

# Commentary: Are you too thin or too fat to have an open-chest cardiac operation? Probably not, but there are risks that you should know about



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Americans are getting fatter at an alarming rate. The World Health Organization (WHO) has taken note and revised their BMI classification system

How to Calculate Body Mass Index (BMI)		Proposed new classification	
BMI = $\frac{\text{Weight (kg)}}{\text{Height}^2 (\text{m}^2)}$ * 703		<18.5	Underweight
12.4 or less	Underweight	18.5-24.9	Normal weight
15.5 to 24.9	Normal	25.0-29.9	Almost American
25.0 to 29.9	Overweight	30.0-34.9	American
30.0 to 39.9	Obese	35.0-39.9	Truly American
40.0 to 49.9	Morbidly obese	40.0-49.9	Really American
50.0 or more	Super obese	50.0-59.9	U.S.A!!! U.S.A!!! U.S.A!!!
		>60.0	Real American Hero

Graphic courtesy of the American Academy of Orthopaedic Surgeons.

Definitions and calculations of body mass index (BMI).

### Central Message

Extremes of population obesity are associated with increased CAD requiring surgical intervention, although this relationship is vague and ill-defined. This seeming problem of affluence and improved living conditions is much less common in poorer countries.

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The article in this issue of the *Journal* by Nishioka and colleagues<sup>1</sup> describes the use of body mass index (BMI) as a tool for optimizing coronary artery bypass grafting risks. One thing that might jump out at readers is that the level of BMI described as abnormal in a Japanese population is different from that in North American or European populations. For example, Japanese patients with BMI greater than 30 kg/m<sup>2</sup> would be considered very obese, but would be less so in European or North American populations. What is “normal” BMI differs in different populations, and this is a strong signal that a blanket statement about the relationship between BMI and cardiac surgical outcomes is not simple.

There are significant limitations to the usefulness of comparative BMI data cited by both the medical community and statisticians ([https://en.wikipedia.org/wiki/List\\_of\\_countries\\_by\\_body\\_mass\\_index#cite\\_note-1](https://en.wikipedia.org/wiki/List_of_countries_by_body_mass_index#cite_note-1)). BMI data have significant weaknesses in accounting for variations in physical characteristics. It was not until the 1980s that the World Health Organization started to use BMI as a public health measure. In 1998, the National Institutes of Health adopted 6 main categories of BMI that were intended to reflect health risk: extremely obese (BMI >40 kg/m<sup>2</sup>), moderately obese (BMI 35-40 kg/m<sup>2</sup>), obese (BMI 30-35 kg/m<sup>2</sup>), overweight (BMI 25-30 kg/m<sup>2</sup>), normal weight (BMI 18.5-25 kg/m<sup>2</sup>), and underweight (BMI <18.5 kg/m<sup>2</sup>).<sup>2</sup> Since that time, it has become apparent that these broad categories of BMI are simplistic and sometimes misleading.<sup>3</sup>

In this issue of the *Journal*, Nishioka and colleagues<sup>1</sup> address the coronary artery bypass grafting risks associated with various BMI levels. They provide some elegant graphs to define mortality and morbidity risk in patients with high and low BMI in their results of an observational study of more than 90,000 elderly Japanese patients (≥60 years old) undergoing coronary artery bypass grafting. They assessed outcomes, including mortality and morbidity, in

patients with varying BMI levels. Nishioka and colleagues<sup>1</sup> are by no means the first group to study this relationship. Even more importantly, their results do not provide a unique observation, but rather add to some of the related studies that address the impact of BMI on cardiac surgical outcomes, and surgical outcomes in general. Table 1 lists some of the studies that have addressed the relationship between BMI and cardiac surgical outcomes. A rough consensus from recent literature suggests a correlation between BMI and cardiac surgical outcomes. A rough consensus from recent literature suggests a correlation between BMI and surgical site infections, but this relationship is blurred both by conflicting results and by less than rigorous study designs. There does seem to be a positive correlation between adverse outcomes and extremes of BMI; however, description of a more nuanced relationship is not possible on the basis of available literature.

It is interesting to recognize the variations in population BMI. The World Health Organization conducted a study on obesity in 200 countries, collecting data based on surveys from national health ministries. According to the World Health Organization, the top 5 most obese countries are American Samoa, Nauru, Cook Islands, Tokelau, and Tonga. All these countries have an adult obesity rate greater than 60%. Yes, more than half of their adult population is obese, and almost their entire adult population is overweight. For instance, American Samoa, located in the South Pacific (all top 5 nations are located in the South Pacific),

TABLE 1. Selected surgical outcomes related to body mass index from recent literature reports

Reference	Patient population	Outcomes related to BMI
Zheng <sup>4</sup> 2011	Population study in more than 1 million Asians	Underweight was associated with a substantially increased risk of death in all Asian populations. The excess risk of death associated with a high BMI, however, was seen among East Asians, but not among Indians and Bangladeshis.
Protopapas <sup>5</sup> 2016	Literature review of 18 relevant published studies	Patients with extreme BMIs undergoing CABG (underweight patients more than morbidly obese) had increased crude mortality.
Jin <sup>6</sup> 2005	Observational retrospective study of 16, 218 patients in Northwest United States	Body size was not a significant risk factor for CABG mortality, but the lowest mortality was found in the high-normal and overweight subgroups relative to obese and underweight subgroups.
Liu <sup>7</sup> 2019	Patients with diabetes undergoing CABG	BMI of the patients with diabetes undergoing CABG had no effect on MACCEs.
Gulack <sup>8</sup> 2018 and Robich <sup>9</sup> 2019	Secondary surgical site infections after CABG	Surgical site infections after CABG were a source of morbidity. This complication often occurred after discharge and was associated with open SVG harvesting, larger body mass, and blood transfusions.
Mariscalco <sup>10</sup> 2017	Effect of mild/moderate obesity on cardiac surgical outcomes	Obesity was associated with lower risks after cardiac surgery, with consistent effects noted in multiple analyses attempting to address residual confounding and reverse causation.

BMI, Body mass index; CABG, coronary artery bypass grafting; MACCE, major adverse cardiac and cerebrovascular event; SVG, saphenous vein graft.

has an obesity rate of 74.6%! According to the Organization for Economic Cooperation and Development, the countries with the most obesity are the United States (38% of adults are obese), Mexico (32%), New Zealand (31%), Hungary (30%), and Australia (28%). There are no countries from sub-Saharan Africa that reach even the top 20 countries with significant adult obesity. There is little doubt that obesity, and attendant medical and surgical obesity-related diseases, are a product of a higher standard of living.

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