Explaining Inequalities in Women's Mortality among U.S. States

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Life expectancy is a powerful “social mirror,” reflecting overall health, well-being, and inequality within a society. During most of the twentieth century, trends in life expectancy for the United States painted a favorable picture. Between 1900 and 2000, life expectancy increased from 49 to 77 years (Arias 2012). However, large inequalities in longevity across subnational areas persisted and have even widened since the early 1980s. The inequalities have grown at multiple levels, including Census-defined regions (Montez and Berkman 2014) and divisions (Fenelon 2013), states (Wilmoth, Boe, and Barbieri 2011), and counties (Ezzati et al. 2008). To put the inequality in context, by 2000 the dispersion in longevity among U.S. states exceeded the dispersion between high-income countries. The range in life expectancy among U.S. states was 7.4 years (72.3 to 79.7) versus 4.7 years (76.7 to 81.4) among a comparison set of high-income countries (Wilmoth et al. 2011). The reasons for the geographic inequalities in mortality within the United States are poorly understood. It is imperative that scholars turn the social mirror toward the inequalities to elucidate their causes and identify strategies to reduce them.

The few studies that have investigated the reasons for the geographic inequalities in mortality within the United States have largely focused on either demographic characteristics of an area’s population or a small set of structural conditions. For instance, an ecological analysis of U.S. counties found that gains in longevity after the early 1980s were positively associated with county income and proportion non-black but unrelated to income inequality and the proportion graduating high school (Ezzati et al. 2008). Another county-level analysis of mortality examined several demographics, such as race, education, single-parent households, and access to medical care (Kindig and Cheng 2013). The factors most strongly predictive of county-level mortality trends during the 1990s were Hispanic ethnicity, education, population density, median household income, and percent smokers (for women). Access to medical care was not a significant predictor. A third study examined eight empirically-derived areas of the United States and concluded that their disparities in longevity could not be explained by race, income, or health-care access and utilization (Murray et al. 2006). Taken together, the findings of these studies indicate that spatial variation in demographic characteristics only partly explains spatial variation in mortality.

To fully elucidate the reasons for geographic inequalities in mortality, the reasons must be conceptualized more comprehensively and examined more systematically. First, studies need to 'bring context back in' and consider the social, political, and economic contexts that have largely been neglected in prior studies (see related critique in Coburn 2000; Diez-Roux 1998). Contextual explanations must include factors such as tax policies (Newman and O'Brien 2011) and education expenditures (Dunn, Burgess, and Ross 2005), that shape mortality by creating opportunities and imposing constraints on people's lives. Second, individual and structural explanations must be jointly assessed and parsed out within a multilevel framework.

The main aim of this study is to explain the inequality in women's mortality across U.S. states using a multilevel perspective. Individual-level explanations tested include women's race, education, employment states, income, and marital status. State-level explanations include six contextual characteristics: economic, sociopolitical, infrastructure, tobacco, collective social functioning, and demographics. Specifically, we ask: (a) to what extent do individual-level and state-level characteristics explain state variation in women's mortality, and (b) which state-level characteristics have the greatest potential for reducing mortality in underperforming states?

Data and Method

Data

The analysis uses data from the National Longitudinal Mortality Study (NLMS), one of the largest and most comprehensive datasets available for examining demographic and socioeconomic inequalities in U.S. mortality (Rogot, Sorlie, and Johnson 1992). The NLMS was created by linking respondents in multiple waves of the Current Population Survey (CPS) and a subset of the 1980 Census to death certificate information provided by the National Center for

Health Statistics. The full version of the NLMS currently contains CPS surveys spanning 1973 to 2002 with mortality follow-up through December 31, 2002.

We analyze the public-use version of the NLMS, which contains a subset of CPS survey years and variables from the full version. The public-use version identifies two periods: (1) CPS surveys taken in the 1980s in which respondents were followed until death or exactly six years, and (2) CPS surveys taken in the 1990s with the same follow-up protocol. We combine the two periods for the study. Aside from the two time period identifiers, the NLMS masks all other temporal information, such as date of interview and date of death.

