Body mass index and clinical performance of patients undergoing percutaneous coronary intervention

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Abstract

Aim: We sought to investigate the impact of body mass index (BMI) on morbidity and all-cause mortality in patients following first-time elective percutaneous coronary intervention (PCI).
Methods: We included in this study 334 patients who underwent for the first-time elective PCI from September 2011 to October 2012 at the Department of Cardiology and were followed for a period of one year. The impact of BMI on prognosis was examined. We excluded patients who had previously undergone revascularization. Patients were categorized according to BMI groups: BMI=18.5-24.9 kg/m^2 (normal group); BMI=25-29.9 kg/m^2 (overweight group) and; BMI>30 kg/m^2 (obese group). The endpoint was defined as all-cause death or, hospitalizations for cardiovascular disease (CVD).
Results: During the follow-up period there was only one death in each group. Compared with normal weight individuals, those overweight had more high risk for coronary anatomy (either three vessel disease or left main stem stenosis) (13.6% vs 1.6%, P=0.0241), length of stents per person higher (29.89±14.75 vs 35.17±18.23, P=0.042) and were older (60.56±9.94 years vs 57.37±10.26 years, P=0.042). The mean diameter of stents per person used in obese individuals was significantly larger compared to normal weight individuals (3.15±0.35 vs 2.95±0.29, P<0.001). Compared to normal weight individuals, those overweight had a significantly reduced number of hospitalizations for CVD (7.9% vs 24.2%, P=0.0008) and all cause death or hospitalizations for CVD (8.5% vs 25%, P<0.001). Also, compared to normal weight, obese individuals had a reduced number of hospitalizations for CVD (11.3% vs. 24.2%, P=0.09).
Conclusion: Patients with increased BMI undergoing percutaneous coronary intervention have a more favorable clinical performance. We suggest that the "obesity paradox" partially can be explained with the existence of a large coronary damage, which may contribute to more favorable outcomes and with the inverse association between diameters of vessels treated and clinical outcomes.

Keywords: body mass index, cardiovascular risk factor, clinic performance, obesity.

Introduction

Obesity has been increasing in epidemic proportions over many decades. In adults, overweight is defined as body mass index BMI=25-29.9 kg/m^2 and obesity as BMI≥30 kg/m^2.

In USA, the prevalence of overweight and obesity increased by nearly 50% during the past two decades (1). Nearly 70% of adults in USA are classified as overweight or obese. The prevalence of obesity in Europe has tripled in the last two decades. Actually, in Europe, the prevalence of overweight ranges between 32% and 79% in men and between 28% and 78% in women; and, the prevalence of obesity ranges between 5% to 23% in men and 7% to 36% in women (2).

Albania has one of the highest prevalence of overweight and obesity in Europe ranging around 58% and 22% in men respectively and 40% and 36% in women respectively (2).

The effects of obesity on overall cardiovascular health (CV) are numerous. Obesity adversely affects cardiovascular (CV) hemodynamics, structure, and function, as well as increases the prevalence of most CV disease (3-5). A higher BMI is associated with an increased risk for coronary artery disease (CAD) (6), cardiovascular events (6), and new-onset heart failure (HF) (7).

Although obesity is clearly a risk factor for developing CAD and HF, once CAD and HF are established, there have been reported more favorable clinical outcomes. It is observed a lower all-cause mortality, and a lower cardiovascular mortality following established coronary artery disease (8,9), acute myocardial infarction (10,11), acute coronary syndromes (12), and heart failure (13-15); also, fewer major cardiovascular events and better survival after coronary revascularization (16-19), and a lower need for repeat revascularization (20).

In this study we sought to investigate the impact of BMI on clinical outcomes; hospitalizations for CV disease and all cause morbidity following first-time elective percutaneous coronary intervention (PCI).

Methods

Data sources

This study included all consecutive patients who underwent first elective PCI procedures from September 2011 to December 2012 and were subsequently followed for hospitalizations for CV disease and all cause mortality for year year. The follow-up was performed by clinic visits or telephone contacts. We excluded patients who had previously undergone PCI or coronary artery by-pass grafting (CABG) and who underwent primary procedures for coronary acute syndromes. Also, we excluded those with BMI<18.5, or BMI>50 kg/m^2. The remaining patients compromised the study cohort. Based on these selection criteria, 334 patients were enrolled.

Definitions

BMI was calculated as body weight (kg) divided by the square of the height (m). Weight was categorized as normal weight (BMI=18.5-24.9 kg/m^2), overweight (BMI=25-29.9 kg/m^2), or obese (BMI≥30 kg/m^2). The patients were divided into three groups according to each BMI category.

