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Obesity Prevalence in Coronary Artery Disease Patients' Cohort: A Retrospective Study

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ABSTRACT

***Rationale**: The prevalence of obesity constantly increasing and epidemiological studies have consistently demonstrated that increased BMI is associated with a progressive rise in the risk of major adverse cardiovascular events (MACE), coronary artery disease (CAD), heart failure, and cardiovascular mortality.*

***Objectives:** The aim of this retrospective study is to evaluate the prevalence and clinical characteristics of obesity in a cohort of patients undergoing percutaneous coronary intervention (PCI), including both acute coronary syndromes and chronic coronary disease presentations. In addition, we sought to explore the relationship between BMI and systemic inflammation and to identify clinical variables independently associated with obesity within this contemporary real-world population.*

***Findings:** Between 2021 and 2023, a total of 2,423 patients underwent percutaneous coronary intervention (PCI) at Mauriziano Hospital in Turin. Among them, 288 patients (11.9%) had a body mass index (BMI) > 30 kg/m². A high prevalence of most common cardiovascular risk factors was observed. The most frequent indication for coronary angiography was NSTEMI (non ST elevation myocardial infarction).*

Despite the high cardiovascular risk, a large proportion of patients failed to achieve guideline-recommended lipid and glycemic targets. This finding highlights a persistent gap between evidence-based recommendations and real-world clinical practice.

Moreover, elevated CRP (C reactive protein) levels have been independently associated with adverse cardiovascular outcomes and may represent an important component of residual inflammatory risk in patients with coronary artery disease.

***Conclusion:** Among obese patients undergoing PCI, achievement of recommended LDL-C and glycemic targets remains suboptimal. BMI is independently associated with higher CRP levels, supporting the presence of an obesity-related inflammatory phenotype. These findings underscore the need of a multidisciplinary approach to these patients.*

Keywords

Obesity, Coronary artery disease, LDL cholesterol, Inflammation, Diabetes.

Introduction

Obesity is defined as a BMI ≥30 [1,2]. Moreover, being overweight (BMI 25.0-29.9 kg/m2) is also associated with an increased risk of chronic heart disease [1]. The prevalence of obesity constantly

increasing (650 million adults worldwide in 2021 according to data from the World Health Organization [WHO]) (1). In Europe it is estimated that overweight affects approximately 59% of adults and almost 1 in 3 children. According to the Higher Institute of Health, in Italy obesity affects more than 10 million people [3].

Excess adiposity is strongly associated with the development of multiple cardiometabolic disorders including arterial hypertension, dyslipidemia, insulin resistance, metabolic syndrome, and type 2 diabetes mellitus (T2DM). These conditions contribute synergistically to the development and progression of atherosclerotic cardiovascular disease (ASCVD). Epidemiological studies have consistently demonstrated that increased BMI is associated with a progressive rise in the risk of major adverse cardiovascular events (MACE), coronary artery disease (CAD), heart failure, and cardiovascular mortality [4,5]. In particular, BMI values above 27 kg/m² have been shown to markedly increase the risk of coronary events even after adjustment for traditional risk factors [6].

Beyond its role in the development of atherosclerosis, obesity also plays a relevant role in the clinical presentation and prognosis of patients with coronary artery disease. A substantial proportion of patients presenting with acute coronary syndromes (ACS) are overweight or obese. Large international registries have reported that up to 40–60% of patients hospitalized for ACS fall within overweight or obese BMI categories [5,6].

Despite the clear association between obesity and cardiovascular risk, management of obesity in patients with established coronary disease remains challenging. Traditional strategies rely on lifestyle interventions including dietary modifications, increased physical activity, and behavioral therapy. However, these interventions alone frequently fail to achieve sustained weight loss in high-risk cardiometabolic populations [7].

Recently, pharmacological therapies targeting obesity have emerged as promising tools for cardiovascular risk reduction. In particular, incretin-based therapies have demonstrated substantial effects on weight loss and cardiometabolic risk factors [7].

