No association between meat intake and mortality in Asian countries$^{1,2}$

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The association between meat consumption and chronic disease incidence and mortality has been evaluated in hundreds of observational epidemiologic studies over the past 3 decades. However, there remains considerable scientific debate as to whether higher intakes of specific meat groups (eg, red meat, poultry, and fish) or individual meats (eg, beef, pork, and chicken) contribute independently to risk of certain diseases, including cancer and cardiovascular disease (CVD), or whether greater consumption of certain types of meat is part of a broader dietary and lifestyle pattern that is responsible for affecting disease risk. Adding to this debate are the inconsistencies and uncertainties in observational studies of diet and chronic disease. Much of the uncertainty in this field arises from issues at the study level, including challenges with confounding, measurement error, highly correlated dietary and lifestyle variables, and generally weak associations. Indeed, RRs from nutritional epidemiologic studies, including those of meat intake and disease risk, often hover around the null value of 1.0, and we commonly observe associations (including summary associations from meta-analyses and pooled analyses) with RRs ranging between 0.8 and 1.25—considered “weak” associations in the context of known and established causal relations.

Most of the available data on meat consumption and chronic disease originate from studies conducted in North American and European populations; less is known about consumption trends and the relation between meat intake and chronic disease in Asian populations. Dietary and lifestyle characteristics in Asia appear to be transitioning to a more “westernized” pattern, with resulting changes in disease patterns as seen in Western countries (1, 2). In this issue of the Journal, Lee et al (3) examined temporal trends in meat consumption in Asia over the past few decades and analyzed the association between meat intake and mortality. First, Lee et al compared per capita consumption of meat, beef, pork, poultry, and fish/seafood in Bangladesh, China, Japan, South Korea, and the United States by using the FAO food balance sheets, which provide data on the food available for human consumption. The authors reported an overall increase in per capita meat consumption in Asian countries, and although per capita consumption of total meat, beef, and poultry is still considerably lower compared with the United States, the gap is slowly becoming narrower. Per capita pork consumption continues to increase in Japan, China, and Korea, with consumption amounts surpassing the United States in all 3 countries. Per capita consumption of fish and seafood in Asian countries is higher than in the United States. The authors hypothesize that chronic disease incidence and mortality rates will continue to increase because of the increasing trends of meat consumption, such as red meat, in Asian countries. However, a clear connection between red meat intake and chronic disease has not been established (4–7), and interpretation is complicated by numerous factors as mentioned above.

Second, Lee et al (3) pooled prospective data from 8 Asian cohorts to estimate the association between meat intake and mortality. Specifically, they combined prospective cohort data from Bangladesh, mainland China, Korea, Japan, and Taiwan involving nearly 300,000 men and women. Food-frequency questionnaires along with other self-administered questionnaires were used to ascertain information on dietary, lifestyle, and anthropometric factors. The outcomes of interest were total mortality, CVD mortality, and cancer mortality. Specific causes of death within these categories were not analyzed. The authors pooled individual-level data across the cohorts to generate an overall estimate of RR. A pooled analysis is distinct from a meta-analysis, the latter of which combines “results” data across studies. In a pooled analysis, raw—or individual-level—data are combined. Thus, a pooled analysis may facilitate the utilization of unpublished participant-level data and a uniform statistical approach to analyze data across several different populations. Published pooled analyses are less common than meta-analyses because of the inherent challenge of gathering raw data from willing researchers or study centers.

After pooling data across the cohorts, Lee et al (3) observed no significant increases in risk of all-cause mortality comparing the highest with the lowest intake categories of total meat, red meat, poultry, or fish. In contrast, most associations were in the inverse direction with significant decreased risks for poultry (among men and women) and fish (women), with a nearly significant decreased risk with greater intakes of red meat in women (upper CI: 1.00). Similar patterns of associations (most indicating a decreased risk) were observed for cause-specific mortality, comparing the highest with the lowest intake categories, significant decreased risks of CVD mortality with red meat (men) and cancer mortality with red meat and poultry (women) were observed. The only significant positive association in the overall analyses was...
for the highest category of fish intake and cancer mortality. Little effect modification was apparent after stratification by educational level and by BMI.