The extent of coronary disease was classified according to the number of coronary arteries with severe (>50%) stenosis, one, two, or three vessel disease of left main stenosis (>50%). High risk anatomy was defined as either three vessel disease or left main stenosis.

Hypertension was defined as blood pressure ≥140/90 mmHg or under antihypertensive therapy. Dyslipidemia was defined as total cholesterol ≥200 mg/dl, LDL≥150 mg/dl, HDL≤40 mg/dl and triglycerides ≥150 mg/dl, or subjects under antilypemic therapy.

Diabetes mellitus was defined as a fasting glucose level ≥126 mg/dl and load glucose level of ≥180 mg/dl, or individuals under therapy for known diabetes mellitus.

We asked also for previous family history for CAD, smoking, previous myocardial infarction left ventricular impairment, or renal function impairment (all defined as categorical variables).

The primary endpoint was defined as all-cause death or hospitalizations for cardiovascular disease. We also examined the following secondary endpoints: (i) all-cause death; (ii) hospitalizations for cardiovascular disease.

Statistical Analyses

The categorical variables are expressed as percentages and compared using the chi-square (χ^2) test. Continuous variables were expressed as average values ± SD and compared with t-test. Statistical significance was set at P≤0.05.

Results

Of the 334 patients who underwent first elective PCI, 108 (32.3%) were normal weight individuals, 164 (49.1%) were overweight, and 62 (18.6%) were obese individuals.

Predominantly, they were males in all groups (85.2% vs 77.4% vs 82.2%), with no significant difference between them (Table 1).

Also, there were no significant differences in the proportions of patients with diabetes mellitus, dyslipidemia, hypertension, a familiar history for coronary artery disease, a history for myocardial infarction, impaired LV function, impaired renal function, or in medical treatment.

Compared with normal weight individuals, overweight participatns were older (57.37±10.26 years vs 13.6 years, P=0.02). There was no difference in age between obese and normal weight individuals.

Overweight and obese individuals had a higher risk anatomy (either three-vessel, or left main stenosis) (13.6 vs 4.6%, P=0.02, and 14.5% vs 4.6%, P=0.05).

Table 1. Baseline characteristics of study participants

	BMI 18.5-24.9 normal	BMI 25-29.9 overweight	P-value	BMI>30 Obese	P-value
Patients	108/334 (32.3%)	164/334 (49.1%)		62/334 (18.6%)	
Male	92/108 (85.2%)	127/164 (77.4%)	0.1551	51/62 (82.2%)	0.7759
Age mean (SD)	57.37 (10.26)	60.56 (9.94)	0.0421	57.81 (10.10)	0.8132
Diabetes Mellitus	25/108 (23.15%)	49/164 (29.9%)	0.2797	20/62 (32.3%)	0.2647
Smoker	42/108 (38.9%)	50/164 (30.5%)	0.1929	21/62 (33.8%)	0.6262
Dyslipidemia	65/108 (60.2%)	110/164 (67.1%)	0.3025	40/62 (64.5%)	0.6923
Family history for CAD	25/108 (23.14%)	42/164 (25.61%)	0.7511	17/62 (27.4%)	0.6623
Hypertension	85/108 (78.7%)	131/164 (79.9%)	0.9353	52/62 (83.9%)	0.5362
St. post MI	54/108 (50%)	73/164 (44.5%)	0.4452	21/62 (33.9%)	0.0604
Impaired LV function	14/108 (12.96%)	19/164 (11.6%)	0.8802	5/62 (8.1%)	0.4698
Impaired renal function	4/108 (3.7%)	3/164 (1.83%)	0.5728	2/62 (3.2%)	0.8709
1 vessel CAD	69/108 (63.9%)	80/164 (48.8%)	0.0201	33/62 (53.2%)	0.2288
2 vessels CAD	34/108 (31.5%)	62/164 (37.8%)	0.3482	15/52 (28.9%)	0.4043
3 vessels CAD/LM	5/108 (4.6%)	22/164(13.6%)	0.0305	9/62 (14.5%)	0.0492
PCI of LAD	61/108 (56.5%)	106/164 (64.6%)	0.2209	31/62 (50%)	0.5115
PCI of LCX	35/108 (32.4%)	41/164 (25%)	0.2325	16/62 (25.8%)	0.4653
PCI of RCA	35/108 (32.4%)	53/164 (32.3%)	0.9876	26/62 (41.9%)	0.2799

