

# **Geographic Inequalities in Mortality in the United States: Looking Beyond Socio-economic and Racial Differentials**

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## **Abstract**

Geographic variations in mortality have tended to decline in the United States up to around 1980 but have increased thereafter, whether measured at the state or at the county level. Because of large differences in the racial and socio-economic composition of the population between geographic areas, most of the geographic variation has been attributed to differential deprivation (factors related to poverty and education). The relationship between mortality and socio-economic factors has been extensively documented. The challenge is to go beyond the socio-economic divide to identify the other factors, hopefully more amenable to intervention than these individual characteristics, contributing to geographic disparities in mortality. A first step in identifying such factors is to measure how much of the inter-state differential in mortality in the U.S. is *not* due to racial and socio-economic characteristics, which is the purpose of this paper.

In the absence of publicly accessible data combining information on both mortality and detailed socio-economic characteristics at the state level, we implement an approach derived from the classic demographic method to standardise mortality rates by age. The basic principle of this approach is to compare two series of mortality rates by sex and age in each state of the U.S. in the year 2000. The first series is directly estimated using vital statistics information (which does not include the desired socio-economic categories) for the year 2000 following standard demographic methods. The second series is produced indirectly using data from the 1998-2002 National Health Interview Survey Linked Mortality Files, with information on survival and socio-economic characteristics but not on geographic location, and from the 2000 Census in a two-stage procedure. The difference between the two series indicates how much of the inter-state differences in mortality is not explained by the direct effect of the socio-economic structure of the population at the state-level.

## Background

In a recent paper, we showed that geographic differentials (whether measured at the State- or at the County-level) have tended to decline up to around 1980 but have increased thereafter (Wilmoth, Boe, and Barbieri, 2011), a result confirming that of other studies (Ezzati et al., 2008 in particular). We demonstrated that a significant part of the degradation in the international ranking of the U.S. on adult (especially male) life expectancy arises from the larger geographic inequalities found in this country compared with other developed countries. Because of large variations in the racial and socioeconomic composition of the population among geographic areas, much of this differential has been attributed to differential deprivation (factors related to poverty and education). In fact, thanks to the works of others, based on large studies of the role of individual and community characteristics on mortality, much is known about the pathways through which such factors influence health and survival. Much of this line of work in the United States is based on two nationally representative sources of information, namely the National Health Interview Survey Linked Mortality Files (see in particular the extensive work carried out by Rogers and Hummer on this issue<sup>1</sup>) and the National Longitudinal Mortality Study (Rogot, Sorlie, and Johnson, 1992; Sorlie, Backlund, and Keller, 1995).

The challenge is now to go beyond the socioeconomic divide (social as mostly measures by racial and education characteristic, and economic as mostly measured by income and wealth) to identify the other factors, hopefully more amenable to intervention than these individual characteristics, contributing to geographic disparities in mortality. A first step in identifying such factors is to measure how much of the inter-state differential in mortality in the U.S. is *not* due to racial and socioeconomic characteristics, which is precisely the purpose of this paper.

## Data and Method

Vital statistics of the United States (U.S.), typically used to estimate mortality risks at the State level, do not include information on the level of education level, income or wealth of the deceased. The National Health Interview Survey Linked Mortality Files (NHIS-LMF), which followed on the survival status of participants to the 1986-2004 NHIS up to the year 2006, have been specifically designed to investigate the relationship between a large variety of factors, including socio-economic characteristics, and mortality. However, the public-use files of this dataset do not include any geographic indicators. The method used in this study to compute standardized mortality rates at the State level relies on three sources of data, namely the NHIS-LMF, the 2000 Census, and vital statistics records from the National Center for Health Statistics (NCHS). Because the public-use dataset of the NHIS Linked Mortality Files provides the survival status of adult participants only, this study will concentrate on adult mortality starting at age 20. In addition, we will limit our analysis to adults below the age of 80 to increase the robustness of our estimations because of serious concerns with age misreporting among the elderly in the NCHS mortality data (Kestenbaum, 1992) and because the proportion of institutionalized individuals (a category not included in the NHIS-LMF) increases substantially after this age.

