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Body mass index and waist circumference in patients with established coronary artery disease over a 20-year period

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There is strong evidence on the causal relationships between obesity and the leading causes of death [1]. The main causes of high mortality following myocardial infarction are insufficient control of risk factors, unsatisfactory lifestyle changes and not optimal pharmacotherapy [2, 3]. Guidelines recommend weight reduction in overweight and obese people in order to reduce blood pressure, low-density lipoprotein cholesterol and the risk of type 2 diabetes as well as a reduction of the risk of cardiovascular events [4, 5]. The scientific evidence suggests that among patients with coronary artery disease (CAD), waist circumference is related to coronary artery calcifications as well as to overall mortality independent of body mass index (BMI) [6, 7]. Recently, a gradual increase was shown in BMI and waist circumference over the course of two decades in patients with established CAD [8]. The aim of present analysis was to assess whether the trends in the proportions of patients with central obesity varies by BMI category.

Data of participants of five surveys assessing secondary prevention following hospitalization due to CAD carried out in 1997–1998, 1999–2000, 2006–2007, 2011–2013, and 2016–2017 were analyzed [8]. The same five hospitals serving the city and surrounding districts (population of about 1.2 million) participated in each study. Methods used in studies were similar each time and were published previously [8]. Briefly, the study sample consisted of consecutive patients hospitalized for coronary artery bypass grafting or percutaneous coronary intervention or myocardial infarction or unstable angina. As only patients below 71 years of age at the time of hospitalization participated in the first (1997–1998) and second (1999–2000) study, they were excluded from present analysis, as were all older participants of the other three studies [8].

The examination was carried out 6–18 months after the index hospitalization. Height and weight were measured using standard scales, and a vertical ruler with the patient in a standing position, without shoes or heavy outerwear. The scales were calibrated at the beginning of each survey. BMI was calculated according to the following formula: BMI = weight [kg]/ (height [m])^2. Waist circumference was measured using a metal tape measure placed horizontally midway between the lowest rim of the rib cage and the tip of the hip bone with the patient in a standing position [8]. Central obesity was defined as the waist circumference ≥ 102 cm in men and ≥ 88 cm in women [4].

The Pearson χ^2 test was used in case of categorical variables. Normally distributed continuous variables were compared using the analysis of variance. Variables without normal distributions were evaluated using the Kruskal–Wallis analysis of variance. Temporal trends were evaluated

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Table 1. Proportions of patients with central obesity by body mass index (BMI) category and survey.

	1997–1998 N = 412	1999–2000 N = 427	2006–2007 N = 422	2011–2013 N = 462	2016–2017 N = 272	P for trend
BMI ≥ 30 kg/m^2 and waist circumference ≥ 102 cm in men or ≥ 88 cm in women	84 (20.4%)	96 (22.5%)	133 (31.5%)	138 (29.9%)	107 (39.3%)	< 0.001
BMI < 30 kg/m^2 and waist circumference ≥ 102 cm in men or ≥ 88 cm in women	50 (12.1%)	77 (18.0%)	83 (19.7%)	84 (18.2%)	60 (22.1%)	< 0.006
BMI ≥ 30 kg/m^2 and waist circumference < 102 cm in men and < 88 cm in women	17 (4.1%)	20 (4.7%)	10 (2.4%)	26 (5.7%)	3 (1.1%)	< 0.010
BMI < 30 kg/m^2 and waist circumference < 102 cm in men and < 88 cm in women	261 (63.3%)	234 (54.8%)	196 (46.4%)	214 (46.3%)	102 (37.5%)	< 0.001

with logistic regression for categorical variables with subsequent studies coded as an independent variable. A two-tailed p value of less than 0.05 was regarded as indicating statistical significance.

The numbers of analyzed patients were as follows: 412 in 1997–1998, 427 in 1999–2000, 422 in 2006–2007, 462 in 2011–2013 and 272 in 2016––2017. The mean age (standard deviation) of study participants was 57.7 (8.3) years in 1997–1998, 58.6 (8.1) years in 1999–2000, 59.6 (7.6) years in 2006–2007, 60.5 (6.6) years in 2011–2013, and 62.1 (6.7) years in 2016–2017 ($p < 0.001$). No significant difference in sex distribution between surveys (in total 70.9% men and 29.1% women) was found, whereas the mean (standard deviation) duration of education was gradually increasing: 11.4 (3.6) years in 1997–1998, 11.6 (3.5) years in 1999–2000, 11.9 (3.3) years in 2006–2007, 12.1 (3.1) years in 2011–2013, and 12.9 (3.0) years in 2016–2017 ($p < 0.001$).

Proportions of patients with and without central obesity by BMI category and survey are presented in Table 1. The proportions of patients with waist circumference ≥ 102 cm in men and ≥ 88 cm in women increased significantly irrespectively of BMI category. On the other hand, the proportions of patients without central obesity decreased significantly in patients with BMI ≥ 30 kg/m^2 as well as in those with BMI < 30 kg/m^2. The adjustment or age, sex, and education did not change the results significantly. Compared to 1997–1998 the odds ratio (95% confidence intervals) of having both central obesity and BMI ≥ 30 kg/m^2 was 1.14 (0.81–1.60), 1.65 (1.41–2.72), 1.84 (1.31–2.59), and 3.00 (2.04–4.40) in 1999–2000, 2006–2007, 2011–2013, and 2016–2017, respectively. Similarly, the odds ratio (95% confidence intervals) of having central obesity and BMI < 30 kg/m^2 was 1.65 (1.11–2.45), 1.78 (1.20–2.65), 1.50 (1.00–2.25), and 2.29 (1.44–3.66).

According to the scientific evidence the survival of coronary patients may be improved through providing optimal secondary prevention, which includes effective addressing the main risk factors and optimal pharmacotherapy [4, 6, 9]. Recently published analysis suggests large waist circumference is related to increased mortality in patients with CAD [7]. Although the morbidity and case--fatality in acute myocardial infarction survivors has decreased over recent decades, mainly thanks to spread of pharmacological and invasive treatment methods, the decrease in cardiovascular risk is lower than one could expect based on the results of randomized trials of new therapies. This confusion could be partly explained on the basis of our results showing a gradual increase in central obesity prevalence which probably counteract the favorable changes in the management of CAD [10].

The present analysis has some limitations. Although consecutive patients were recruited with established CAD who were inhabitants of the same residential area, the observation was restricted to those who experienced an acute CAD event or underwent a revascularization treatment. Therefore, the survey participants were not representative of all CAD patients and the applicability of the results to other regions is uncertain. In addition, the study groups could differ in respect to a number of unidentified factors which could explain the differences obtained.

In conclusion, the present analysis of five multicenter studies provides evidence for gradual

increase in the proportion of coronary patients with central obesity over a 20-year period. This trend could be seen both in patients with BMI below and over 30 kg/m^2.

Conflict of interest: None declared

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