

## book reviews

### Recent Atlases of Mortality in the United States:

#### A Comparative Review

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*Atlas of Cancer Mortality in the United States, 1950-94.* by Susan S. Devesa, Dan J. Grauman, William J. Blot, Gene A. Pennello, Robert N. Hoover, and Joseph F. Fraumeni, Jr. Bethesda, Maryland: National Cancer Institute, September 1999. NIH Publication No. 99-4564, softcover. 360 pp., maps, graphs, tables, references, appendices.

*Atlas of Respiratory Disease Mortality, United States: 1982-1993.* by Jay H. Kim. Cincinnati, Ohio: National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, August 1998. DHHS (NIOSH) Publication No. 98-157, softcover, vii, 75 pp., maps, appendix.

*Women and Heart Disease: An Atlas of Racial and Ethnic Disparities in Mortality.* by Michele L. Casper, Elizabeth Barnett, Joel A. Halverson, Gregory A. Elmes, Valerie E. Braham, Zainal A. Majeed, Amy S. Bloom, and Shaun Stanley. Morgantown, West Virginia: Office for Social Environment and Health Research, West Virginia University, December 1999. ISBN 0-9665085-1-3, softcover, xiii, 239 pp., maps, graphs, tables, index.

Following rapidly on the heels of the publication of the *Atlas of United States Mortality* (Pickle et al. 1996) and the first edition of the *Dartmouth Atlas of Health Care* (1996), disease and mortality atlases have become a growth industry in the fields of public

health and medical geography. The utility of small area disease mapping has captured the attention of clinicians and health researchers interested in evidence-based practice and outcomes management (Gundersen 2000). Three recent national atlases of mortality from specific diseases provide an opportunity for a comparative review of purposes, methods, disease mapping strategies, approaches to data visualization and statistical comparison, methods of print and interactive presentation, and overall effectiveness. In contrast to Walter and Birnie (1991), this review does not provide an empirical analysis of the characteristics of each atlas. Rather, as the three atlases represent very different approaches in a number of respects, and point out several areas where methodologies continue to evolve, the contents and features of each atlas are briefly described, followed by a comparison of their salient features.

#### Atlas of Cancer Mortality in the United States, 1950-94

Cancer mortality atlases have evolved into a separate subject heading in the disease atlas genre. The present atlas is the fifth American offering from the National Cancer Institute; previous publications covered mortality by county for 1950-69 (Mason et al. 1975), mortality among nonwhites for 1950-69 (Mason et al. 1976), mortality among whites for 1950-80 (Pickle et al. 1987) and among nonwhites during the same time period (Pickle et al. 1990). The data for this latest atlas are derived from national death certificate files, and are based on underlying cause of death. The heart of the atlas is a series of maps, in 262 pages, showing age-adjusted mortality rates by US counties and separately by State Economic Areas (SEAs), separately by gender and race (white and black), for all cancers and for

each general site or body system (37 in all). Furthermore, separate maps show the patterns for the periods 1950-1969 and 1970-1994. The enterprising reader, calculator in hand, may determine an expected total number of maps (perhaps  $2 \times 2 \times 2 \times 37$ ) and come up short. One reason is that certain cancers are gender-specific. Additionally, data on black cancer mortality are provided only for the period 1970-1994, and only by SEA, and for certain cancer sites black mortality was not high enough to generate statistically meaningful maps (i.e. sparse data for cancer of the testis, salivary glands, thyroid gland, among others). Additionally, county level maps are presented for only half to two-thirds of the cancer sites (more for white females than for white males). Even with these exclusions, the authors present a wealth of statistical data on cancer mortality.

The authors provide an abbreviated discussion of methods, as well as a section describing the results, overall and by cancer site, of the mapping exercise. Here we learn, for example, that the 1970 U.S. standard population was used, with direct age adjustment across 18 five-year age groups, and that Atlas Pro and Atlas GIS for Windows software were used to create the maps. While some statistical analyses and comparisons are provided, the national maps do not show statistical significance. Rather, each map shows the areal units (counties or SEAs) classified across age-adjusted rate deciles, using a familiar color scheme ranging from full intensity red for those areas in the highest decile, to full intensity blue for those areas in the lowest decile, with eight gradations in between; areas with sparse data are shown in gray. Areas with sparse data were defined as: a) observed cases less than six, b) less than twelve and not statistically different from the national rate, or c) expected cases less than six and

not statistically different from the national rate.