In this evolving therapeutic landscape, understanding the epidemiology and clinical characteristics of obese patients undergoing coronary interventions becomes increasingly relevant. However, real-world data describing the prevalence of obesity, associated cardiometabolic burden, and inflammatory profile in contemporary populations with coronary disease remain limited.

Therefore, the aim of this retrospective study is to evaluate the prevalence and clinical characteristics of obesity in a cohort of patients undergoing percutaneous coronary intervention (PCI), including both acute coronary syndromes and chronic coronary disease presentations. In addition, we sought to explore the relationship between BMI and systemic inflammation and to identify clinical variables independently associated with obesity within this contemporary real-world population.

Methods

Study design

Study population included patients underwent PCI between 2021 and 2023 at Mauriziano Hospital in Turin. They were overall 2557: 1366 ACS and 1191 chronic coronary disease, respectively. In 2021: 837 PCI (516 ACS and 321 chronic coronary disease). In 2022: 892 PCI (456 ACS and 436 chronic coronary disease). In 2023: 828 PCI (394 ACS and 434 chronic coronary disease).

The prevalence of obesity (BMI >30) was evaluated in this patients' cohort. Moreover, demographic, clinical, laboratory, instrumental and procedural variables were collected. Demographic variables age and sex. Clinical features: smoke habits, hypertension, diabetes mellitus, dyslipidemia, chronic kidney disease, peripheral artery disease, previous stroke, CAD history and therapy at admission. The presence of cardiogenic shock at admission were also be notified.

Laboratory data: renal function, hemoglobin, lipid profile, PCR and glycated hemoglobin. Echocardiographic data, in particular ejection fraction at admission and at discharge were investigated. Procedural information such as number of vessels diseased, number of vessels treated, complete revascularization, periprocedural myocardial infarction, stroke or major bleeding during hospital stay.

Statistical analysis

Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) was used for statistical analyses. Continuous variable with normal distribution were reported as mean ± standard deviation. Categorical variables were indicated as percentage.

A multivariable linear regression model was constructed to identify independent predictors of systemic inflammation (log-transformed CRP). Data were considered statistically significant with a p-value < 0.05.

Results

Between 2021 and 2023, a total of 2,423 patients underwent percutaneous coronary intervention (PCI) at Mauriziano Hospital in Turin. Among them, 288 patients (11.9%) had a body mass index (BMI) > 30 kg/m². The cohort included 210 men (72.9%) and 78 women (27.1%), with a mean age of 69.2 ± 11.1 years (68.0 years in men and 72.5 years in women).

Cardiovascular risk factors and medical history

Baseline features are summarized in Table 1.

Among patients with BMI > 30 kg/m², 98 patients (34.0%) were active smokers, 120 (41.7%) had diabetes mellitus, 231 (80.2%) had arterial hypertension, 208 (72.2%) had dyslipidemia, and 40 patients (13.9%) had chronic kidney disease (estimated GFR <60 mL/min/1.73 m²). Peripheral artery disease was present in

44 patients (15.3%), 8 patients (2.8%) had a history of ischemic stroke, and 13 patients (4.5%) had previously undergone coronary artery bypass grafting (CABG). A prior myocardial infarction was documented in 85 patients (29.5%), while 110 patients (38.2%) had a history of previous PCI.

Medical therapy

At admission, 169 patients (58.7%) were receiving statin therapy; among them, 69 patients (24.0%) were treated with a combination of statin plus ezetimibe. Only 2 patients (0.7%) were on PCSK9 inhibitors, while 90 patients (31.3%) were treated with oral hypoglycemic agents.

Table 1: Baseline characteristics of patients with BMI > 30 kg/m². Values are expressed as mean ± standard deviation or n (%).

