

## Meat Consumption and Health: Food for Thought

For some time, medical and science organizations have been beating the drum that red and processed meat are bad for you. For almost as long, they have lamented that their efforts to inform the public have not convinced enough people to change their consumption. This month's issue offers us food for thought on why.

The field of nutritional epidemiology is plagued by observational studies that have conducted inappropriate analyses, accompanied by likely erroneous conclusions (1). Many studies selectively report results, and many lack an a priori hypothesis. Many use notoriously unreliable self-reports of food consumption while failing to collect or appropriately control for data on numerous potential confounders.

Let's start with the evidence for the health-related needs to change our diets. There is controversy over whether consumption of meat, and what kind of meat, leads to poor health outcomes, such as cancer and cardiovascular disease. Although many studies report health risks (2), many—some even examining the same data sets as those reporting a significant risk (3)—do not. Some reviews of the literature conclude that processed meat is carcinogenic, and red meats are “probably carcinogenic” (4). Other reviews conclude that evidence supporting the association between red meat consumption and colon cancer and cardiovascular disease is weak (5).

Four more studies join the evidence base this month, and because they review all of the evidence that came before, they cannot be accused of cherry-picking. The first was a meta-analysis of cohort studies that focused on how dietary patterns, including differing amounts of red or processed meat, affected all-cause mortality, cardiometabolic outcomes, and cancer incidence and mortality (6). More than 100 studies including more than 6 million participants were analyzed. The overall conclusions were that dietary patterns, including differences in meat consumption, may result in only small differences in risk outcomes over long periods.

The next study was a meta-analysis that homed in specifically on cohort studies examining how reductions in red and processed meat might affect cancer incidence and mortality (7). It included 118 studies with more than 6 million participants, and it, too, found that the possible impact of reduced meat intake was very small. The third study was a meta-analysis of cohort studies that looked specifically at meat consumption and its relationship to all-cause mortality and cardiometabolic outcomes (8), and—once again—it found that any link was very small.

Of course, because the studies included in these meta-analyses are all observational, they are subject to significant confounding. Most resulted in GRADE scores that rendered the authors able to provide only low or very low certainty in their conclusions. For many outcomes, they were unable to provide any certainty at

all. Over and over again, they stressed that even if the results were statistically significant, their certainty was low and the absolute differences seen were small and potentially confounded.

Higher-quality interventional studies would be better. They also exist. In a fourth analysis in this issue (9), researchers examined randomized controlled trials that compared diets with differing amounts of red meat consumption for at least 6 months. They found 12 eligible studies, but one of them—the Women's Health Initiative—was so large (almost 49 000 women) that it dominated the analysis. We can wish for more studies, and we could hope that they had more homogenous outcomes and better fidelity to assigned diets, but the overall conclusions from what they had were that “red meat may have little or no effect on major cardiometabolic outcomes and cancer mortality and incidence.”

Even this was offered with low to very low certainty.

Despite this lack of consistent evidence, the case has long been made for reducing meat consumption to reduce risk for cardiovascular disease and various cancers. Indeed, reduction of meat intake is generally endorsed in dietary guidelines.

A fifth article this month is a new guideline, however, based on these reviews (10). It was voted on by 14 members, including 3 community members, from 7 countries and had strict criteria concerning conflicts of interest. The overall recommendations, contrary to almost all others that exist (4, 11, 12), suggested that adults continue to eat their current levels of red and processed meat, unless they felt inclined to change them themselves.

This is sure to be controversial, but it is based on the most comprehensive review of the evidence to date. Because that review is inclusive, those who seek to dispute it will be hard pressed to find appropriate evidence with which to build an argument.

The final article on this topic (13) reports on 4 systematic reviews examining experimental and observational evidence on people's values and preferences regarding meat consumption, and their willingness to change their consumption habits in the face of health concerns (13). Reasons for eating meat included enjoyment, considering meat essential to a healthy diet, considering meat to be part of one's culture, and uncertainty about preparing adequate and tasty meals that did not include meat. None of these are really a surprise. Nor is the fact that participants were reportedly unwilling to give up meat-eating or switch to meat substitutes, even when presented with information about potential negative health effects.

Many reported a belief that they had already reduced their levels of meat consumption. Others felt that the negative health effects were negligible compared with those of such activities as smoking tobacco. A willingness to change other lifestyle factors in pursuit of better health, such as increasing exercise and fruit

and vegetable consumption, was reported. Mistrust of the scientific information provided was often reported as contributing to participant's reasoning for not reducing meat consumption.

Given the findings presented in this issue, it's hard to argue that this is a misinformed set of beliefs. Research suggests that presenting an individual with information that opposes their beliefs could result in them holding on more tightly to those beliefs (14). Some of this is due to the Dunning-Kruger effect, which describes the inverse relationship between actual and perceived knowledge about a topic: The less people know, the more they actually think they know (15). Although some of this effect relates to a lack of knowledge and thus a lack of context to evaluate one's own gaps in understanding, other data tell us that resistance to facts that contradict one's views has very little to do with intelligence (16).

But in this case, it's not even clear that those who disbelieve what they hear about meat are wrong. We have saturated the market with warnings about the dangers of red meat. It would be hard to find someone who doesn't "know" that experts think we should all eat less. Continuing to broadcast that fact, with more and more shaky studies touting potential small relative risks, is not changing anyone's mind.

Moreover, it may be time to stop producing observational research in this area. These meta-analyses include millions of participants. Further research involving much smaller cohorts has limited value. High-quality randomized controlled trials are welcome, but only if they're designed to tell us things we don't already know.