Analytic Sample

The analytic sample includes U.S.-born women aged 30-89 years during the six years of mortality follow-up. We had complete information for 94% of respondents (6% were excluded from the analysis). The women represent all 50 states, excluding the District of Columbia.

We create a person-quarter data file for the analysis. The person-quarter file contains an observation for every quarter the respondent was alive from their interview until death or six years. The age of the respondent is then incremented every fourth quarter. Respondents can also "age-in" and "age-out" of the analytic sample (e.g., see Montez and Zajacova 2013). The final dataset contains 9,958,411 person-quarter observations and 25,855 deaths.

Individual-Level and State-Level Variables

We include six variables measured at the individual level: age, race/ethnicity, educational attainment, employment status, family income-to-poverty ratio, and marital status. We include six state-level latent factors. The latent factors capture the state's economic, sociopolitical, infrastructure, tobacco, collective social functioning, and demographic contexts. Economic variables include state gross product per capita, median household income, unemployment rate, gini coefficient, and percentage of female household families below poverty. Sociopolitical variables include indicators of regressive taxation, progressive taxation, education spending, social expenditures, Medicaid generosity, and presidential voting patterns. Infrastructure variables include the percentage of the population living in a metropolitan statistical area, percentage of workers using public transportation, and housing affordability. Tobacco variables reflect production, consumption, and controls. Collective social functioning variables include crime rates and Putnam's social capital index (2000). Demographic, or compositional, variables include nativity, education, and race/ethnicity. The values of all variables reflect circa 1990 to center the data on the midpoint of the mortality follow-up.

Multilevel Models

We estimate a series of multilevel, discrete-time event history models. (Guo and Zhao 2000; Subramanian, Jones, and Duncan 2003). The multilevel models account for the two-level hierarchical structure of the data, with individuals (level 1) nested within states (level 2). The baseline model is shown below; subscript "*i*" identifies respondents and "*j*" identifies states.

$$\ln(p_{ij}/(1-p_{ij}) = \beta_0 + \beta_1(age_{ij}) + u_j$$

$$\text{where } u_j \sim N(0, \sigma_u^2)$$

The coefficient β_0 is the overall intercept. It can be interpreted as the ln(odds) of death when $age_{ij} = 0$ and $\mu_j = 0$. The term μ_j is the random effect of state. It will be greater (or less) than 0 depending on whether the state has a higher (or lower) than average ln(odds) of death. Thus, the intercept for state "*j*" is $\beta_0 + \mu_j$. The coefficient β_1 can be interpreted as the effect of a one unit change in age on the ln(odds) of death among individuals within a given state. Finally, the between-state variance in the ln(odds) of death, adjusted for age, is σ_u^2.

After estimating the baseline model, we progressively add individual-level variables and state-level contextual effects. We also compare the contribution of individual and state variables to the variation in mortality among states. All models are estimated with xtmelogit in Stata 12.1.

Results

The annual probability of death among native-born women aged 30-89 years during the study period ranges from 0.74% in Hawaii (followed by 0.80% in South Dakota and 0.83% in Minnesota) to 1.24% in Nevada (right after 1.22% in Tennessee and 1.21% in West Virginia).

The multilevel models (tables not included) indicate that roughly one-third of mortality variation across states is explained by the individual-level characteristics we examined. Adjusting for women's race/ethnicity reduced the random effect of state from 0.090 ($p<0.001$) to 0.073 ($p<0.001$), a 19% reduction. The effect was further reduced to 0.068 ($p<0.05$) after additionally accounting for education and then to 0.066 ($p<0.05$) after adding employment and poverty to the model. After including marital status in the full model the random effect was attenuated to 0.058 ($p<0.05$), a 36% reduction from the baseline model. Models including the state-level characteristics are in progress.

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