Title

The Epidemiologic and Cancer Transition Theories: Evidence from the US, select European Nations, and Japan

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Abstract (250 Words or Less)

This paper engages Omran's classic "epidemiologic transition", incorporating what we now know about cancers (Omran, 1971). Key to the epidemiologic transition theory is the idea that when nations develop, they move from a regime of high and fluctuating mortality to a regime of low mortality. This process is accompanied by a transition from an epidemiologic profile dominated by infectious diseases to one that is dominated by what Omran called "degenerative diseases and man-made diseases". In our study, we demonstrate that the opposition between the two types of diseases might be artificial due to the infectious root of many cancers.

We demonstrate that a "cancer transition" is under way in a number of highly-developed countries. The "cancer transition" mirrors the epidemiologic transition with its four different stages: in the first phase, cancers with infectious roots (e.g. stomach cancer) dominate and mortality from these cancers is high; then mortality from such cancers starts declining while mortality from non-infectious cancers increases (e.g. those resulting from smoking); next, the most lethal cancers of non-infectious origin also start declining (e.g. breast, colo-rectum, brunch and lung). We speculate that a fourth stage of the cancer transition could be foreseen, similar to the fourth stage of the health transition as proposed by Olshansky and Ault (1986), that is when the age pattern of mortality from cancer shifts to higher and higher ages.

Thus, there is a "mini" epidemiologic transition that is still playing out within the broad cancer grouping, rendering the health transition theory still very relevant today.

Extended Abstract (2-4 pages with figures and tables)

Introduction

Abdel Omran's original paper on the "epidemiologic transition" -- published in 1971, nearly 45 years ago -- is a seminal article that has had a deep and wide-ranging influence on a number of academic fields. In his paper, Omran argues in favor of a transition from high to low mortality with well-defined stages that all countries in the world have followed or will follow. Omran's transition is accompanied by major changes in the age- and cause-of-death structure of mortality as a population moves from one stage to the next. While initially high and fluctuating mortality conditions are characterized by an epidemiologic profile dominated by infectious diseases, chronic diseases, which Omran calls "degenerative and man-made diseases", are the leading causes of death at the close of the transition. The shift between one pattern to the other takes place during the second, central, stage of the transition. In Omran's view, these chronic diseases, cancer and cardiovascular conditions in particular, are opposed to the acute infectious diseases of the past.

Some researchers (e.g., Hazra and Gulliford, 2017; Olshanky and Ault, 1986) have claimed that Omran's epidemiologic transition theory does not take into account more recent trends and they argue in favor of a 4th or even 5th stage of the transition. These scholars believe that we have "moved beyond" the three stages of the epidemiologic transition though they also share the conventional view of cancer as a chronic disease. The research question, then, in our paper is, “If we take into account what is now known about cancers, is the epidemiological transition as described by Omran still relevant, or have we somehow 'moved beyond' its last stage"?

Our work most directly extends that by Gersten and Wilmoth (2002), and less so by Bray and colleagues (2012) and Knaul and colleagues (2012).

Data

Cause-of-death data have been obtained directly from National Statistics Offices and combined with life table series from the Human Mortality Database (HMD, www.mortality.org) to compute age-standardized death rate for various types of cancers in six countries: The United States (US), Norway, England and Wales, France, Sweden, and Japan. These countries have been selected because of the availability, detail and quality of their cause-of-death records for an extended period of time. The European 2013 standard population was used for the standardization, to account for differences in age structure across the six countries.

For this exploratory analysis which presents results for both sexes and all ages combined and for a selected number of cancers, grouped according to their known etiology. Cancers with a demonstrated infectious origin, namely cancers of the cervix uterus, stomach, and liver, have been combined into a single category while those with a root in non-infectious causes (cancers of the lung, colorectum, breast, pancreas, esophagus, and prostate) have been treated separately. These nine cancers accounted for 67.3% of all world-wide cancer deaths in 2018 (Bray, Ferlay, Soerjomataram, et. al., 2018). The International Classification of Diseases (ICD), implemented by all study countries during the time period under consideration, has gone through numerous revisions, from the 6th in 1950 to the 10th currently. These ICD revisions introduce some disruptions in the data series. However, as documented in the literature, cancer is a diseases much better defined than many others and these disruptions are small enough that a general picture of the overall trends still emerges very clearly (Percy and Dolman, 1978; Hoel et al., 1993). Similarly, differences in diagnostic and coding practices regarding cancer do not appear to be large enough across countries to bias international comparisons in mortality trends (Percy, Stanek and Gloeckler, 1981; Kelson and Farebrother, 1987).

