IJE Commentary

Food, Health, and Climate Change: Can Epidemiologists Contribute Further?

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We appreciate the efforts of Jung et al. to address the twin challenges of providing diets for everyone that are both healthy and sustainable.[1] Unlike many other threats to health, this goal has unique urgency because our current diets are contributing importantly to climate change, which is accelerating and crossing irreversible tipping points, such as melting of the Greenland ice cap.[2] These rapid increases in global temperature, and accompanying variability in weather patterns, are adversely affecting health in many ways, including those mediated by reductions food production.[3] Here we offer suggestions for future analyses in this critical area and also a proposal to incorporate both human and planetary health routinely in epidemiologic studies of diet.

For their analysis, Jung et al. used available data from the United States National Health and Nutrition Survey (NHANES) to create a four-dimensional composite index, the Sustainable Diet Index (SDI), representing nutritional, environmental, economic, and sociocultural variables. Among 22,414 men and women, 2,100 deaths occurred during 11 years of follow-up; the multivariate hazard ratio for mortality among those in the highest compared with the lowest quintiles was 0.64, 95% CI 0.49–0.84, *P*=0·002). The authors concluded that their findings support adopting sustainable dietary patterns to improve both human and planetary

health. While this conclusion is consistent with the overall body of evidence, a deeper look at their findings does not directly support this interpretation.

Each of the four components of the overall index created by Jung et al. is important, but it is clear that the overall association that they report primarily reflects the economic component, which is the ratio of expenditures for food divided by total family income. Because food costs vary only modestly by income, both nationally and internationally, this variable is primary the inverse of family income. Given their scoring, it is not surprising that higher income is strongly related to lower mortality. Although this association with income may be partially related to better diet quality with higher incomes, this is likely to be mediated by many additional pathways such as housing and access to health care, which would confound their findings.

In the Jung et al. analysis, the dietary component was not significantly associated with mortality (quintile 5 vs 1, hazard ratio = 0.81, 95% confidence interval = 0.63 to 1.04). The component representing a healthy diet in this analysis was based entirely on nutrient intakes rather than foods, even though many of these nutrients, such as total protein, zinc, and copper, have not had clear relationships with total mortality or other health outcomes within the US population. Many other diet quality indices, primarily food-based, have been associated with health outcomes, including indices specifically based on the EAT-Lancet reference diet that addresses both health and sustainability.[4] We appreciate that no single method exists to score adherence to a healthy and sustainable dietary pattern, in part because of variations in food patterns among different populations and differences in the food intake data that are available. However, scoring of food groups should incorporate gradients in adherence to targets and ranges of intakes; simple dichotomies are not consistent with biological relationships and are not likely to provide good resolution of associations. In addition to using a sub-optimal representation of healthy diets, the authors correctly noted that the NHANES cohort is seriously limited by having only two days of dietary recalls with no updating of dietary data during follow-up.

Jung et al. express surprise that their variable for environmental sustainability of diets was adversely associated mortality. Although some foods such as red meat are associated with adverse effects on both health

and environmental variables, some major sources of energy, such as refined grains and sugar, have adverse health effects but low environmental impacts.[5] Thus, attempts to minimize environmental impacts are not likely to result in optimal diets; some environmental impacts of producing food are inevitable, and our goal should be to identify diets that are healthy and that can be produced while staying within sustainable environmental boundaries.

The socio-cultural component used by Jung et al. was limited by availability of data from NHANES and might have been more specifically described as food preparation. This was not clearly associated with mortality, but did not include specific questions about cooking at home, which has been associated with better health outcomes;[6] whether this reduces environmental impacts deserves further evaluation.

Although the four components identified by Jung et al. are all conceptually important, in developing the EAT-Lancet reference diet we intentionally kept them separate to avoid the confusing and confounding issues intrinsic to the SDI created by Jung et al. We explicitly developed the reference diet based on health outcomes for food groups because few would dispute that a diet should be healthy. Also, we now have substantial evidence and consensus on the broad description of healthy diets, even though details of dose-response relationships, effects of food subgroups, and interactions need further refinement. Further, some parts of our population deny the existence of climate change or do not prioritize the environmental impacts of their personal decisions. Thus, we separately considered the environmental impacts of the reference diet as outcome variables, and evaluated various alternative scenarios; we found a wide range of dietary scenarios could be produced sustainably, although even modest increases in global consumption of meat and dairy foods would exceed environmental boundaries. We also purposely did not constrain diets by cost because that would compromise the health of people with low incomes. As expected, the EAT Lancet diet is currently not affordable for several billon people who now consume mainly starchy staple foods with limited diversity, but a healthy and sustainable dietary pattern is not more expensive than many current national dietary recommendations of low-income countries.[7] Our collective goal should be to reduce poverty and make healthy food affordable rather than lower dietary standards to accommodate the present conditions. We also found that to remain within planetary boundaries for

water use and other environmental variables will require reductions in food loss and waste and improvements in agricultural production.

As a general point, we suggest avoidance of composite indices, despite their appeal for integrating cross-disciplinary insights. Several problems can result from making inferences using such indices; these are illustrated in the paper by Jung et al. First, the sub-indices are often indirectly related to the variable of interest, preferably this variable would be estimated as directly and specifically as possible. For example, the Nutrient Rich Foods index was presumably used to make inferences about nutrient adequacy, but this was already done by calculating nutrient adequacy ratios. Second, composite indices can hide important judgements on the inclusion and representation of sub-indices. As mentioned previously, nutrient adequacy is a poor marker of overall healthiness, yet it is the only health-related domain included in the SDI. Lack of a more comprehensive diet-related health measurement in an index that aims to integrate environmental, health, and socio-economic considerations casts doubt on the validity of the SDI as applied here. Third, composite indices also incorporate important judgements on trade-offs within the sub-components. In their SDI, Jung et al. first averaged (i.e., traded off) within the environmental component (e.g., GHG emissions with water use) and second within the overall index (e.g., economics with environment). On both levels, this procedure is questionable. First, dietary changes may not have equal impacts or value as environmental changes, and the relative impact can be of interest. In our explicit calculations of the environmental burden of diets,[8] dietary changes were substantially more important, indeed essential, for limiting GHG emissions and climate change than ensuring sustainable water use, for which technical and management-related approaches are more effective. Giving equal weight to each environmental domain can lead to a misleading characterisation of diet-related impacts. Also, trading off the main index components can be problematic. For example, trading off the socio-cultural index with the environmental one mixes value judgements on food preparation habits with environmental considerations. The latter measures the environmental impacts of diets, whereas the former might or might not be associated with health impacts or descriptive of socio-economic conditions. A more explicit treatment of any of these dimensions would be preferable and illuminating than obscuring them in a composite index. At a minimum, comprehensive sensitivity analyses with different weighing/aggregation schemes should be commonplace when composite indices are used.

Because of the extreme urgency in changing the course of climate change, and in the spirit of the effort by Jung et al. to consider effects of diets on human and planetary health together, we propose that papers on diet and health routinely include a statement on climate change and possibly other environmental impacts. We specifically suggest that the IJE, with other journals hopefully following, require or at least encourage such a statement. This could be an additional analysis, such as including calculating greenhouse gas equivalents as an outcome when comparing different foods, food groups, or dietary patterns.[9] Or, this could be just a sentence or two with a citation if the association with a dietary pattern score has already been published. Databases for such calculations are now available (e.g.), and are likely to become more findings and specific with time. This can be one modest way in which our field can contribute to awareness, and hopefully action, that is needed to avoid environmental disaster in the coming decades.

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