It's also probably time for a major overhaul of the methods for communicating nutritional data in ways that might get through to target populations and change health outcomes. One finding from the studies reviewed by Valli and colleagues (13) that may hold promise is that there are many reasons other than health to reduce meat consumption. Ethical concerns about animal welfare can be important, as can concerns about the effects of meat consumption on the environment. Both of these issues might be more likely to sway people, and they have the added benefit of empirical evidence behind them. And if they result in reducing meat consumption, and some receive a small health benefit as a side effect, everyone wins.

Aaron E. Carroll, MD, MS

Tiffany S. Doherty, PhD

Center for Pediatric and Adolescent Comparative Effectiveness Research, Indiana University School of Medicine  
Indianapolis, Indiana

**Disclosures:** Dr. Carroll has written a book on nutrition and science (*The Bad Food Bible*), for which he receives royalties. Authors not named here have disclosed no conflicts of interest. Disclosures can also be viewed at [www.acponline.org/authors/icmje/ConflictOfInterestForms.do?msNum=M19-2620](http://www.acponline.org/authors/icmje/ConflictOfInterestForms.do?msNum=M19-2620).

**Corresponding Author:** Tiffany S. Doherty, PhD, Center for Pediatric and Adolescent Comparative Effectiveness Research, HITS Building, Suite 2000A, 410 West 10th Street, Indianapolis, IN 46202; e-mail, [tsdohert@iu.edu](mailto:tsdohert@iu.edu).

Current author addresses are available at [Annals.org](http://Annals.org).

*Ann Intern Med.* 2019;171:767-768. doi:10.7326/M19-2620

## References

- Ioannidis JPA. The challenge of reforming nutritional epidemiologic research. *JAMA*. 2018;320:969-970. [PMID: 30422271] doi:10.1001/jama.2018.11025
- Levine ME, Suarez JA, Brandhorst S, et al. Low protein intake is associated with a major reduction in IGF-1, cancer, and overall mortality in the 65 and younger but not older population. *Cell Metab*. 2014;19:407-17. [PMID: 24606898] doi:10.1016/j.cmet.2014.02.006
- Kappeler R, Eichholzer M, Rohrmann S. Meat consumption and diet quality and mortality in NHANES III. *Eur J Clin Nutr*. 2013;67:598-606. [PMID: 23486512] doi:10.1038/ejcn.2013.59
- Bouvard V, Loomis D, Guyton KZ, et al; International Agency for Research on Cancer Monograph Working Group. Carcinogenicity of consumption of red and processed meat. *Lancet Oncol*. 2015;16:1599-600. [PMID: 26514947] doi:10.1016/S1470-2045(15)00444-1
- McAfee AJ, McSorley EM, Cuskelly GJ, et al. Red meat consumption: an overview of the risks and benefits. *Meat Sci*. 2010;84:1-13. [PMID: 20374748] doi:10.1016/j.meatsci.2009.08.029
- Vernooij RWM, Zeraatkar D, Han MA, et al. Patterns of red and processed meat consumption and risk for cardiometabolic and cancer outcomes. A systematic review and meta-analysis of cohort studies. *Ann Intern Med*. 2019;171:732-41. doi:10.7326/M19-1583
- Han MA, Zeraatkar D, Guyatt GH, et al. Reduction of red and processed meat intake and cancer mortality and incidence. A systematic review and meta-analysis of cohort studies. *Ann Intern Med*. 2019;171:711-20. doi:10.7326/M19-0699
- Zeraatkar D, Han MA, Guyatt GH, et al. Red and processed meat consumption and risk for all-cause mortality and cardiometabolic outcomes. A systematic review and meta-analysis of cohort studies. *Ann Intern Med*. 2019;171:703-10. doi:10.7326/M19-0655
- Zeraatkar D, Johnston BC, Bartoszko J, et al. Effect of lower versus higher red meat intake on cardiometabolic and cancer outcomes. A systematic review of randomized trials. *Ann Intern Med*. 2019;171:721-31. doi:10.7326/M19-0622
- Johnston BC, Zeraatkar D, Han MA, et al. Unprocessed red meat and processed meat consumption: dietary guideline recommendations from the Nutritional Recommendations (NutriRECS) Consortium. *Ann Intern Med*. 2019;171:756-64. doi:10.7326/M19-1621
- Mithril C, Dragsted LO, Meyer C, et al. Guidelines for the new nordic diet. *Public Health Nutr*. 2012;15:1941-7. [PMID: 22251407] doi:10.1017/S136898001100351X
- U.S. Department of Health and Human Services. 2015-2020 dietary guidelines for Americans. Washington, DC: U.S. Department of Health and Human Services; December 2015. Accessed at [www.health.gov/DietaryGuidelines](http://www.health.gov/DietaryGuidelines) on 13 August 2019.
- Valli C, Rabassa M, Johnston BC, et al. Health-related values and preferences regarding meat consumption. A mixed-methods systematic review. *Ann Intern Med*. 2019;171:742-55. doi:10.7326/M19-1326
- Nyhan B, Reifler J. When corrections fail: the persistence of political misperceptions. *Polit Behav*. 2010;32:303-330.
- Kruger J, Dunning D. Unskilled and unaware of it: how difficulties in recognizing one's own incompetence lead to inflated self-assessments. *J Pers Soc Psychol*. 1999;77:1121-34. [PMID: 10626367]
- Stanovich KE, West RF, Toplak ME. Myside bias, rational thinking, and intelligence. *Curr Dir Psychol Sci*. 2013;22:259-64.

**Current Author Addresses:** Drs. Carroll and Doherty: Center for Pediatric and Adolescent Comparative Effectiveness Research, Indiana University School of Medicine, HITS Building, Suite 2000A, 410 West 10th Street, Indianapolis, IN 46202.