Variable	Value
Demographic characteristics	
Age (years)	69.2 ± 11.1
Male sex	210 (72.9%)
Female sex	78 (27.1%)
Cardiovascular risk factors	
Active smoking	98 (34.0%)
Diabetes mellitus	120 (41.7%)
Arterial hypertension	231 (80.2%)
Dyslipidemia	208 (72.2%)
Chronic kidney disease (eGFR <60)	40 (13.9%)
Medical history	
Peripheral artery disease	44 (15.3%)
Prior ischemic stroke	8 (2.8%)
Prior myocardial infarction	85 (29.5%)
Previous PCI	110 (38.2%)
Previous CABG	13 (4.5%)
Therapy at admission	
Statins	169 (58.7%)
Statin + ezetimibe	69 (24.0%)
PCSK9 inhibitor	2 (0.7%)
Oral hypoglycemic agents	90 (31.3%)

Clinical presentation

Clinical presentation at admission was heterogeneous. The most common indication for coronary angiography and PCI was NSTEMI (18.6%), followed by stable angina (17.5%), documented ischemia on non-invasive testing (14.0%), STEMI (11.9%), and unstable angina (8.4%), with the remaining patients presenting with less frequent indications (Figure 1).

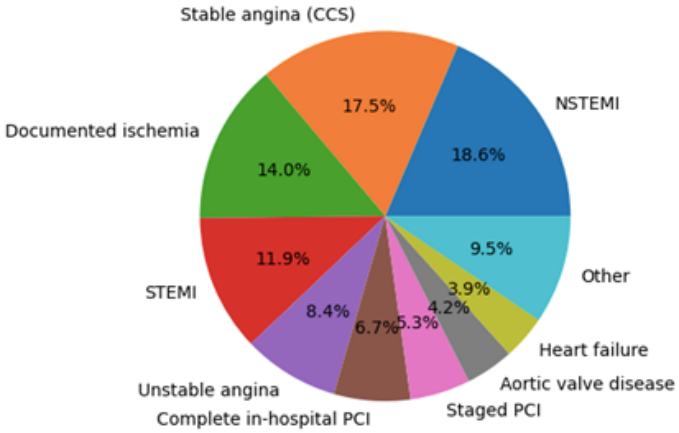

Figure 1: Clinical presentation of patients with BMI > 30 kg/m² undergoing PCI.

Angiographic findings and procedural outcomes

Angiographic assessment revealed single-vessel coronary artery disease in 107 patients, two-vessel disease in 90 patients, and three-vessel disease in 73 patients. Left main coronary artery disease was identified in 9 patients. Complete revascularization was achieved in 233 patients (80.9%). Periprocedural complications were infrequent: 3 patients (1.0%) experienced periprocedural myocardial infarction, 1 patient (0.3%) suffered an in-hospital ischemic stroke, and no major bleeding events were observed during hospitalization.

Left ventricular function

Mean left ventricular ejection fraction (LVEF) at admission was 52.3% ± 10.7%, increasing to 52.9% ± 10.1% at discharge. At baseline, 9 patients (3.1%) had severely reduced LVEF (<30%), whereas 174 patients (60.4%) showed preserved systolic function (LVEF ≥55%).

Laboratory findings

Among patients with available laboratory data, mean total cholesterol was 146.6 mg/dL, LDL-cholesterol 84.5 ± 39.3 mg/dL, HDL-cholesterol 38.8 ± 11.6 mg/dL, and triglycerides 140.4 ± 65.8 mg/dL. Mean C-reactive protein was 4.0 ± 8.2 mg/L, mean glycated hemoglobin (HbA1c) was 48.8 ± 16.0 mmol/mol, mean hemoglobin was 13.4 ± 1.25 g/dL, and mean estimated GFR was 69.7 ± 20.5 mL/min/1.73 m².

Among patients with BMI > 30 kg/m², 113 patients had a history of coronary artery disease (prior myocardial infarction, PCI, or CABG). LDL-cholesterol values were available in 102 patients (90.3%). Of these, only 44 patients (43.1%) achieved the recommended LDL-C target of <55 mg/dL according to current European guidelines, despite a high prevalence of lipid-lowering therapy.

