Invited Commentary

Organic Foods for Cancer Prevention—Worth the Investment?

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In 2015, the International Agency for Research on Cancer[1] classified 3 pesticides frequently used in agriculture—glyphosate, malathion, and diazinon—as carcinogenic to humans (group 2A) based on evidence from studies of occupational exposure in humans and laboratory studies in animals. Through occupational exposure (primarily in agricultural settings), malathion is associated with prostate cancer, diazinon is associated with lung cancer, and all 3 pesticides are individually linked to non-Hodgkin lymphoma.[1] In the general population, low-level pesticide exposure is widespread, and the primary route of exposure is diet, especially intake of conventionally grown fruits and vegetables.[2] In the United States, more than 90% of the population have detectable pesticides in their urine and blood.[3] Organic foods are produced without synthetic pesticides and are less likely to contain pesticide residues than conventionally produced, nonorganic foods.[4] Crossover trials have shown that switching from consuming conventionally grown foods to organic foods decreases urinary concentrations of pesticide metabolites, suggesting reduced exposure to pesticides.[4] Nevertheless, the health consequences of consuming pesticide residues from conventionally grown foods are unknown, as are the effects of choosing organic foods or conventionally grown foods known to have fewer pesticide residues.

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In this issue of *JAMA Internal Medicine*, Baudry et al[5] examine the association between self-reported organic food intake and cancer risk in the NutriNet-Santé cohort, hypothesizing that organic food consumers would have a lower risk because of reduced pesticide exposure. At baseline, the authors classified 68 946 participants according to their self-reported intake of 16 groups of organic products and then followed them for a mean of 5 years. Participants with the highest frequency of organic food consumption had a 25% lower risk of being diagnosed as having cancer during follow-up compared with those with the lowest frequency. This inverse association was restricted to risk of postmenopausal breast cancer and lymphomas. The lymphoma finding is consistent with previous studies of occupational exposure and findings from the Million Women Study[6] in the United Kingdom, which also linked self-reported organic food intake to a 21% lower risk of non-Hodgkin lymphoma. These consistent results indicate that the association between pesticide exposure at levels observed in the general population and lymphoma risk is worth further study. However, the Million Women Study also found that organic food consumption was linked to a slightly increased breast cancer risk, which raises questions about the meaning of these findings.

While the study by Baudry et al[5] has several notable strengths, such as its large sample size, prospective design, and modest loss to follow-up, it also has significant weaknesses, which mandate careful interpretation of the findings. Most salient among the weaknesses is the fact that the organic food questionnaire was not validated; therefore, it is unclear what the intended exposure, organic food consumption, was actually measuring. Organic food intake is notoriously difficult to assess, and its self-report is highly susceptible to confounding by positive health behaviors and socioeconomic factors, as is evident from the data presented in the first table of the article by Baudry et al[5] and in previous work from this group.[7] The authors had a unique opportunity to address this confounding because NutriNet-Santé participants reporting no organic food intake had the option to disclose their reasons for never consuming organic foods, including price barriers, limited availability, or lack of interest. However, the authors treated all nonconsumers equally in their exposure score, which simplifies scoring for the analysis but does nothing to minimize biases related to health behaviors.

Another important limitation is that, throughout the article, the authors imply that higher self-reported intake of organic foods serves as a proxy measure for lower exposure to pesticide residues from food.[5] However, they offer no empirical evidence that this is the case. This is not necessarily a flawed assumption. In fact, 2 independent groups in the United States have shown that food intake data can be used to estimate an individual's relative exposure to pesticides through diet. Using data from the Multi-Ethnic Study of Atherosclerosis cohort, Curl and colleagues[8] showed that self-reported food frequency questionnaire data, including self-reported intake of organic produce, can be used to predict urinary levels of organophosphate pesticide (dialkylphosphate) metabolites. Similarly, Chiu and collaborators created a Pesticide Residue Burden Score by combining self-reported food frequency questionnaire data on fruit and vegetable consumption with pesticide surveillance data. The score predicted urine and serum pesticide levels in the US National Health and Nutrition Examination Survey[9] and urinary pesticide concentrations in the Environment and Reproductive Health (EARTH) Study.[2] However, self-reported organic produce intake was not related to urinary pesticide biomarkers in the EARTH Study. Pesticide biomarkers reflect sources of pesticide exposure other than diet and thus cannot serve as indicators of organic food consumption. However, they can help validate lower-cost tools, such as the Pesticide Residue Burden Score, to estimate dietary pesticide exposure or organic food consumption in relation to health effects in large prospective cohorts.

At the current stage of research, the relationship between organic food consumption and cancer risk is still unclear. While ideal, randomized clinical trials would likely not be feasible in this situation because of the high cost of organic products and long follow-up period necessary to detect cancer cases. Therefore, prospective cohort studies that use validated exposure assessments and carefully control for confounders are neces-

sary. The study by Baudry et al[5] provides justification for future studies to create validated tools to assess organic food consumption and investigate its association with cancer risk. More research in this area is urgently needed because cancer is a serious public health challenge and foods containing pesticide residues are widely consumed. If future studies provide more solid evidence supporting the consumption of organic foods for cancer prevention, measures to lower costs and ensure equitable access to organic products will be crucial.

While the link between cancer risk and organic food intake is still uncertain, there is compelling evidence that improving other factors, such as body weight, physical activity, and diet, can lower cancer risk.[10] For cancer prevention, the American Cancer Society[10] recommends consuming a healthy diet that limits red and processed meat and added sugars, replaces refined grains with whole grains, and increases consumption of fruits and vegetables. For overall health, current evidence indicates that the benefits of consuming conventionally grown produce are likely to outweigh the possible risks from pesticide exposure. Concerns over pesticide risks should not discourage intake of conventional fruits and vegetables, especially because organic produce is often expensive and inaccessible to many populations. While more research is needed to examine the role of organic foods in cancer prevention, current recommendations should continue to focus on modifiable risk factors that are backed by solid evidence and encourage healthy dietary patterns, including higher intake of fruits and vegetables, whether conventional or organic.

ARTICLE INFORMATION

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