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<sup>1</sup> Their most comprehensive study, also based on the analysis of NHIS-MLFs, was presented in a volume published in 2000 (Rogers, Hummer, and Nam, 2000). There are numerous papers by other authors on the relationship between mortality risks and socio-economic or racial characteristics, including many using the same sources of information (to cite a few among the most influential and starting with Antonovsky, 1967; Pappas et al, 1993 Lochner et al., 2001 ; Murray et al., 2006 ; Danaei et al., 2010).

(1) We first compute age-standardized mortality rates at 20-79 years of age by sex from the detailed mortality files prepared by NCHS for the year 2000<sup>2</sup> for the 50 States of the U.S. plus the District of Columbia. We apply standard demographic methods for this calculation, using the total population of the United States in the 2000 Census as the reference population (see Figure 1 for illustration of results).

(2) We independently compute age-standardized mortality rates for the period 12 to 48 months after the interview by sex, level of education, income and race, also at ages 20-79 for the U.S. as a whole with the same reference population, using the 1998-2002 sample of the NHIS. The period 1998-2002 is selected to provide a large enough pool of respondents so as to estimate stable mortality rates by age, sex, level of education, income, and race and to center on the year of the 2000 Census, which is used in the next step. We decided not to use mortality follow-up information for the first 12 months to limit the risk of under-estimating the mortality rate. Indeed, the probability of institutionalization is probably higher during the months preceding a death and institutionalized individuals are excluded from the NHIS, thus biasing downward survival risks computed from this data. We censor mortality follow-up to 48 months after the interview so as to roughly center our mortality estimates from the NHIS on the year 2000, the year for which we have detailed census information on the racial and socio-economic distribution of the population for each State of the U.S.<sup>3</sup>

(3) We then compute age-, racial- and socioeconomically-standardized mortality rates at 20-79 by applying the rates estimated in step (2) to the population distribution by sex, age, level of education, income, race, and State in the 2000 Census.

(4) Last, we compare age-standardized (but not racial- or socioeconomically-standardized) mortality rates computed for each of the 50 U.S. State (plus D.C.) directly from vital statistics records in step (1) to age-, racial-, and socioeconomically-standardized mortality rates computed from the NHIS-LMF and applied to the 2000 Census population by State in step (3). States for which the NHIS-derived mortality rates are lower than the mortality rates derived from vital statistics data are said to exhibit a lower level of mortality than expected based on their socioeconomic and racial population distribution, while States for which the former is higher than the later are said to exhibit a higher level of mortality than expected.

## Discussion

Differences between the two sets of mortality estimates can spring from a number of factors. First, such a difference could result from our exclusion of important factors of variations, such as marital status or wealth. Next, it could result from variations in the strength of the relationship between mortality and individual racial and socioeconomic characteristics. Also, it could result from the mitigating influence of macro-level characteristics, such as effective health interventions or other contextual factors. Or it could result from significant interactions between individual characteristics and characteristics of the community or the larger geographic area. Future work will be conducted to follow through on these hypotheses. On the one hand, we will request the restricted-use NHIS Linked Mortality Files (which do contain information at the State-level) to investigate inter-State differences in the relationship between mortality and socioeconomic factors. On the other hand, we will extend the study to

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<sup>2</sup> Vital Statistics NCHS's Multiple Cause of Death Data, downloaded from <http://www.nber.org/data/vital-statistics-mortality-data-multiple-cause-of-death.html>.

