4 Flaws in Assessing the Influence of the Environment on Cancer

By Geoffrey Kabat — May 15, 2017

Credit: Shutterstock [1]

Last week, a colleague sent me an article in the *Daily News* titled "Increased cancer rate in US linked to bad environment" and asked my opinion of it.

The opening sentence read, "Improving the worst environments in the US could prevent 39 in every 100,000 cancer deaths." The *Daily News* item refers to an article [2] published in the journal *Cancer*, which is published by the American Cancer Society, and to an accompanying editorial [3].

The article examined the correlation between "environmental quality" and cancer incidence rates in 2,687 U.S. counties. Environmental quality was measured by the Environmental Quality Index (EQI), which includes county-level data on exposures in different domains: air, water, land, the built environment, and socio-demographic factors. For example, the air domain includes 87 variables representing regulated air pollutants.

According to the authors, analysis of county-level data in relation to cancer rates showed that cancer rates were highest in counties with the poorest EQI. Of specific cancer types, prostate cancer and female breast cancer showed the strongest correlation with EQI, with rates of these cancers being highest in counties with the poorest EQI.

This immediately raised a red flag because these two cancers have been studied intensively over decades, and there is little-to-no evidence that environmental pollution plays a role. I'll come back to that in a moment.

The accompanying editorial by Scarlett Gomez of the Cancer Prevention Institute of California holds this study up as a model of a new, comprehensive approach to identifying the wide range of factors that could be influencing cancer rates. She notes that, although cancer death rates have declined in the past 35 years, some areas such as the Southeast and Appalachian regions have remained high.

Areas of concern about the study

The use of cancer maps in pinpointing areas of unusually high cancer rates for further, more detailed, study was pioneered by the National Cancer Institute. One example of this geospatial approach is the hotspot in male lung cancer rates that was identified in southern Louisiana in the 1970s. Subsequent studies [4] showed that the elevated lung cancer rates were due to asbestos exposure in shipyards along the Gulf Coast. The example of the shipbuilding industry was successful because researchers identified a striking anomaly – unusually high rates of lung cancer in men in a specific location. This finding paved the way for more focused studies that identified the causative exposure.

But the shipbuilding example helps understand the serious problems with the *Cancer* paper, which both the authors and the editorial writer largely pass over, showing little interest in examining them the least bit critically or putting them in context.

First, this is what is referred to as an "ecologic" study, which means that both the data on exposure (the components making up the EQI) and cancer incidence pertain to counties, rather than individuals. They represent "aggregate data" -- averages for each of the counties. This is in contrast to epidemiologic studies, where we have information on exposure and cancer in individuals. Ecological studies have well-known limitations.

Second, the EQI is composed of different domains (air pollutants, water pollutants, land pollutants, socioeconomic variables, etc.). Some of these will be positively correlated, and some will be inversely correlated, making it difficult to pinpoint a specific domain.

Third, many of the exposures of interest are related to sociodemographic factors, and sociodemographic factors have a strong influence on cancer rates and on health generally.

Here we come to the central problem with this study and the editorial praising it.

We know from forty years of research on factors that contribute to cancer that the major factors are things that pertain to individuals – age, smoking, heavy alcohol consumption, obesity, and genetics. As much as one-third of cancer is attributable to smoking.

Epidemiologists tend to define "the environment" broadly as including personal habits and exposures as well as exposures in the wider world. However, in this paper the authors define "environment" in a narrow way (things in our external surroundings: air pollutants, water pollutants, etc.), and this leads them to give short shrift to the role of personal exposures, which we know make the greatest contribution to developing cancer. While exposure to pollutants could be important in some locations, it is unevenly distributed within counties, and its effects are likely to be dwarfed by the effects of personal behaviors.

The aggregate nature of the exposure data and the fact that most exposures are likely to be at very low levels makes the EQI a blunt tool identifying hotspots.

Although the authors adjusted for smoking at the county level, this adjustment is crude, since they only had information on the **percentage of ever smokers** in each county. Thus, their adjustment does not take into account either the intensity or the duration of smoking, which are the key determinants of smoking-related risk. Furthermore, we know that smoking rates are highest in low-income/low education groups and economically depressed areas [5]. Thus, we should be wary of attempts to identify diffuse "environmental exposures" for lung cancer, as the authors do, when they cannot adequately capture the effects of smoking.

This may have something to do with their strange results regarding lung cancer. Lung cancer in men DECREASES as environmental quality gets worse, whereas there is no pattern for lung cancer in women.

The fourth and final anomaly

Now, we come to the final anomaly in the paper, which would lead anyone familiar with what is known about cancer to question this study. As mentioned earlier, the two cancers that showed the strongest correlation with environmental quality were prostate cancer and breast cancer. Since these two cancers are associated with HIGHER socioeconomic status, **this implies that higher socioeconomic status is associated with poorer environmental quality**, which makes no sense.

As if to provide a rationale for their surprising findings, the authors write in their introduction that breast and prostate cancers are associated with "environmental exposures, such as ionizing radiation, solvents, and environmental mutagens." But this statement is misleading because these exposures are uncommon and, at most, account for a small proportion of these cancers. (The mention of "ionizing radiation" is based on Japanese women exposed to the atomic bomb dropped on Hiroshima). Again, what we have learned from large epidemiologic studies carried out over the past 3-4 decades indicates that these two leading cancers are caused by personal factors, including reproductive history (breast cancer), family history (breast and prostate cancer), and ethnicity (prostate cancer), as well as genetics.

No one would deny that certain aspects of the external environment may play an important role in health. There is increasing interest in the many ways that material and socioeconomic circumstances shape and limit behaviors (from the availability of fresh produce to parks and playgrounds that encourage physical activity).

Studies like this one reported in *Cancer* serve as a reminder of how difficult it is to study these effects. When a study using a weak methodology coupled with questionable data produces a striking result, we need to evaluate it critically.

Geoffrey Kabat is a cancer epidemiologist at the Albert Einstein College of Medicine, a member of the American Council on Science and Health Board of Scientific Advisors, and author of Getting Risk Right: Understanding the Science of Elusive Health Risks [6]. Also appears on the Forbes blogging site. Read it here [7].

Source URL: https://www.acsh.org/news/2017/05/15/4-flaws-assessing-influence-environment-cancer-11278

Links

[1] https://www.shutterstock.com/download/success?src=pz92HJW8ECwKac8ZvpzmCQ-1-15
[2] http://onlinelibrary.wiley.com/doi/10.1002/cncr.30709/abstract
[3] http://onlinelibrary.wiley.com/doi/10.1002/cncr.30711/full
[4] https://www.ncbi.nlm.nih.gov/pubmed/291745
[5] https://www.forbes.com/sites/geoffreykabat/2014/03/30/a-new-report-documents-how-smoking-and-its-consequences-has-become-largely-confined-to-the-poor-a-trend-which-was-pointed-out-forty-years-ago/?source=acsh.org
[6] https://www.amazon.com/dp/B01MAXIL21/ref=dp-kindle-redirect?_encoding=UTF8&btkr=1
[7] https://www.forbes.com/sites/geoffreykabat/2017/05/13/assessing-the-influence-of-the-environment-on-cancer/?source=acsh.org