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Bowling alone, dying together: The role of social capital in mitigating the drug overdose epidemic in the United States

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ABSTRACT

Background: Drug overdose deaths have risen precipitously over the last fifteen years. Substantial geographic variation, beyond a simple rural-urban dichotomy, exists in the concentration of overdose deaths, suggesting the existence of as-yet unidentified environmental variables that predict resilience (or vulnerability) to drug overdoses. Motivated by reports highlighting the role of community fragility in the opioid epidemic, we explore whether social capital attenuates overdose death rates.
Methods: We conducted an ecologic temporal trends study from 1999 to 2014 to investigate the association between mortality due to drug overdose and social capital. Data from multiple sources were compiled at the county-level to produce an analytic dataset comprising overdose mortality, social capital, and a host of potentially confounding variables indicated by the literature (N = 49,664 county-years). Multinomial logistic regression was used to estimate the likelihood that a county falls in low (<4 deaths per 100,000), moderate, or high (>16 deaths per 100,000) categories of annual overdose morality.
Results: We observed a strong and statistically significant inverse association between county-level social capital and age-adjusted mortality due to drug overdose ($p < 0.01$). Compared to the lowest quintile of social capital, counties at the highest quintile were 83% less likely to fall in the "high-overdose" category and 75% less likely to fall in the "moderate-overdose" category.
Conclusion: This study finds large-sample evidence that social capital protects communities against drug overdose. This finding could help guide policymakers in identifying where overdose epidemics are likely to occur and how to ameliorate them.

1. Introduction

A recent editorial noted that the year 2014 marked the "highest number of individuals considered to have opioid addiction since statistics began to be collected in the late 19th century" (Olsen, 2016). More than ten million Americans report non-medical use of prescription opiates and two million non-medical users of opiates meet criteria for substance use disorders (Olsen, 2016). Climbing rates of opiate use and abuse have precipitated increases in morbidity and mortality. Over the last 20 years, drug overdose fatalities have increased throughout the United States (US) for all gender, age, and racial/ethnic subgroups (Rossen et al., 2016). In 2014, almost 50,000 Americans fatally overdosed on drugs; opiates accounted for about 60% of total drug poisonings, the nation's leading cause of accidental death (Rudd et al., 2016). Age-adjusted death rates for all-drug poisonings have doubled in the last fifteen years, from 6.1 per 100,000 in 1999 to 14.7 per 100,000 in 2014 (Rudd et al., 2016).

Epidemiologic evidence suggests that temporal increases in overdose deaths are due to both prescription opioids and, more recently, illicit opioid use, particularly heroin. These trends are interrelated since most people who have initiated heroin use recently report doing so after being prescribed analgesic opiates (Rudd et al., 2016). Furthermore, opioid use and abuse is most pronounced among non-Hispanic (NH) whites, the group with the largest increases in overdose death rates since 1999 (Rossen et al., 2016). The deleterious effects of increased opiate prescriptions have prompted the Centers for Disease Control and Prevention (CDC) to issue new, more stringent guidelines about their use (Dowell et al., 2016). Moreover, policymakers at all levels of government have attempted to deal with the opiate epidemic. Congress has extended funding for states' Prescription Drug Monitoring Programs through 2020 and required Veterans Affair's opiate prescriptions to use state monitoring programs (United States

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Congress, 2016a) and significantly expanded funding for opiate prevention efforts and law enforcement targeting the trafficking of opiates (United States Congress, 2016b). At the state level, almost all states have passed legislation expanding access to Naloxone (Davis and Carr, 2015). Despite these efforts, the crisis shows few signs of abating (Olsen, 2016).

Both scholarly articles (McLean, 2016; Sundquist et al., 2016) and popular press reports (Achenbach and Keating, 2016) often cite the role of community fragility in contributing to the opiate epidemic. A recent New York Times article (Kolata and Cohen, 2016) notes that "the nation is seeing a cohort of whites who are isolated and left out of the economy and society and who have gotten ready access to cheap heroin and to prescription narcotic drugs." Indeed, the spike in opiate overdoses drives the finding that absolute mortality among middle-aged (45–54 years) whites *has increased* since 1999 (Case and Deaton, 2015). Substantial geographic variation, beyond a simple rural-urban dichotomy, exists in the concentration of overdose deaths (Rossen et al., 2013), suggesting the existence of as-yet unidentified environmental variables that predict resilience (or vulnerability) to overdoses.

One potentially protective factor is social capital—the extent and depth of social trust, norms, and networks (Sirianni and Friedland, 2001). The central premise of social capital is that social networks matter (Field, 2008). More concretely, social capital consists of five characteristics: (1) the density of community and personal networks; (2) civic engagement and participation; (3) a sense of belonging in the community; (4) reciprocity and cooperation with fellow citizens; (5) trust in the community (De Silva et al., 2005). Neighborhood associations, religious congregations, and civic organizations are sources of social capital. Research from political scientist Robert Putnam posited that high levels of social capital can predict a variety of social outcomes, such as lower crime levels, higher rates of volunteerism, and longer life expectancy. Drawing on several national surveys of membership and participation in civic organizations over three decades, Putnam argued that levels of social capital have been declining in the US since 1950, a phenomenon he described as "bowling alone" (Putnam 2000).