Given the overall positive, but inconsistent, patterns between meat consumption and chronic disease in North America and Europe, the authors provided some possible explanations for not observing positive associations. First and foremost among possible explanations should be that meat intake (overall or specific meat groups) may not be independently associated with mortality in Asian populations. Dietary, lifestyle, socioeconomic, and clinical characteristics are changing in Asian countries; thus, factors such as physical activity, smoking and alcohol use, hypertension, obesity, and access to medical care may be stronger predictors of mortality than meat consumption. Indeed, higher meat intakes have been correlated with higher socioeconomic status in some Asian countries, and thus may be a surrogate for protective factors for chronic disease (3, 8). With regard to a lack of a positive association between meat intake and mortality, the authors suggest that nondifferential measurement error could bias results toward the null value. If true, then most associations would be stronger, but in the inverse direction. In fact, for red meat, 17 of 18 HRs for the mortality outcomes were in the inverse direction and 10 were significant. Therefore, if random error biased associations toward the null value, then these 17 HRs would be even stronger in the direction of a decreased risk of mortality.

Two large previous cohort studies have been published on meat intake and mortality. Pan et al (9) conducted an analysis of red meat consumption and mortality in 37,689 men from the Health Professionals Follow-Up Study and in 83,644 women from the Nurses’ Health Study. The authors reported multivariate-adjusted significant HRs generally ranging between 1.10 and 1.26 in their primary analyses for total red meat, unprocessed red meat, and processed red meat and all-cause mortality, CVD mortality, and cancer mortality. A similar pairing occurred in 2009 when Sinha et al (10) found suggestive associations between red meat and mortality in a large cohort study. In brief, the authors reported significant HRs ranging between 1.20 and 1.50 for red meat intake (highest quintile) and total mortality, cancer, and cardiovascular disease. Interestingly, a significant association between high red meat intake and mortality from injuries and sudden death (including accidents and homicide) was observed among men (HR: 1.26; 95% CI: 1.04, 1.54), a statistical caveat not readily explained by alleged mechanisms, which added uncertainty to the already complex interplay between dietary factors and mortality. Consistent inverse associations for all mortality outcomes were observed for white meat intake (chicken, turkey, and fish).

The results of these 2 studies are in contrast with the associations reported by Lee et al (3) for red meat but similar for poultry and fish. Participants consumed less red meat in the study by Lee et al; however, when similar intake categories were compared with the 2 other studies, a divergent direction of effect remained. The role of confounding and differences in dietary and lifestyle patterns may be the strongest contributors to the variable associations between studies. Indeed, in the cohorts analyzed by Pan et al (9), increasing servings per day of red meat were monotonically positively correlated with alcohol consumption (men only), increased BMI, a higher proportion of smoking (monotonic among men), total energy intake, consumption of dairy products (men only), and family history of diabetes (women only) to name a few examples. Increased red meat intake was monotonically inversely associated with physical activity, multivitamin use, daily servings of fruit, and servings of fish. Strikingly similar (and, in some cases, more pronounced) patterns of correlation were reported by Sinha et al (10). Potential confounding is especially problematic when the health outcome of interest is broad, such as all-cause mortality or CVD incidence as in Pan et al, thereby resulting in an abundance of risk factors that could act as uncontrolled confounders.

Making sense of the relation between diet and disease is complicated by the difficult problems of interpretation that arise from a combination of the well-known limitations of observational studies and the complexity of understanding and generalizing results across diverse study populations. The entanglement of the exposure under study with other dietary and lifestyle factors, socioeconomic characteristics, clinical variables, and genetic traits makes it difficult to isolate the independent effects of a specific food or food group, such as meat intake, on disease risk. It may be this constellation of “other” factors that weigh in most heavily in observed associations between meat intake and chronic disease incidence and mortality outcomes from nutritional epidemiologic studies. In the absence of data from randomized controlled clinical trials on meat intake and chronic disease, future analyses of prospective cohorts of meat intake should focus on analyses that are stratified and substratified by potentially important confounding factors, such as BMI or physical activity, in an effort to better understand or clarify any potential associations between meat consumption and mortality and chronic disease outcomes.

The author has published several meta-analyses on meat intake and cancer outcomes. He had no financial interests related to the outcome of this publication.

REFERENCES