI≤40)	Grade 3 Obesity (BMI>40)	Pearson Chi-square/ Pearson Correlation (r)	*P*
N (%)	1 (0.4%)	51 (19.6%)	128 (49.2%)	62 (23.8%)	11 (4.2%)	3 (1.2%)	-	-
Age	60.00	59.09	60.67	57.33	60.81	63.00	-	-
Gender (F/M)	1/0	17/34	33/95	28/34	8/3	1/2	-	-
DM	1 (100%)	10 (19.60%)	37 (28.90%)	16 (25.80%)	2 (18.18%)	2 (66.66%)	7.277	0.201
HTN	1 (100%)	23 (45.09%)	67 (52.34%)	42 (67.74%)	7 (63.63%)	1 (33.33%)	8.173	0.147
Hyperlipidemia	1 (100%)	9 (17.64%)	21 (16.40%)	7 (11.29%)	3 (27.27%)	0 (0%)	7.997	0.156
SYNTAX score I	22.50	7.60	11.57	7.13	5.68	6.66	-0.072	0.254
SYNTAX score II (PCI)	38.00	27.81	28.78	24.46	27.40	24.23	-0.117	0.061
SYNTAX score II (CABG)	18.10	21.95	22.90	17.75	20.00	22.06	-0.133	0.034
Clinical SYNTAX score	6.00	5.64	6.57	4.25	4.00	6.00	-0.103	0.101

Note. BMI: body mass index; DM: diabetes mellitus; HTN: hypertension; PCI: percutaneous coronary intervention; CABG: coronary artery bypass graft.

They reported that the incidence of CAD increased by increasing the BMI to more than 30, and beyond this threshold, further increases in BMI were inversely associated with the incidence of CAD (18). However, the results of a cohort study conducted by Iliodromiti et al on 296535 people without CVDs for five years represented a J-shape association between BMI and the incidence of CVDs. They further found that BMI <18.5 was associated with an increased occurrence of CVDs and reported this issue as the reason for higher comorbidity in the group with low BMI (19).

Bhattacharyya et al investigated the association between cardiovascular risk factors and the syntax score in 102 patients with three-vessel disease and reported no association between BMI and the increased syntax score (20).

In another study, Niraj et al compared 770 patients who were referred for angiography in terms of risk factors and the severity of coronary artery involvement and their association with BMI and found that people with higher BMI had a lower mean age and lower coronary involvement (21).

In Iran, Parsa and Jahanshahi evaluated 414 patients with CAD and compared the angiographic results of patients in terms of the syntax score in different BMI groups. Based on their results, the severity of CAD was inversely associated with BMI while directly associated with the waist-to-hip ratio (22).

Recently, several studies have used syntax score II, and primary studies have shown that it is a better predictor of patients' outcomes and mortalities (23,24). The Campos review study investigated the data of seven studies and found that the syntax score II can identify higher-mortality patients for PCI. Moreover, lower syntax scores and female gender favours CABG recommendations (25). This cross-sectional study reported that the syntax score II was not different in various BMI groups with the same risk factors, and according to the results of other studies, it does not affect mortality indirectly.

A study on 874 patients having CABG measured the CSS of all patients and examined major adverse cardiac and cerebrovascular events and all causes of participants' mortality in a three-year follow-up. The results showed that the CSS >14.5 is a reliable tool for predicting mortality and complications of cardiovascular major events (26). However, no study was found on the association between BMI and CSS.

The main limitation of the current study was the small number of participating patients in different BMI groups, particularly underweight and obese patients of grade II and III. A relatively small sample size, due to strict inclusion and exclusion criteria and a predominantly Iranian-Azeri population could be a shortcoming of our study, which limits the generalizability of the results. Therefore, more multicenter surveys are recommended with larger cases for evaluating definitive results.

Conclusions

Generally, in patients with stable angina who are candidates for angiography, the severity of coronary artery involvement was not different according to the syntax score, syntax score II, and the CSS in different BMI groups under the same conditions. Furthermore, there was no difference in terms of other risk factors for CAD.

This study highlights another piece of the puzzle in discovering possible physiopathologic mechanisms underlying the "obesity paradox". Finally, remodeling the risk factors will improve the clinical evaluation and management of CAD patients.

Authors' Contribution

Study concept and design: SG, and ZR; analysis and interpretation of data: MB, and ZR; drafting of the manuscript: SG, ZR; critical revision of the manuscript for important intellectual content: SG and ZR; statistical analysis: MB.

Conflict of Interests

The authors have no conflict of interests.

Ethical Issues

The current study was confirmed by the Ethics Committee of Tabriz University of Medical Sciences (No. IR.TBZMED.REC.1398.589), and the confidentiality of information was observed during the study implementation.

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References

1. Yusuf S, Joseph P, Rangarajan S, et al. Modifiable risk factors, cardiovascular disease, and mortality in 155 722 individuals from 21 high-income, middle-income, and low-income countries (PURE): a prospective cohort study. Lancet. 2020;395(10226):795-808. doi:10.1016/s0140-6736(19)32008-2
2. Mendis S, Puska P, Norrving B, World Health Organization. Global Atlas on Cardiovascular Disease Prevention and Control. World Health Organization; 2011.
3. Glovaci D, Fan W, Wong ND. Epidemiology of diabetes mellitus and cardiovascular disease. Curr Cardiol Rep. 2019;21(4):21. doi:10.1007/s11886-019-1107-y
4. Michelin RS, Santosa S, Buddington S, Taha A. Lipoproteins large to small particle size ratio is significant predictor in CAD and stroke outcomes. Arterioscler Thromb Vasc Biol. 2019;39 Suppl 1:A680. doi:10.1161/atvb.39.suppl_1.680
5. Saadat S, Yousefifard M, Asady H, Moghadas Jafari A, Fayaz M, Hosseini M. The most important causes of death in Iranian population; a retrospective cohort study. Emerg (Tehran). 2015;3(1):16-21.
6. Hajar R. Risk factors for coronary artery disease: historical perspectives. Heart Views. 2017;18(3):109-114. doi:10.4103/heartviews.heartviews_106_17
7. Benjamin EJ, Virani SS, Callaway CW, et al. Heart disease

