Adiposity and cardiovascular disease: are we using the right definition of obesity?

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This editorial refers to 'Diagnostic performance of body mass index to detect obesity in patients with coronary artery disease' by A. Romero-Corral et al., on page 2087

Obesity is associated with a wide variety of co-morbidities, some of which may lead to disability or death. In general, the risk of developing co-morbidities rises as body mass index (BMI) increases. The most widely used classification of obesity is expressed in terms of BMI, where individuals whose BMI is <18.5 kg/m² are considered as underweight whereas those whose BMI ranges from 18.5 to 24.9 kg/m² are classified as having normal or acceptable weight. Those whose BMI ranges from 25 to 29.9 kg/m² are commonly referred to as overweight. Obesity is said to be present when BMI is ≥30 kg/m². There are three grades of obesity: grade 1 (BMI ranging from 30 to 34.9 kg/m²), grade 2 (BMI ranging from 35.0 to 39.9 kg/m²), and grade 3 (BMI ≥40 kg/m²). There is a controversy in the literature, termed the 'obesity paradox', which associates better survival and fewer cardiovascular events in patients with mildly elevated BMI afflicted with chronic diseases.

In a cross-sectional analysis of 95 patients with coronary artery disease (CAD), Romero-Corral et al. hypothesized that BMI will not adequately discriminate between body fatness and lean body mass. The investigators provided evidence that BMI does not have the discriminatory power to distinguish between lean mass and percentage body fat, especially in patients with a BMI <30 kg/m². As expected, BMI was correlated with both percentage body fat (P = 0.66) and lean mass (P = 0.41). Also, half the patients with true excess body fat, as determined by air displacement plethysmography, were misclassified as non-obese since BMI was only 43% sensitive in determining obesity in patients with a BMI ≥30 kg/m². An interesting observation emphasizing the lack of sensitivity of BMI is demonstrated in patients >65 years old showing a higher percentage body fat with lower BMI than patients <65 years. This reinforced the notion of sarcopenic obesity in older patients.

The data provide important information to understand the conflicting results of epidemiological studies assessing the association between BMI and adverse events. Furthermore, the findings support that an accurate diagnosis of obesity may entail more refined investigations of body composition in patients with CAD. Hence, in patients with CAD and mildly elevated BMI, body composition techniques might be necessary to diagnose obesity accurately. Nevertheless, this study has limitations. At baseline, the diagnosis of diabetes and the metabolic syndrome could have been underestimated. This is of importance since both are associated with the risk of CAD. In addition to waist circumference, it would have been desirable for the authors to have used the presence of the metabolic syndrome to explain the variability accounting for BMI. Also, a small number of women were included in the study. Finally, it would have been interesting to assess sensitivity and specificity of waist circumference to detect total body fat since waist circumference may be a better surrogate marker of 'at risk' obesity. Numerous techniques (air displacement plethysmography, bioelectrical impedance, skinfold thickness, X-ray absorptiometry, hydrostatic weighing, etc.) may be used to assess obesity, but waist circumference may be the next best clinical tool to assess 'at risk' obesity.

Previous investigations have found BMI to be both directly and inversely associated with mortality, to have no independent association, or to have a U- or a J-shaped association. Possible explanations for a lack of consistency and reproducibility in the relationship between BMI and death may be the covariance of BMI with other cardiac risk factors, unmeasured confounders, or misclassification bias from use of surrogate markers of obesity. A recent meta-analysis, published by the same group of investigators, regarding the influence of body weight or obesity measures in patients with CAD reported a better outcome for cardiovascular and total mortality seen in overweight and mildly obese groups. The authors suggested that this could be due to the lack of discriminatory power of BMI to reflect adiposity adequately. They tried to address this issue in the current study.

Waist circumference or waist-to-hip ratio have been used as a proxy measure for body fat distribution when investigating the health risk increased with an increasing ratio. Waist circumference reflects abdominal or intra-abdominal fat, and hip circumference reflects different aspects of body composition in the gluteofemoral region, i.e. muscle mass, bone, and fat mass. Waist circumference among

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both men and women showed a strong dose–response-type of relationship with mortality when adjusted for BMI, whereas the low range of BMI was inversely associated with mortality when adjusted for waist circumference. Since BMI measures total body mass, both fat and lean mass, after adjusting for waist circumference, BMI may better represent the protective effect of lean body mass on mortality. This negative confounding may have been underappreciated in previous studies that did not adjust for measures of abdominal obesity.

In post-menopausal women with CAD from the Heart and Estrogen/progesterin Replacement Study, it was reported that both BMI and waist circumference were associated with mortality, but waist circumference may be more important than BMI. In the Nurses’ Health Study, waist-to-hip ratio and waist circumference were also independently strongly associated with increased risk of coronary heart disease among women with a BMI of ≤25 kg/m² and in the Paris prospective study, sagittal diameter, i.e. abdominal obesity, was the only significant predictor of cardiac death. In patients with known cardiovascular disease (CVD) or following acute myocardial infarction, overall obesity as assessed by BMI was not associated with cardiovascular mortality, myocardial infarction, and total mortality when abdominal obesity indexes (waist-to-hip ratio, waist circumference) were integrated into the statistical analysis. Guidelines for optimal weight in older individuals are limited by uncertainty about the ideal BMI. The excess health risk associated with a higher BMI declines with increasing age. An explanation for the lack of a positive association with BMI and mortality at older ages is that, in older persons, BMI is a poor measure of body fat. Sarcopenic obesity, which is defined as excess fat with loss of lean body mass, is a highly prevalent problem in older individuals. The ideal BMI may be higher in older adults than in middle-aged adults. It was recently reported in ~4000 persons aged ≥75 years that the waist-to-hip ratio rather than waist circumference predicted mortality in non-smoking men and women, mainly because of the association with cardiovascular deaths. It was found in the Cardiovascular Health Study in >5000 patients aged ≥65 years with a mean BMI of 26.3 kg/m² (42% overweight) that higher BMI values indicated a lower mortality risk once the risk attributable to waist circumference was accounted for, whereas waist circumference values indicate a higher mortality risk once the risk attributable to BMI was accounted for. Death rates were highest in individuals with a high waist circumference within the overweight and obese BMI categories. Finally, in a large case–control study, waist-to-hip ratio was found to be more strongly associated than was BMI with myocardial infarction, whereas the association with BMI was weak and intermediate for waist circumference in older patients. In order to discriminate between low risk and high risk subjects, maybe the waist-to-hip ratio would be more useful.

The introduction of waist circumference as a simple risk measure in public health settings has already begun, but this simplification is under debate. The discrepancies between the findings regarding obesity, CVD, and mortality need to be addressed, and the current paper may shed some light on explaining the controversy surrounding BMI and events in chronic diseases. Through the years, researches have refined some indices associated with CVD, but refinements are now needed in the assessment of ‘at risk’ obesity (Table 1).

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**References**


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| BMI, body mass index; LDL, low-density lipoprotein; HDL, high-density lipoprotein; TG, triglycerides.