Is Meat Killing Us?
Heather Fields, MD; Denise Millstine, MD; Neera Agrwal, MD; and Lisa Marks, MLS, AHIP

Patients commonly ask physicians about the diet’s role in health, including preventing disease and decreasing mortality. Primary care physicians must navigate nutrition evidence to answer these questions, but the science is commonly flawed in study design or bias. Currently, low-carbohydrate/high animal protein diets are popular, and many people in the United States consider “meat and potatoes” to be culinary staples. Yet, concern exists that meat consumption is harmful. How should physicians apply the evidence to offer advice about inclusion and quantity of meat in a diet when patients ask about their food choices?

In this brief review, we identified 6 articles that evaluated the effects of meat and vegetarian diets on mortality (Table 1). We discuss some of the pertinent available evidence regarding whether primary care physicians should discourage some or all consumption of meat.

The Evidence
Table 2 summarizes the effects of meat consumption on mortality, and Table 3 summarizes the effect of the vegetarian diet on mortality.

Does Meat Consumption Increase Mortality?
In a 2014 meta-analysis and systematic review, Larsson and Orsini review 9 prospective cohort studies conducted in the United States, Europe, and China. They evaluated the association of processed meat (eg, bacon, sausage, salami, hot dogs, ham), unprocessed red meat (eg, uncured, unsalted beef; pork; lamb; game), and total red meat with all-cause mortality in more than 1 million people over follow-up periods ranging from 5.5 to 28 years.1 All-cause mortality for the highest vs lowest category of processed meat and total red meat intake was statistically significant (RR, 1.23 [95% CI, 1.17-1.28] and RR, 1.29 [95% CI, 1.21-1.35], respectively). Unprocessed red meat consumption increased all-cause mortality in the US cohorts (RR, 1.23 [95% CI, 1.17-1.30]) but not in the European cohorts (RR, 0.90 [95% CI, 0.59-1.38]). In addition, the steepest increase in mortality was found at the smallest increases of intake from the reference ranges of 0.6 g/d (0.02 oz/d) of processed meat and 13.9 g/d (0.49 oz/d) of total red meat, indicating that even a small amount of meat may have an impact on mortality risk.

Another 2014 meta-analysis, by Abete et al,2 encompassed 6 of the same cohort studies included by Larsson and Orsini,1 along with 7 other studies, for a total of 13 studies and more than 1.5 million people. The analysis not only looked at all-cause mortality but also examined associations with mortality from cardiovascular disease (CVD) and ischemic heart disease (IHD). Abete et al2 included white meat (poultry or rabbit) in addition to processed and red meats. In comparing highest vs lowest consumption of meats, only processed meat significantly increased risk for all-cause mortality (RR, 1.22 [95% CI, 1.16-1.29]).2 Both processed meat and red meat were positively associated with CVD mortality (RR, 1.18 [95% CI, 1.05-1.32] and RR, 1.16 [95% CI, 1.03-1.32], respectively). However, total meat (white meat, processed meat, and unprocessed red meat) (RR, 1.08 [95% CI, 0.85-1.36]) and white meat

Clinical Question: Does meat consumption affect mortality?

Evidence: All-cause mortality is higher for increased daily consumption of red meat, especially processed meat. However, the compiled evidence does not link other meat products to all-cause mortality.

Recommendation: Physicians should encourage patients to limit animal products when possible, and substitute red meat and processed red meat with plant-based foods. Patients may supplement a plant-based diet with moderate amounts of fish, poultry, eggs, and dairy if desired.
These findings were confirmed by Huang et al. in a 2012 meta-analysis and systematic review of vegetarianism and associated cancer incidence and CVD mortality. This review included 7 observational studies with a total of 124,706 participants (including a longer follow-up of the aforementioned investigation). Results showed that vegetarians had a significant decrease in IHD mortality (RR, 0.71 [95% CI, 0.56-0.87]) and reduction in cancer incidence (RR, 0.82 [95% CI, 0.67-0.97]), but the study did not reveal a statistically significant reduction in all-cause mortality (pooled RR, 0.91 [95% CI, 0.66-1.16]).

In 2014, Le and Sabaté published a review of 3 large prospective cohort studies of Adventists in North America. Adventists who were vegetarians had a 10% to 20% decrease in all-cause mortality compared with nonvegetarian-matched Adventist cohorts, and a 26% to 68% decreased risk of mortality from IHD, CVD, and cerebrovascular disease. Vegetarians also had an 8% risk reduction for overall cancer.

The study defined a nonvegetarian diet as containing red meat or poultry and allowed the vegetarian diet to contain fish, milk, and eggs. Yet, in this review, the vegan diet (void of fish, milk, eggs, and all animal products) extended further protection for obesity, hyperten-
One study included moderate aerobic exercise, stress management training, tobacco cessation, and group support in its intervention group. However, another study, which included 60,903 Adventists, compared different types of vegetarian diets and their associations with type 2 diabetes mellitus and elevated BMI. Vegan and lacto-ovo-vegetarian diets decreased the risk for type 2 diabetes mellitus by half compared with an omnivorous diet. Pesco-vegetarian and semi-vegetarian (meat consumption less than once per week but more than once per month) diets also decreased this risk by one-fourth to one-third. The study found that only the vegan diet was associated with a BMI in the optimal range. In addition to mortality effects, the topic of plant-based diets in chronic disease has been reviewed and found to be potentially beneficial in weight management, CVD, and metabolic disorders.