and stroke statistics-2018 update: a report from the American Heart Association. Circulation. 2018;137(12):e67-e492. doi:10.1161/cir.0000000000000558
8. Koliaki C, Liatis S, Kokkinos A. Obesity and cardiovascular disease: revisiting an old relationship. Metabolism. 2019;92:98-107. doi:10.1016/j.metabol.2018.10.011
9. Farmer RE, Mathur R, Schmidt AF, et al. Associations between measures of sarcopenic obesity and risk of cardiovascular disease and mortality: a cohort study and Mendelian randomization analysis using the UK Biobank. J Am Heart Assoc. 2019;8(13):e011638. doi:10.1161/jaha.118.011638
10. Kopp W. How western diet and lifestyle drive the pandemic of obesity and civilization diseases. Diabetes Metab Syndr Obes. 2019;12:2221-2236. doi:10.2147/dmso.s216791
11. Wilding JPH, Jacob S. Cardiovascular outcome trials in obesity: a review. Obes Rev. 2020. doi:10.1111/obr.13112
12. Ng M, Fleming T, Robinson M, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2014;384(9945):766-781. doi:10.1016/s0140-6736(14)60460-8
13. Aune D, Sen A, Prasad M, et al. BMI and all cause mortality: systematic review and non-linear dose-response meta-analysis of 230 cohort studies with 3.74 million deaths among 30.3 million participants. BMJ. 2016;353:i2156. doi:10.1136/bmj.i2156
14. Xia JY, Lloyd-Jones DM, Khan SS. Association of body mass index with mortality in cardiovascular disease: new insights into the obesity paradox from multiple perspectives. Trends Cardiovasc Med. 2019;29(4):220-225. doi:10.1016/j.tcm.2018.08.006
15. Modolo R, Chichareon P, van Klaveren D, et al. Impact of non-respect of SYNTAX score II recommendation for surgery in patients with left main coronary artery disease treated by percutaneous coronary intervention: an EXCEL substudy. Eur J Cardiothorac Surg. 2020;57(4):676-683. doi:10.1093/ejcts/ezz274
16. Guedeney P, Barthélémy O, Zeitouni M, et al. Prognostic value of SYNTAX score in patients with infarct-related cardiogenic shock: insights from the CULPRIT-SHOCK trial. JACC Cardiovasc Interv. 2020;13(10):1198-1206. doi:10.1016/j.jcin.2020.04.003
17. Topol EJ, Teirstein PS. Textbook of Interventional Cardiology E-Book. Elsevier Health Sciences; 2015.
18. Stalls CM, Triplette MA, Viera AJ, Pathman DE, Cohen MG, Rossi JS. The association between body mass index and coronary artery disease severity: a comparison of black and white patients. Am Heart J. 2014;167(4):514-520. doi:10.1016/j.ahj.2013.12.009
19. Iliodromiti S, Celis-Morales CA, Lyall DM, et al. The impact of confounding on the associations of different adiposity measures with the incidence of cardiovascular disease: a cohort study of 296 535 adults of white European descent. Eur Heart J. 2018;39(17):1514-1520. doi:10.1093/eurheartj/ehy057
20. Bhattacharyya PJ, Vijapur S, Bhattacharyya AK. A study of cardiovascular risk factors correlation with the angiographic severity of coronary artery disease using Syntax score. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS). 2016;15(1):21-28. doi:10.9790/0853-15142128
21. Niraj A, Pradhan J, Fakhry H, Veeranna V, Afonso L. Severity of coronary artery disease in obese patients undergoing coronary angiography: "obesity paradox" revisited. Clin Cardiol. 2007;30(8):391-396. doi:10.1002/clc.20113
22. Parsa AF, Jahanshahi B. Is the relationship of body mass index to severity of coronary artery disease different from that of waist-to-hip ratio and severity of coronary artery disease? paradoxical findings. Cardiovasc J Afr. 2015;26(1):13-16. doi:10.5830/cvja-2014-054
23. Garg S, Sarno G, Garcia-Garcia HM, et al. A new tool for the risk stratification of patients with complex coronary artery disease: the Clinical SYNTAX Score. Circ Cardiovasc Interv. 2010;3(4):317-326. doi:10.1161/circinterventions.109.914051
24. Abu Sharar H, Helfert S, Vafaie M, et al. Identification of patients at higher risk for myocardial injury following elective coronary artery intervention. Catheter Cardiovasc Interv. 2020;96(3):578-585. doi:10.1002/ccd.28549
25. Campos CM, Garcia-Garcia HM, van Klaveren D, et al. Validity of SYNTAX score II for risk stratification of percutaneous coronary interventions: a patient-level pooled analysis of 5,433 patients enrolled in contemporary coronary stent trials. Int J Cardiol. 2015;187:111-115. doi:10.1016/j.ijcard.2015.03.248
26. Melina G, Angeloni E, Refice S, et al. Clinical SYNTAX score predicts outcomes of patients undergoing coronary artery bypass grafting. Am Heart J. 2017;188:118-126. doi:10.1016/j.ahj.2017.03.016