	BMI 18.5-24.9 normal	**BMI 25-29.9 overweight**	**P-value**	**BMI>30 Obese**	**P-value**
N. stents mean (SD)	1.63 (0.79)	1.93 (1,01)	0.0429	1.65 (0.91)	0.9134
Stent length mean (SD)	28.89 (14.75)	35.17 (18.23)	0.042	32.2 (19.9)	0.4871
Stent diameter Mean (SD)	2.95 (0.29)	3.04 (0.45)	0.092	3.15 (0.35)	0.0006
B-blocker	91/108 (84.25%)	133/164 (81.1%)	0.6123	45/62(72.6%)	0.1024
Ca-blocker	34/108 (31.5%)	68/164 (41.5%)	0.1246	29/62 (46.8%)	0.0684
ASA	102/108 (94.4%)	154/164 (93.9%)	0.8525	55/62 (88.7%)	0.2916
Statins	103/108 (95.4%)	152/164 (92.7%)	0.8045	55/62 (88.71%)	0.1865
ACEI+ARB	71/108 (65.7%)	117/164 (71.3%)	0.3986	47/62(75.8%)	0.2309
Diuretics	30/108 (27.8%)	40/164 (24.4%)	0.6287	16/62 (25.8%)	0.921
Hospitalizations	26/108 (24.2%)	13/164 (7.9%)	0.0008	7/62 (11.3%)	0.304
All-cause Death	1/108 (0.9%)	1/164 (0.6%)	0.42	1/62 (1.6%)	0.6893
Events (hosp or death)	27/108 (25%)	14/164 (8.5%)	0.0009	8/62 (12.9%)	0.0928

Overweight compared to normal individuals had also higher number of stents per person (1.93±1.01 vs 1.63±0.79, P=0.43) and a higher length of stents per person (35.17±18.23 vs 29.89±14.75, P=0.04).

The mean diameter of stents per person used in obese individuals is significantly larger compared to normal weight individuals (3.15±0.35 vs 2.95±0.29, P<0.001), while in overweight individuals the diameter is larger to normal weight individuals but not quite significant (3.04 ±0.45 vs 2.95±0.29, P=0.10).

During the follow-up, there was only one death in each group. Compared to normal weight individuals, those overweight had a significant reduced number of hospitalizations for CVD (7.9% vs 24.2%, P<0.001) and all-cause death, or hospitalizations for CVD (8.5% vs 25%, P<0.001) (Figure 1). Also compared to normal weight, obese individuals had a reduced number of hospitalizations for CVD, but not quite significant (11.3% vs 24.2%, P=0.09) (Figure 2).

Figure 1. Hospitalizations for CV disease after PCI procedure

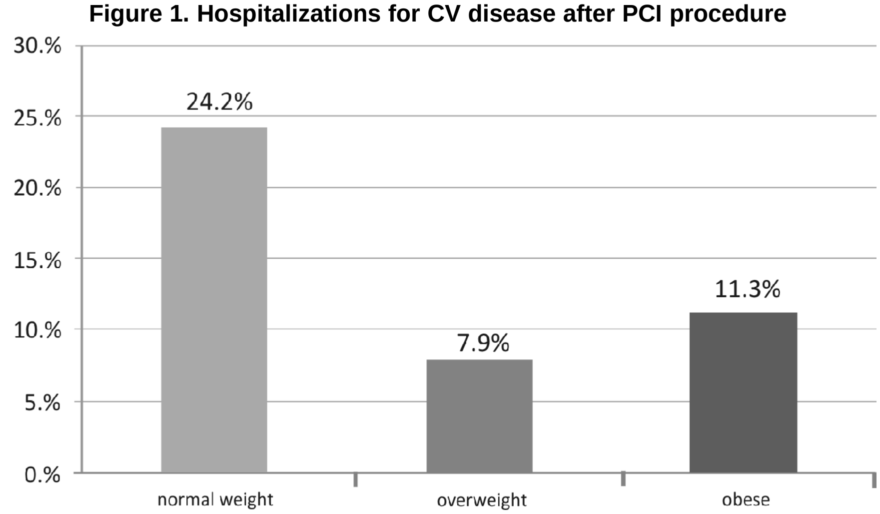
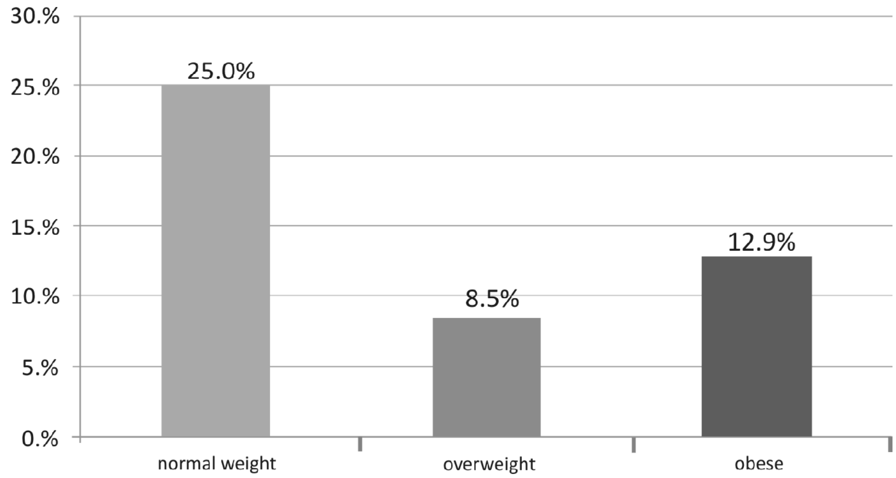