The aforementioned studies suggest that perhaps complete avoidance of meat could be best for improved health. However, several of the cohorts in these reviews examined the effects of white meat separately and revealed opposing results. In a 2009 cohort study, those who consumed the highest quintile of white meat had a statistically significant decrease in all-cause mortality (hazard ratio [HR], 0.92 [95% CI, 0.88-0.96]) and cancer mortality (HR, 0.89 [95% CI, 0.83-0.95]) compared with the cohort of the lowest quintile of white meat. Another cohort showed no significant effect on all-cause mortality with daily poultry consumption and noted a J curve in which the lowest HR for all-cause mortality was in people with low to moderate red meat consumption (10.0-19.9 g/d) with an HR of 1.00 (set at reference) rather than no red meat (0-9.9 g/d) at an HR of 1.07 (95% CI, 1.01-1.13). In a review of 2 US cohort studies, a substitution analysis estimated the effect of replacing 1 serving of red meat with 1 serving of either fish, poultry, nuts, legumes, low-fat dairy products, or whole grains. It showed a statistically significant lower risk of all-cause mortality with every type of substitution.

### Additional Evidence

Past clinical trials have shown substantial benefits of a vegetarian or vegan diet in reduced body mass index (BMI), reversal of CVD, and improved hypertension and type 2 diabetes mellitus. Limitations of these studies include a small number of participants and a short duration. In addition, many studies included confounding dietary variables in the intervention group, such as the elimination of added oils, avocado, nuts, dairy, processed foods, and sugary foods; avoidance of caffeine and alcohol; and a reduction in sodium intake. One study included moderate aerobic exercise, stress management training, tobacco cessation, and group support in its intervention group. However, another study, which included 60,903 Adventists, compared different types of vegetarian diets and their associations with type 2 diabetes mellitus and elevated BMI. Vegan and lacto-ovo-vegetarian diets decreased the risk for type 2 diabetes mellitus by half compared with an omnivorous diet. Pesco-vegetarian and semi-vegetarian (meat consumption less than once per week but more than once per month) diets also decreased this risk by one-fourth to one-third. The study found that only the vegan diet was associated with a BMI in the optimal range. In addition to mortality effects, the topic of plant-based diets in chronic disease has been reviewed and found to be potentially beneficial in weight management, CVD, and metabolic disorders.

### Table 2. Statistically Significant Increase in Mortality With Increased Meat Intake

<table>
<thead>
<tr>
<th>Increased Mortality</th>
<th>Red</th>
<th>Processed</th>
<th>White</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All Cause</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Larsson and Orsini</td>
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<td>NA</td>
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<tr>
<td>Abete et al</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Singh et al</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
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<tr>
<td><strong>Cardiovascular Disease</strong></td>
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</tr>
<tr>
<td>Abete et al</td>
<td>Yes</td>
<td>Yes</td>
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<td>No</td>
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<tr>
<td>Singh et al</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Ischemic Heart Disease</strong></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Abete et al</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Singh et al</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td><strong>Cancer</strong></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Singh et al</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
</tr>
</tbody>
</table>

*a* Only the article by Abete et al evaluated the effects of total meat defined as white processed and unprocessed red meat. The other studies combined red and processed meat at times, but these combinations are not reflected in this table.

*b* Singh et al reported a statistically significant increase in cardiovascular disease mortality among men but not among women.

Abbreviation: NA, not applicable.
A pooled analysis of Asian cohorts revealed an inverse association with poultry intake for all-cause mortality in men and women (P=.02 and .03, respectively) and cancer mortality in women (P<.01). In addition, all-cause and CVD mortality in women were inversely associated with seafood intake (P=.05 and .04, respectively). The associations of different types of vegetarian diets with all-cause mortality in a cohort from the previously described review found the most benefit in the pesco-vegetarian diet (HR, 0.81 [95% CI, 0.69-0.94]).

**Conclusion**

Despite variability in the data, the evidence is consistent that increased intake of red meat, especially processed red meat, is associated with increased all-cause mortality. Red meat also increases CVD and cancer mortality in Western cohorts. A vegan diet has been shown to improve several parameters of health, including reversal of CVD, decreased BMI, decreased risk of diabetes, and decreased blood pressure in smaller studies. Data regarding inclusion of some fish and white meat are conflicting—although fish and white meat consumption are not clearly associated with increased mortality, they do decrease mortality when they replace red meat in the diet.

Even though limitations exist in these studies (eg, lack of large, long-term randomized controlled trials; large amount of heterogeneity), avoidance of red and processed meats and a diet rich in plant-based whole foods including fruits, vegetables, whole grains, nuts, and legumes is a sound, evidence-based recommendation. If such a recommendation represents a difficult change for a patient, physicians should encourage limited animal products when possible and substituting red meat with plant-based proteins, fish, or poultry. (doi:10.7556/jaoa.2016.059)

### References


### Table 3.

<table>
<thead>
<tr>
<th>Source</th>
<th>All Cause</th>
<th>Cardiovascular Disease</th>
<th>Ischemic Heart Disease</th>
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<td>Key et al¹</td>
<td>No</td>
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<td>Yes</td>
<td>Sometimes²</td>
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<tr>
<td>Huang et al¹</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Le and Sabaté²</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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</table>

* The study by Key et al¹ was a collaborative analysis of 5 large cohorts. It separated cancer into categories of cancer of the stomach, colon, lung, female breast, and prostate without combining these results. The results were fairly heterogeneous, so none of the cancers had a consistent statistically significant decrease in mortality in all 5 cohorts.

**Abbreviation:** NA, not applicable.


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