Scholars have long used social capital to explain variation in health outcomes between communities. State-level measures of social capital have been associated with better self-reported health (Kawachi et al., 1999) and reduced mortality (Kawachi et al., 1997; Weaver and Rivello, 2006). At the county level, social capital has been shown to explain the "rural paradox"—the observation that rural communities experience lower all-cause death rates (Yang et al., 2011) and infant mortality (Yang et al., 2009) than their poorer socioeconomic indicators and health behaviors would predict. Social capital is thought to explain the link between inequality and worsened health (Yamaguchi, 2014), and neighborhood income inequality is associated with fatal drug overdoses in New York City (Galea et al., 2003). In contrast, scholars found no relationship between regional measures of "civicness", a concept similar to social capital, and drug overdoses in Italy after controlling for income; instead, provincial wealth was the primary driver of overdose fatalities, with wealthier provinces experiencing more overdose deaths (Gatti et al., 2007). In this paper, we address a gap in knowledge by leveraging multiple data sources to explore whether social capital moderates drug overdose deaths.

2. Methods

2.1. Study design

We conducted an ecologic temporal trends study from 1999 to 2014 to investigate the association between drug overdose mortality and social capital. Data from multiple sources, primarily federal organizations, were compiled at the county-level to produce an analytic dataset comprising (1.) age-adjusted drug overdose mortality, (2.) social capital, (3.) availability of drug abuse treatment centers, 4.) prescription drug claims prescribed by health care providers, (5.) population demographics, (6.) urbanicity, and (7.) socioeconomic status.

2.2. Data sources and measures

2.2.1. Drug overdose mortality. County-level estimates of overdose (drug poisoning) deaths from 1999 to 2014 were obtained from the CDC's National Vital Statistics System and Health Indicators Warehouse (Rossen et al., 2016). Deaths were classified using the International Classification of Diseases, Tenth Revision (ICD–10) and overdose deaths were defined as an underlying cause-of-death code in the X40–X44 (unintentional poisoning), X60–X64 (intentional/suicidal poisoning), X85 (homicidal poisoning), or Y10–Y14 (poisoning from an undetermined intent) range. Age-adjusted overdose rates (deaths per 100,000 U.S. standard population for 2000) were calculated using the direct method, and small-area estimation techniques (Rossen et al., 2013) were used to calculate stable estimates of county-level death rates each year, particularly for counties in which data are sparse due to small population size. An advantage of employing this data is its comprehensiveness: first, death certificates are issued to more than 99% of all legal residents over the age of one, and second, counties were not excluded due to privacy concerns or statistical instability of infrequent occurrences. The final estimated outcome (smoothed, county-level, age-adjusted overdose mortality rate) was initially captured as an ordinal variable with 11 categories ranging from 0 to 2 overdose fatalities per 100,000 people to >20 deaths per 100,000 (Rossen et al., 2016).

2.2.2. Social capital. County-level measurements of social capital for the years 1997, 2005, and 2009 were obtained from Rupasingha et al. (2006). The social capital index is generated at the county level using the following four factors: (1.) the density of civic associations and non-profit organizations in the county; (2.) the percentage of county adults who voted in presidential elections; (3.) the county's response rate to the census; and (4.) the number of tax-exempt non-profit organizations in the county. Principal components analysis was used to create a single index from these four variables; based on our data we estimated that this single index captures 55% of variation in the four factors in 1997, 49% of the variation in 2005, and 45% in 2009. Our use of direct measures of county-level variables, rather than aggregated individual survey-data, avoids biases resulting from the ecological fallacy (Best and Radcliff, 2005). Values for intermediary years were interpolated from the surrounding years, and values for the years 2010–2014 were extrapolated from the surrounding years using linear forecasting. In panel data, county correlates of the social capital index were found to be consistent across time (Rupasingha et al., 2006).

2.2.3. Sociodemographic characteristics. Median household income and poverty data were obtained for each county-year from the US Census Bureau's Small Area Income and Poverty Estimate (SAIPE). The SAIPE estimates were mostly absent for the years 2005 and 2006, so these values were interpolated from 2004 and 2007 values, respectively. Racial/ethnic characteristics were obtained for each county-year from the US Census Bureau's county characteristics population estimates. The Census Bureau's designation of a county on the Rural-Urban County Continuum (RUCC) provides a nine-level classification scheme representing the degree of urbanization, in which 1 is densest and 9 is least dense. RUCCs are only updated each decennial (2003 and 2013); therefore, for 1999–2006 we used the 2003 county-level measure, and for later years we