The atlas is available in three forms: this softcover edition, currently obtainable at no cost from the National Cancer Institute, and two websites (accessed by pointing your browser in version 4 or greater of Netscape Navigator or Microsoft Internet Explorer to <http://www.nci.nih.gov/atlas/mortality.html>), one static and one dynamic. It is unfortunate that the authors failed to include the website address in the printed version, but enterprising readers should be able to find it through use of their favorite search engine. The Atlas On-Line web-based application provides everything contained in the printed version of the Atlas. This includes not only the color maps, but also the databases, text, and related graphics files. Users interested in accessing the underlying data for each map can obtain this information here. The second application enables the user to create maps from the underlying database, with flexibility in determining the number of data ranges and colors, and zoom in and out capability. The potential set of maps appears to be limited to those included in the printed version of the Atlas. The dynamic application continues to evolve, and readers are encouraged to log on and examine its technical aspects while viewing some of the cancer mortality maps that can be created.

Strengths of this atlas include its consistent manner of presentation, omission of extraneous detail, and presentation of age-adjusted rates rather than classifications based on inferential statistics. Weaknesses include the rather long time intervals displayed (1950-69 and 1970-94), failure to smooth the age-adjusted rate data prior to final map presentation, and reliance on underlying rather than multiple cause of death information for identification of cancer cases. This

latter issue varies in significance with the site and type of cancer under study.

All in all, the authors are to be commended for the creation of a comprehensive atlas, one that will prove highly useful in focusing attention on spatial variations in the incidence of cancer mortality across the United States.

#### **Atlas of Respiratory Disease Mortality, United States: 1982-1993**

The second atlas under review provides maps of respiratory disease mortality across the United States. The conditions studied derive from a variety of ICD-9 rubrics, including tuberculosis, sarcoidosis, lung cancer and pleural malignancy, pneumonia, chronic obstructive pulmonary disease, asthma, hypersensitivity pneumonitis, asbestosis, silicosis, several forms of pneumoconiosis, byssinosis, and several other conditions. Data were obtained from national vital statistics sources, for calendar years 1982-1993, focusing on deaths among individuals 15 years and older. Age-adjusted rates were calculated using the 1980 U.S. standard population, across four age groups (15-34, 35-54, 55-74, 75+), and mapped by health service areas (HSAs), aggregated from counties, as defined by NCHS (1991). Data for each disease are based on underlying or contributing cause of death. There are no maps displaying patterns by gender and race, nor was this reviewer able to find any discussion of potential variations in mortality for any of these conditions by these characteristics. Two maps are presented for each disease: 1) age-adjusted, classed in five strata, and 2) compared to US rate as a rate ratio, with no confidence intervals or p-values. On each map, the five strata represent the following centiles of the distribution of values: lowest 10<sup>th</sup>, 10-30<sup>th</sup>, 30-70<sup>th</sup>, 70-90<sup>th</sup>, and highest 10<sup>th</sup>. For each rate ratio map, rate

ratios were calculated by dividing the age-adjusted rate for each HSA by the U.S. rate. HSAs with fewer than 20 deaths for any given cause are shown double-hatched to warn the reader that rates are based on small numbers of cases, but shaded according to the category in which the actual value falls. The age-adjusted rate maps use a brown to yellow scale with gray for the lowest category, while the rate ratio maps use a dark green to lime green scale, also with gray to show HSAs where the rate ratio is less than 1.00. Each pair of maps is accompanied by an abbreviated discussion (never more than one page) of known and suspected occupational and environmental risk factors, with selected references for each disease. The atlas concludes with appendices showing the boundaries of the health service areas and their names. Readers who wish to determine which counties fall into each HSA will need to consult another source document (Makuc et al. 1991).

Strengths of this atlas include its concise approach and national perspective, with two maps and a page of text summarizing the information for each respiratory disease. The author is also to be commended for his restraint, in an era of p-values and tests of statistical significance, for not presenting any maps showing HSAs with rate ratios statistically different from the national rate. Weaknesses are more numerous, and include the limited discussion of statistical and cartographic methods, concerns about the methods used to calculate the rate ratios (especially the failure to account for race and/or gender differences in respiratory disease mortality), and the manner of graphical display (choice of intervals, decision to show rates and rate ratios with cross-hatching even when these are unstable estimates).

Given the relative infrequency of deaths associated with several

of these diseases, one wonders whether this national atlas should have been produced. The time period studied makes it difficult to compare these maps with other disease atlases. Another concern is whether mortality from respiratory diseases is adequately captured using underlying, as opposed to multiple, cause of death codes. While this point has been studied for some of the diseases in question (Davis et al. 1992), it may pose issues for some of the less common illnesses mapped here. Although NIOSH may have plans for an interactive web-based application using the data presented in this atlas, there is no mention of this made anywhere in the text. Although not referenced, the entire contents of the atlas can be downloaded as pdf files, from <http://www/cdc.gov/niosh/98-157pd.html>. Generally speaking, while this atlas is useful to the interested reader, compared to others (i.e. Pickle et al. 1996) it is substantially less comprehensive and statistically detailed.

