

# A Review of “BMI-Mortality Paradox and Fitness in African American and Caucasian Men with Type 2 Diabetes”

Reviewed by Adam T. Chrusch, MD, and Neil Skolnik, MD

## STUDY

Kokkinos P, Myers J, Faselis C, Doumas M, Kheirbek R, Nylen E: BMI-mortality paradox and fitness in African American and Caucasian men with type 2 diabetes. *Diabetes Care* 35:1021–1027, 2012.

## SUMMARY

**Objective.** To assess the association between BMI, fitness, and mortality in men with type 2 diabetes and to explore racial differences in this association.

**Design and methods.** This was a prospective, observational cohort study of veterans ( $n = 4,156$ ) from 1986 to 2010. The cohort consisted of 2,000 Caucasian men, 2,013 African-American men, and 143 men of unknown or undetermined race.

Information was accessed via patients' electronic medical records. Vital statistics assessed included BMI, cardiac risk factors, medications, and peak exercise capacity in metabolic equivalents (METs), evaluated by a standardized treadmill protocol.

All-cause mortality was accessed across BMI, race, and fitness categories. BMI ranges were 18.5–24.9 kg/m<sup>2</sup> (normal weight,  $n = 668$ ), 25–29.9 kg/m<sup>2</sup> (overweight,  $n = 1,610$ ), 30–34.9 kg/m<sup>2</sup> (obese,  $n = 1,160$ ), and  $\geq 35$  kg/m<sup>2</sup> (obese II and III,  $n = 718$ ). The fitness levels were divided into four categories based on the peak MET level attained before volitional failure:  $\leq 5$  METs (least fit,  $n = 1,162$ ),

5.1–7.0 METs (moderately fit,  $n = 1,163$ ), 7.1–8.7 METs (fit,  $n = 995$ ), and  $> 8.7$  METs (highly fit,  $n = 836$ ).

**Results.** A total of 1,074 deaths occurred over a median time period of 7.5 years. An association was seen individually among age, hypertension, smoking, BMI, exercise capacity, and mortality. Mortality was reduced by 12% for every 1-MET increase in exercise capacity across the entire cohort.

There was an even greater reduction in mortality (18% per 1-MET increase) in the two highest BMI groups (BMI 30–34.9 and  $> 35$  kg/m<sup>2</sup>) with increasing fitness. The reduction in risk with increased fitness was such that the group with risk factors in addition to diabetes who had a high fitness level had a lower risk of mortality than the group with no additional risk factors and a low fitness level (Figure 1).

When looking at the mortality rates compared to the BMI classes, there was a significantly higher mortality rate in the lowest BMI category. No significant difference in mortality was seen among the three highest BMI categories. The researchers attempted to correct for reverse-causation by removing those patients who died within 2 years and had an exercise tolerance of  $\leq 5$  METs. However, the inverse association between mortality rate and BMI remained.

**Conclusion.** This study supports the association between increased activ-

ity and decreased mortality regardless of race or BMI in patients with diabetes. This study also supports the previously described and consistently surprising finding of a low BMI being associated with increased mortality.

## COMMENTARY

The rate of obesity in the United States and worldwide is increasing and is associated with an increase in type 2 diabetes. Six of the top 10 leading causes of death are directly associated with obesity.<sup>1</sup>

## BMI-Mortality Paradox

Several studies have documented what has been called the “BMI-mortality paradox,” an observation that low BMI is associated with increased mortality. This is considered a paradox because most of the risk factors, including hypertension, hypercholesterolemia, and diabetes, are associated with higher BMIs, so a low BMI would be expected to decrease, not increase, mortality.<sup>2–4</sup>

The researchers in this study have confirmed that this paradox exists in male patients with diabetes across ethnicities. The risk of mortality in this study was 39.7% higher for patients in the lowest BMI group ( $< 25$  kg/m<sup>2</sup>). The mortality rate for African Americans was statistically higher in the lowest BMI group than for Caucasians in the same group (45.6 vs. 35.6%). The researchers tried to control for reverse-causation by eliminating patients in the lowest