Among patients with BMI > 30 kg/m², 101 diabetic patients were treated with oral glucose-lowering agents and/or insulin. HbA1c values were available in 65 patients (64.4%), and only 29 of them (44.6%) achieved the recommended glycemic target (HbA1c <53 mmol/mol) at hospital admission.

BMI–Inflammation Analysis

In the subgroup of obese patients undergoing PCI with available CRP measurements (N = 269), we specifically investigated the relationship between body mass index and systemic inflammation. First, using Spearman correlation analysis, we observed a statistically significant positive association between BMI and CRP levels (Table 2).

A multivariable linear regression model was constructed to identify independent predictors of systemic inflammation (log-transformed CRP). After adjustment for age, sex, diabetes, dyslipidemia, hypertension, smoking status and chronic kidney disease, BMI remained independently associated with higher CRP levels. For each 1 kg/m² increase in BMI, CRP increased by approximately 3.89% (95% confidence interval: +0.63% to +7.25%, p = 0.019) (Figure 2).

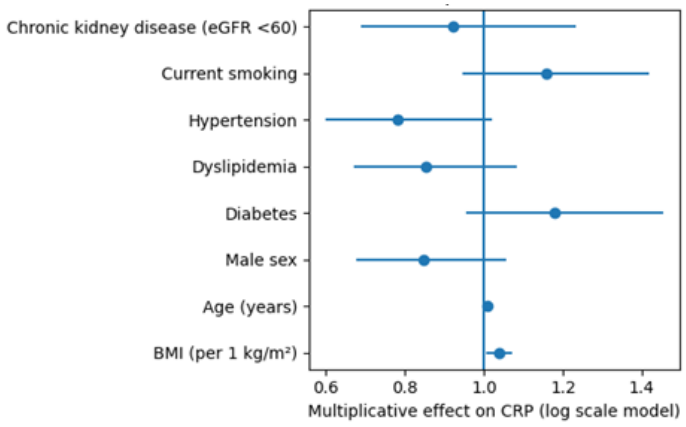

Figure 2: Multivariable Model - Independent Predictors of inflammation.

Table 2: Association between body mass index and C-reactive protein levels in obese patients undergoing PCI.

Analysis	N	rho	95% CI lower	95% CI upper	p-value
Spearman correlation BMI–CRP	269	0.183	0.066	0.297	0.0026

Discussion

The present study provides a contemporary real-world overview of obesity among patients undergoing percutaneous coronary intervention in a referral center. Several relevant findings emerge from our analysis.

First, obesity was highly prevalent in our PCI population, confirming the growing burden of excess body weight among patients with established CAD. This observation is consistent with large international registries reporting that overweight and obesity affect a substantial proportion of patients presenting with both ACS and chronic coronary syndromes [8,9]. The progressive increase in obesity prevalence observed in the general population is therefore reflected in contemporary interventional cardiology cohorts [10,11]. Of note, although it is well established that obesity increases the risk for incident cardiovascular (CV) disease, prior literature reported that obese patients experience paradoxically better in-hospital outcomes than their normal body mass index (BMI). This obesity paradox has been well documented for short-term mortality and may be at least partially explained by more aggressive in-hospital management of overweight and obese patients. The CRUSADE registry demonstrated that all-cause long-term mortality was generally lower for overweight and obese older patients after non–ST-segment–elevation myocardial infarction relative to those with normal weight [10].

Second, despite the presence, high cardiovascular risk and established coronary disease, a large proportion of patients failed to achieve guideline-recommended lipid and glycemic targets. This finding highlights a persistent gap between evidence-based recommendations and real-world clinical practice. Therapeutic inertia, the complexity of cardiometabolic disease, and the coexistence of multiple comorbidities may all contribute to the difficulty in achieving optimal risk factor control in obese patients with coronary artery disease [12].