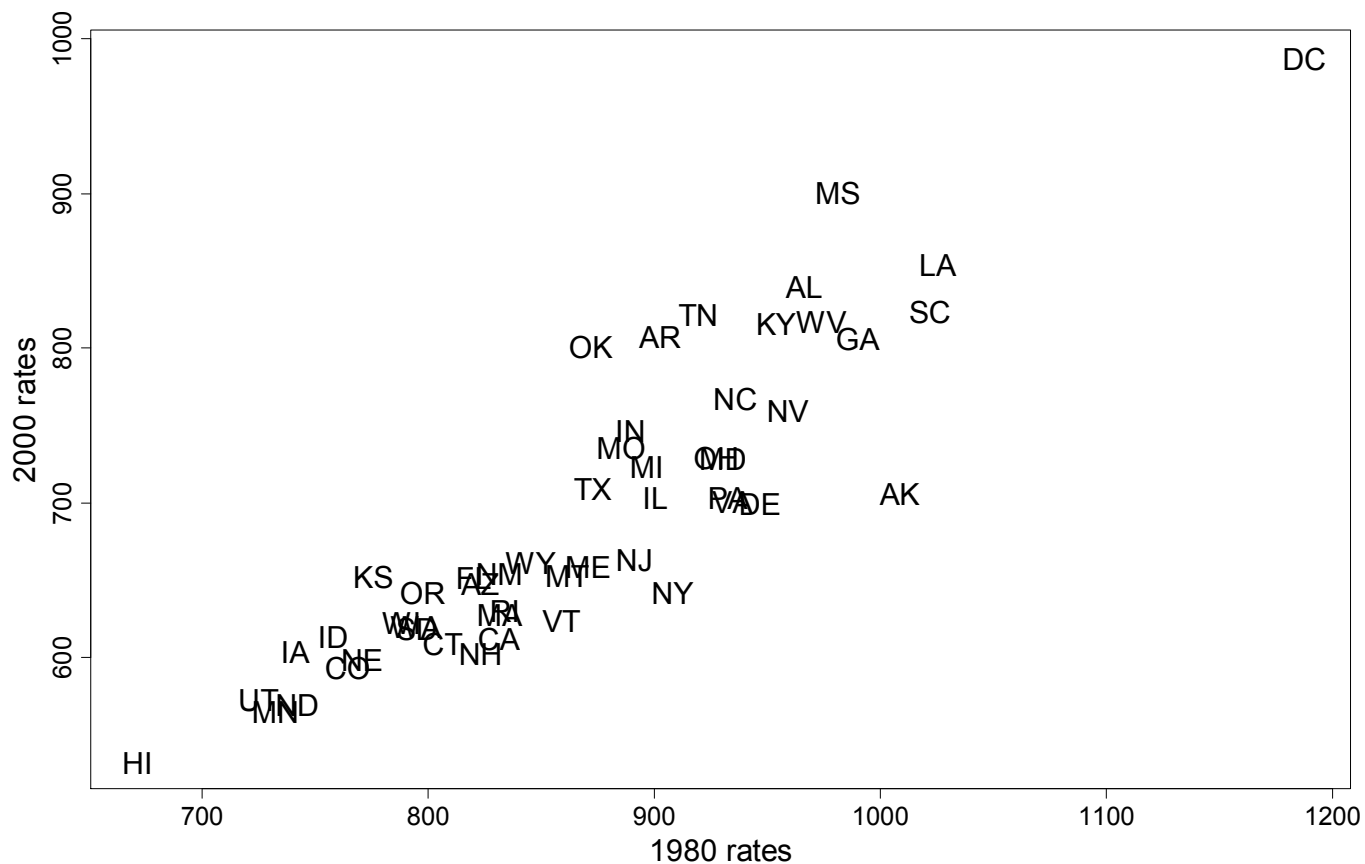
<sup>3</sup> We realize that the American Community Survey provides the same type of information as the Census and we may very well resort to this alternative data in the future (especially when looking at long term trends in inequalities) but for the sake of simplicity, we decided to use the 2000 census only for this preliminary study.

cause-specific mortality rates so as to better understand the forces driving these differences. Further down the road, we are planning to select two U.S. States to conduct monographic work on their mortality levels and differentials in relation with their individual, family, community, and State-level characteristics. One will be selected among States with lower-than-expected mortality based on their socioeconomic and racial composition and the other among States with higher-than-expected mortality.

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**Figure 1. Age-standardized<sup>4</sup> mortality rates at 20-79 years in 1980 and 2000 per 100,000 by State of the U.S.**



Source: Figure produced by the author using NCHS Multiple Cause-of-Death Data (downloaded from <http://www.nber.org/data/vital-statistics-mortality-data-multiple-cause-of-death.html>)

<sup>4</sup> Reference population: U.S. population of both sexes at the 2000 Census.