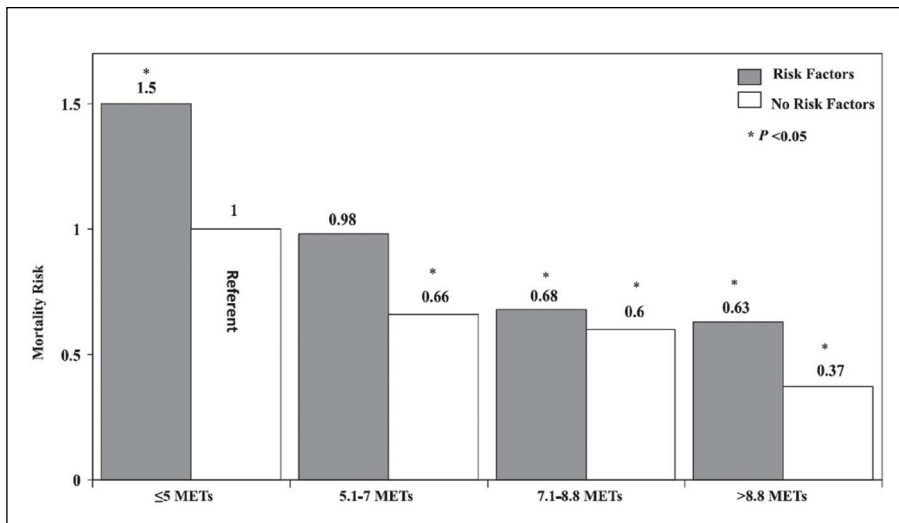


Figure 1. Adjusted mortality risk within each fitness category for diabetic individuals with and without additional risk factors.

\*Different from lowest fit category (≤5 METs) with no additional risk factors

exercise tolerance group who died within 2 years. However, the mortality trend remained.

This paradox remains unexplained. However, the most plausible explanation might be that a low BMI is actually a confounding variable, that is, a variable that is associated with mortality but does not actually contribute to mortality itself. In a population-based, observational study such as this one, low BMI may be seen in people with serious chronic illnesses that have not yet been diagnosed, such as uncontrolled diabetes or undiagnosed cancer. These groups of people would have a diminished life expectancy. The association between low BMI and higher mortality might actually reflect the fact that people with a low BMI may also have illnesses that are associated with a higher-than-average mortality.<sup>5,6</sup>

### Mortality Risk Versus Fitness

The most important take-home point in this article is the association between fitness and all-cause mortality. This study adds further support to an expanding literature showing the beneficial effects of fitness on

cardiovascular disease and mortality in individuals both with and without diabetes.<sup>7-10</sup> For the entire cohort of patients in the study, the adjusted mortality rate was 12% lower for each 1-MET increase in fitness, as demonstrated on exercise stress testing.

To put the categories of fitness into perspective, two examples are helpful. Achieving 4 METs of activity would require being able to attain a 15 minutes/mile pace. Achieving >8.8 METs of activity would be jogging at a 12 minutes/mile pace.

In this study, being able to walk or jog slightly faster than a 15 minutes/mile pace decreased the mortality risk by 44% for those who had no cardiovascular risk factors and 50% for those with cardiovascular risk factors, compared to the lowest level of fitness. As the cohort got progressively more fit, the benefit increased, although the increase was not as large as the increase seen between the least fit and moderately fit groups. Those in the study with cardiac risk factors who could jog at a 12 minutes/mile pace (5 mph, 8.8 METs) had an 87% decrease in their

mortality risk. Figure 1 shows this relationship.

The relationship between fitness and mortality is important. Often, clinicians are too quick to write prescriptions to address cardiovascular risk factors with the goal of decreasing the probability of patients developing cardiovascular illness. Because of time constraints, physical activity counseling is often underemphasized. However, there is accumulating evidence that lifestyle modification can be accomplished in the office setting.<sup>11,12</sup>

This study shows that a small improvement in fitness significantly decreases mortality risk. In the Taichung Diabetes Study,<sup>8</sup> exercise was correlated with a greater risk reduction, compared to lack of exercise, than abstaining from smoking and alcohol. The current recommendation for exercise for most patients is 150 total minutes/week of cardiovascular exercise.<sup>13</sup>

Patients are often overly ambitious when it comes to exercise and stop lifestyle modifications because they do not attain their lofty goals. Given the significant improvement in mortality with only moderate levels of physical fitness, this study adds credence to the idea of setting small, attainable goals that, when achieved, can have a large long-term effect on health and mortality.

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