Importantly, the coexistence of obesity and diabetes identifies a particularly high-risk phenotype characterized by insulin resistance, accelerated atherosclerosis, endothelial dysfunction, and increased residual cardiovascular risk despite contemporary secondary prevention therapies. Several studies have demonstrated that patients with both obesity and type 2 diabetes experience a substantially greater burden of recurrent cardiovascular events compared with non-diabetic individuals, emphasizing the need for comprehensive cardiometabolic management beyond traditional risk factor control [12]. Therefore, the SURPASS trials were conducted, demonstrating the efficacy and safety of tirzepatide in these patients, even in long-term follow-up [13]. Semaglutide also demonstrated a significant reduction in body weight and glycated hemoglobin in the STEP 2 study [14].

Obesity is also increasingly recognized as a chronic low-grade inflammatory state. Adipose tissue dysfunction promotes macrophage infiltration and the release of pro-inflammatory cytokines such as interleukin-6 and tumor necrosis factor-α, which stimulate hepatic production of C-reactive protein (CRP) [15,16]. This inflammatory milieu contributes to endothelial dysfunction, plaque instability, and progression of atherosclerosis. Elevated CRP levels have been independently associated with adverse cardiovascular outcomes and may represent an important component of residual inflammatory risk in patients with coronary artery disease [17,18].

Our findings are consistent with prior epidemiological evidence showing a positive association between BMI and CRP levels across different populations [18,19]. Adipose tissue is not merely a passive energy storage organ but an active endocrine tissue producing a wide array of inflammatory mediators. Increased adiposity leads to macrophage infiltration, cytokine activation, and oxidative stress, all of which promote endothelial dysfunction and accelerate atherosclerotic disease.

In recent years, the concept of obesity as a modifiable therapeutic target in cardiovascular disease has gained increasing attention. Randomized trials investigating pharmacological weight reduction have provided compelling evidence that targeting obesity may improve cardiovascular outcomes [20-25].

The SELECT trial was the first large randomized controlled trial including patients with overweight or obesity and established cardiovascular disease without diabetes, treatment with semaglutide resulted in a significant reduction in major adverse cardiovascular events compared with placebo. Importantly, these benefits were observed independently of glucose-lowering effects, suggesting that weight reduction and metabolic improvements directly contribute to cardiovascular risk reduction [26].

Similarly, dual incretin receptor agonists have demonstrated unprecedented weight-loss efficacy. Tirzepatide, a dual GIP/GLP-1 receptor agonist, has been shown to induce substantial body weight reductions exceeding those observed with earlier GLP-1 receptor agonists. In addition to weight loss, tirzepatide improves insulin sensitivity, lipid profile, blood pressure, and markers of inflammation. The recently completed cardiovascular outcome trial SURPASS-CVOT demonstrated the non- inferiority to dulaglutide with respect to a composite of death from cardiovascular causes, myocardial infarction, or stroke, among patients with type 2 diabetes and atherosclerotic cardiovascular disease [27].

These findings support a paradigm shift in the management of cardiometabolic disease. Historically, obesity was often considered a secondary or lifestyle-related risk factor. However, emerging evidence suggests that obesity itself should be regarded as a primary therapeutic target in patients with established cardiovascular disease [28-31].

Our real-world cohort highlights the magnitude of this unmet need. The coexistence of obesity, suboptimal lipid control, incomplete glycemic control, and persistent systemic inflammation suggests that many patients remain undertreated

from a global cardiometabolic perspective. In this context, novel pharmacological therapies capable of inducing significant weight loss may play an increasingly important role in primary and secondary cardiovascular prevention.

Conclusion

Among obese patients undergoing PCI, achievement of recommended LDL-C and glycemic targets remains suboptimal. BMI is independently associated with higher CRP levels, supporting the presence of an obesity-related inflammatory phenotype. These findings underscore the need that a multidisciplinary approach to patients suffering from obesity integrating a pharmacological and non-pharmacological therapeutic skill is essential, in order to improve patients' quality of life and cardiovascular outcome, also with a cost-effective benefit.

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