Factors Associated With County-Level Differences in U.S. Drug-Related Mortality Rates

Shannon M. Monnat, PhD

**Introduction:** Over the past 2 decades, drug-related deaths have grown to be a major U.S. public health problem. County-level differences in drug-related mortality rates are large. The relative contributions of social determinants of health to this variation, including the economic, social, and healthcare environments, are unknown.

**Methods:** Using data from the U.S. Centers for Disease Control and Prevention Multiple-Cause of Death Files (2006–2015, analyzed in 2017); U.S. Census Bureau; U.S. Department of Agriculture Economic Research Service; Agency for Healthcare Research and Quality; and Northeast Regional Center for Rural Development, this paper modeled associations between county-level drug-related mortality rates and economic, social, and healthcare environments. Spatial autoregressive models controlled for state fixed effects and county demographic characteristics.

**Results:** The average county-level age-adjusted drug-related mortality rate was 16.6 deaths per 100,000 population (2006–2015), but there were substantial geographic disparities in rates. Controlling for county demographic characteristics, average mortality rates were significantly higher in counties with greater economic and family distress and in counties economically dependent on mining. Average mortality rates were significantly lower in counties with a larger presence of religious establishments, a greater percentage of recent in-migrants, and counties with economies reliant on public (government) sector employment. Healthcare supply factors did not contribute to between-county disparities in mortality rates.

**Conclusions:** Drug-related mortality rates are not randomly distributed across the U.S. Future research should consider the specific pathways through which economic, social, and healthcare environments are associated with drug-related mortality.


**INTRODUCTION**

From 2006 to 2015, a total of 515,060 people in the U.S. died from drug overdoses and other drug-related causes. A large share (42.3%) involved opioids, but other drugs, including benzodiazepines (12.1%) and cocaine (12%), also contributed. The economic, social, and emotional tolls of these deaths are substantial, but some parts of the U.S. are bearing heavier burdens than others. Empirical explanations for this geographic heterogeneity are lacking. Most existing studies of drug mortality examine temporal trends rather than geographic differences, and those that examine geographic disparities are largely descriptive, emphasizing data challenges or differences in population composition (e.g., age, race) rather than the “fundamental” social determinants of health known to contribute to geographic differences in other types of mortality and morbidity.

This study employs the WHO social determinants of health and socioecological frameworks to develop hypotheses about factors that contribute to between-
county disparities in drug-related mortality rates. Social determinants of health are the structural conditions in which populations live, work, and socialize that influence stress, relationships, health behaviors, and mortality, including economic resources, the social environment, and the healthcare infrastructure. Based on these frameworks, this study tests the hypothesis that counties’ economic, social, and healthcare environments contribute to between-county variation in drug-related mortality rates.

Environmental features can be derived or integral. Derived measures capture aggregate characteristics of individuals, families, and households, reflecting county composition. But they also shape residents’ health environments. Economic disadvantages like unemployment, poverty, low education, and housing challenges are associated with increased risk of family conflict, social isolation, stress, and substance misuse. Concentrated economic disadvantage can contribute to collective frustration and hopelessness, out-migration, community disinvestments, and social disorders like substance misuse. Therefore, counties with greater economic, housing, and family distress should have higher drug-related mortality rates.

Integral measures capture structural (contextual) characteristics external to individuals. Features like the healthcare environment and opportunities for social interaction are inversely associated with all-cause mortality, whereas unstable labor markets and manually labor-intensive occupations have been found to be associated with mental health problems, injuries, and chronic pain. Studies have yet to examine whether these same factors contribute to geographic differences in drug-related mortality rates. Counties reliant on heavy manual labor industries, like mining and manufacturing, that have suffered substantial employment downturns and wage stagnation in recent decades, may have higher drug-related mortality rates. Opportunities for social interaction through community associations, recreational facilities, and churches facilitate trust, goodwill, and social cohesion, which may buffer against isolation, depression, and substance misuse. Therefore, counties with more of these social capital–promoting establishments may have lower drug-related mortality rates. Access to physical health care may help protect against injury risk or long-term chronic pain and disability for which opioids are commonly prescribed. Access to mental health care may facilitate necessary substance abuse treatment. Counties lacking these services may have higher drug-related mortality rates.

Ultimately, distinguishing which (if any) of these social determinants of health contribute to geographic disparities in drug-related mortality is an essential step toward developing place-level targeted interventions. Therefore, these analyses test associations between county-level social determinants of health and drug-related mortality rates.

**METHODS**

**Study Sample**

A pooled cross-section of county-level mortality rates (2006–2015) were extracted from the U.S. Centers for Disease Control and Prevention’s Wide-Ranging Online Data for Epidemiologic Research (WONDER) multiple cause-of-death (MCD) files. Categorization of drug-related deaths used ICD-10 codes, including accidental poisoning, intentional self-poisoning, and poisoning of undetermined intent by exposure to drugs, drug-induced diseases, drugs in the blood, and mental/behavioral disorders due to drugs. Appendix A (available online) provides specific codes.

There are practical and conceptual reasons for using MCD versus underlying cause-of-death files. Data suppression for counties with <10 deaths results in suppressed mortality rates for more than one third of counties in the underlying cause-of-death data, even when pooling 10 years of data. Suppressed counties have smaller populations. Excluding them would limit study generalizability and could bias results. Because all contributing causes of death are included in the MCD files, fewer counties have suppressed mortality rates in the MCD data (note that deaths were counted only once, even if multiple drug-related causes contributed to the death). Second, using MCD data reduces risk of undercounting because of misclassification, which has been especially pronounced for drug-related suicides. Third, identifying a single factor as the underlying cause of death is an oversimplification of the clinical and pathologic processes that led to death and ignores the possibility that the death may not have occurred if drugs were not involved (e.g., motor vehicle accident).

**Measures**

County-level predictors were selected based on the social determinants of health and socioecological frameworks. When possible, analyses used measures for the working-age population because drug-related mortality rates are highest in that group, and that age group makes the largest contributions to county economies. Data availability prevented matching age ranges for some variables. Analyses used measures that captured conditions pre-2006 to reduce reverse-causality bias (i.e., possibility that high drug abuse rates created the county-level conditions used as predictors). Sensitivity analyses were conducted using variables that captured more recent county conditions.

The economic environment was measured with indicators for county economic distress, housing distress, and labor market structure. Economic distress included the U.S. Census 2000 percentage aged 25–54 years in poverty, aged 25–54 years unemployed/not in labor force, aged 21–64 years with disability affecting employment, aged ≥25 years with less than 4-year college degree, households with supplemental security income, households with public assistance income, Gini coefficient of income inequality, and aged 18–64 years without health insurance in 2008. Housing distress included the percentage of vacant

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