In future versions of the paper, we will include analyses for each sex separately and we will investigate the age pattern of cancer mortality by site. We will also seek to extend the study period to include more recent years of data and we will measure the contribution of each specific cancer site to the general trends.

Results

Figure 1 shows trends in the age-standardized death rates from infectious and non-infectious cancers for all ages and both sexes combined in all six countries. In all countries, mortality from infectious cancers appears to have declined steadily throughout the time period, except for Japan. At the beginning of the study period, the age-standardized death rates from cancers of infectious causes ranged from about 50 per 100,000 in the United States to 120 per 100,000 in Norway and Japan, a ratio of 1 to 2.5. Note, however, that the series only starts in 1959 in the former country but in 1950 in the latter two. In Japan, the only country where mortality from these cancers increased, the peak was reached at around 150 per 100,000 in 1960. At the end of the period (2012-2014, depending on the country), the rates range from less than 20 per 100,000 in the United States and in England and Wales to 60 per 100,000 in Japan.

All countries also exhibit an increasing trend in other cancers, with a maximum reached in the 1970s in Sweden, which seems to be a pioneer, around 1990 in most other countries, and around 2000 in Japan, a laggard in the cancer transition among all study countries. Everywhere, mortality from non-infectious cancers is at its lowest at the beginning of the study period but the range in the initial rates is much larger than for infectious cancers, from about 30 per 100,000 in Japan to 160 per 100,000 in England and Wales, a ratio of 1 to more than 5. The peak also varied from one country to another, with a maximum from 120 per 100,000 in Japan (in the late 1990s and early 2000s) up to over 200 per 100,000 in the United States and England and Wales (in the early 1990s). While the rates have remained high with little signs of decline in Japan, Norway and Sweden, they nearly immediately started to decline after reaching their peaks in France, the United States and England and Wales, and they stand at 130, 135 and 150, respectively in these three countries, in the most recent year.

Norway and, most strikingly, Japan are the only two countries where trends in mortality from the two groups of cancer intersect (in the early 1950s in Norway and late 1980s in Japan) but it is easy to imagine that a similar pattern would have been observed in the other countries as well with enough historical depth in the available data.

Discussion

It is unfortunate that our data series start in 1950 at best as we are obviously catching only part of the historical trend in cancer mortality. However, assuming that all countries have followed a similar path (a strong assumption), we can suggest a plausible scenario by arranging our graphs in a logical sequence (based on the gap between the two types of cancer at the beginning of the study period), with each country located in a different time window with respect to the cancer transition as organized in Figure 1. The transition would thus evolve in the following way: 1) initially, infection-related cancer mortality rates are high and non-infectious-related cancer mortality is low; 2) then infection-related cancer mortality starts declining while non-infectious cancer mortality increases, 3) next, infection-related cancer mortality reaches a low level and non-infectious cancer mortality (the stage we are in now in some of the study countries) starts declining after reaching a peak; 4) we can speculate that in the near future, even if non-infectious cancer mortality remains fairly prevalent, death from such cancers will occur at higher and higher ages due to improvements in detection and treatment.

Our preliminary results thus suggest that the “classical” view of cancer as a non-infectious disease does not take into account our current understanding of cancers’ etiology since we clearly see opposite trends in infectious versus non-infectious cancers that mirror the trends in infectious versus non-infectious diseases in general, though with a significant dealy. Paradoxically, these results suggest that far from having become obsolete, Omran's epidemiological transition theory and its later revisions are still very relevant today within the broad category of cancers.

At this point in our research, we do not have good explanations for all the declines and dips we have highlighted, but our future work will investigate these trends in more detail.

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Figure 1. Infectious and non-infectious cancers, all ages combined, both sexes, age-standardized death rates, 6 study countries