### **Women and Heart Disease: An Atlas of Racial and Ethnic Disparities in Mortality**

The third atlas reviewed here focuses on women and heart disease mortality, explicitly examining gender-specific race/ethnic differences from a national and state perspective. While the previous atlases were from the National Cancer Institute and National Institute of Occupational Safety and Health (a unit of the Centers for Disease Control and Prevention), respectively, this work is the product of a collaboration between staff at the National Center for Chronic Disease Prevention and Health Promotion at the Centers for Disease Control and Prevention and the Office for Social Environment and Health Research at West Virginia University.

This atlas utilizes mortality data

from national vital statistics for 1991-95, analyzed primarily across counties, focusing on women 35 years and older. Heart disease mortality cases were identified using underlying cause of death classified by the ICD-9-A (nosological coding system for United States death certificates used from 1979-1998) to codes 390-398, 402, and 404-429. The atlas includes several national maps using counties as units of analysis, showing demographic patterns from the 1990 Census, official population projections, and other sources. A series of national maps show smoothed age-adjusted heart disease death rates by county for each race/ethnic group (all women, American Indian and Alaska Native, Asian and Pacific Islander, black, Hispanic, and white women), with counties classed into quintiles and areas with sparse data shown in gray. These six maps provide the only national perspective on heart disease mortality among women; all maps in the atlas from that point on provide intra-state data. For each state, there are two pages, each with up to three maps at the county level within the state. The number of maps depends on the race/ethnic distribution of women in each state.

This atlas provides a focused, deliberate, highly professional presentation, with a text that both outlines all weaknesses of which the authors are aware and carefully describes all methods employed. One major concern has to do with the series of maps for each state. Maps show heart disease mortality by race/ethnic group for all women, white, black, Asian and Pacific Islander, Hispanic, and American Indian and Alaska Native women. For each state, counties are classed into quintiles based on the distribution of age-adjusted rates for that state and race/ethnic group. This facilitates comparisons across counties within race/ethnicity, which may have been the authors'

primary goal. However, it renders comparisons across states more problematic, although there are national maps included in the atlas. Another way to do this would have been to determine quintiles across all counties in the United States, so that the colors on each race/ethnicity-specific map would represent the same age-adjusted rate interval across all state maps.

The authors are currently finalizing a companion volume on male heart disease mortality forthcoming late in 2000.

The atlas is also available in a downloadable version, at <http://oseahr.hsc.wvu.edu> or <http://www.cdc.gov/nccdphd/cvd/womensatlas>.

### **Comparison and Comment**

The three atlases examined here all focus on national patterns of disease-specific mortality, yet each takes a different approach to the analysis and display of statistical data in map form. The heart disease atlas focuses explicitly on counties as units of analysis, while the cancer atlas provides maps both by county and by SEAs, and the respiratory disease atlas provides maps by HSAs. Each of the atlases focuses on mortality defined by underlying cause of death, and all utilize the direct method of age-adjustment. Two of the atlases (cancer, heart disease) also provide gender- and race-specific maps, while the respiratory disease atlas does not. The years for which data are mapped differ widely among the three atlases. The atlases also differ as to manner of data display, with the heart disease atlas focusing on quintiles based on the rates displayed in each map, the cancer atlas similarly using deciles, and the respiratory disease atlas using five strata based on centiles. In contrast to the *United States Atlas of Mortality* (Pickle et al. 1996), only one of these atlases (respiratory disease)

includes maps based on statistical comparisons between each area and the United States as a whole. A general discussion of the appropriateness of maps that make statistical inferences, with standards or guidelines for their creation and dissemination, from the multiple perspectives of environmental epidemiology, cartographical methods and spatial analysis, public health, and mass communications, is clearly in order. Comparison of results from atlas to atlas would be enhanced by the adoption of a single standard population for age adjustment, and by the use of the same age groupings in computing adjusted rates.

Disease atlas designers should give some thought to the potential of indirect age-adjustment as a technique for presentation of small area variation in mortality and disease. The recent *Atlas of Leading and 'Avoidable' Causes of Death in Countries of Central and Eastern Europe* (Józan and Prokhorskas 1997) provides an interesting contrast to the methods used in these three atlases.

Statistical and cartographic methodologies for small area analysis are evolving rapidly, with new techniques and critiques of older as well as recently proposed approaches appearing continually. Thus it comes as no surprise that these atlases employ differing methods, and we can be sure that as these reports are updated with more current data, experiments with newer methods will continue. Medical geographers and environmental epidemiologists must cautiously balance the complexity of statistical methods with the interpretability of the final product to the public audience. None of these atlases provides the final answer, but we can be sure that the presentation of the maps included in each will allow researchers and members of the public to frame more questions. And that, in the final analysis, is the ultimate pur-

pose of an atlas of mortality rates or disease incidence.

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