Figure 2. All-cause mortality or hospitalization for CVD after PCI procedure



Discussion

Our results support the "obesity paradox" in Albanian patients. In our study, there were significantly fewer hospitalizations and events in overweight patients than in normal weight counterparts. Also, there was a trend of fewer events even in obese patients, which was not statistically significant though. Our results are compatible with other studies conducted elsewhere. Oreopouolos et al. (17), in a meta-analysis of ten cohorts of patients undergoing percutaneous coronary interventions (PCI), demonstrated a lower risk of dying among both overweight and obese patients.

Hastie et al. (18), in a cohort of 4880 consecutive undergoing PCI, increased BMI was associated with improved 5-year survival. This paradox is explained with the possibility that the adverse effects of excess adipose tissue may be offset by beneficial vasoactive properties.

In another meta-analysis using PubMed, CINAHL, Cochran CENTRAL, Scopus, and the Web of Science databases, Sharma et al. (19) demostrated a higher risk of total mortality, CV mortality, and MI among underweight patients characterized by a low BMI and a lowest CV mortality among overweight patients after coronary artery disease revascularization procedures (PCI and CABG).

Obesity plays a negative role affecting the major coronary heart disease (CHD) risk factors including hypertension, dyslipidemia, and diabetes mellitus (DM). In our study, there was a trend in overweight and obese patients who had a higher prevalence of hypertension, dyslipidemia, diabetes mellitus, which nevertheless were not statistically significant. Anyway, these factors impact adversely, and we would expect that overweight and obese patients would have worse outcomes than normal patients, which is contrary to our outcomes. On the other hand, an increased prevalence of hypertension in overweight and obese patients can be a favorable factor, because a more aggressive treatment with ACE-inhibitors and beta-blockers (cardioprotective medications) can be tolerated. However, in our study, there was no significant difference between groups under medical treatment.

Normally, longer stents predict more re-stenosis which is translated in more revascularizations (21). Surprisingly, in our study, overweight and obese patients had a longer stent implanted period, but nonetheless manifested a better clinical performance.

In our study, overweight and obese patients had a significantly higher prevalence of high risk anatomy (either three-vessel disease, or left main stenosis). At this point, we can speculate that having a large coronary damage may contribute to more favorable outcomes. This population may have had a higher metabolic reserve to affront heighten catabolic status in patients with chronic diseases such as CAD - a form of "preconditioning".

In our study, higher BMI was related to larger vessels treated with larger stent diameters. Smaller stents may predict more re-stenosis and need for revascularization (21,22). This can be a mechanism of an inverse association of BMI and clinical outcomes after PCI. This speculation need to be confirmed in other studies.

Adipose tissue is a big endocrine organ (23). Cytokines and neuroendocrine profiles of obese patients may be also protective (13). Obesity is associated with high serum levels of low density lipoproteins that scavenge unbound circulating lipopolysaccharides and, consequently, have an anti-inflammatory effect. Among patients with heart failure, obese individuals have lower levels of tumor necrosis factor and other inflammatory cytokines. Adipose tissue produces soluble tumor necrosis factor-alpha receptors and could play a protective role in obese patients by neutralizing the adverse biological effects of tumor necrosis factor-alpha (24).

It should be emphasized that, in our study, the sample size was relatively small and our follow-up period for total mortality and hospitalizations for CVD was restricted to one year only. In addition, we used only BMI to define overweight and obesity. BMI does not have a discriminatory power to differentiate between body fat and lean mass, and between central and peripheral adiposity.

Conclusion

Patients with increased BMI undergoing percutaneous coronary intervention have a more favorable clinical performance. We suggest that the "obesity paradox" partially can be explained with the existence of a large coronary damage, which may contribute to more favorable outcomes and with the inverse association between diameters of vessels treated and clinical outcomes.

Conflicts of interest: None declared.

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