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Geographic variation in male suicide rates in the United States

Andrew B. Trgovac [a], Peter J. Kedron [b], Sharmistha Bagchi-Sen [a, *]

[a] State University of New York at Buffalo, United States
[b] Ryerson University, Canada

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ABSTRACT

This study examines geographic variability of factors associated with male suicide in the United States using county-level data covering 2000 to 2006. Three variables are used as indicators of social isolation: separated/divorced marital status, migration status, and unemployment. A geographically weighted regression analysis shows variation from analogous global ordinary least squares and spatial error regression analyses. Separated/divorced marital status demonstrated a global positive influence. Migration and unemployment effects ranged from positive to negative across the United States, showing some geographic clustering. The findings suggest regional variation is masked by global models and the effect of social isolation indicators have on suicide may vary with geographic context. Any detection of at-risk population will require careful evaluation of privacy issues given the sensitive nature of the health topic.

Introduction

Deaths resulting in suicide have been steadily increasing over the past decade in the United States (Hu, Wilcox, Wissow, & Baker, 2008) with male suicide occurring at a rate nearly four times that of women (NCHS, 2010). From 2000 to 2006, suicide ranked as the eleventh leading cause of death in the United States and the eighth leading cause of death among American men (NCHS, 2011a). Examining the suicides of males age 35–64, the Centers for Disease Control identified a 28.4 percent increase in the suicide rate between 1999 and 2010 (CDC, 2013). In 2009 more Americans died from suicide than from motor vehicle accidents, falls, poisoning, or homicide (Rockett et al., 2012). These statistics reaffirm the need to focus resources and investigations on understanding suicide in the United States, in particular, the incidence of male suicide.

The complex etiology of suicide and the difficulty in identifying at-risk populations make the study of suicide a public health challenge (Baca-Garcia et al., 2011; Hawton & van Heeringen, 2009; Knox & Caine, 2005). Within the United States, suicide rates exhibit a non-random geographic distribution with higher rates primarily in western states, which suggests local factors likely influence suicidal behavior. Research highlights the importance of localized effects when examining connections between suicide and unemployment (e.g., mass lay-offs) (Classen & Dunn, 2012), specific ethnic groups (e.g., Hispanic migrants) (Borges et al., 2009; Wadsworth & Kubrin, 2007), or social isolation (e.g., lack of religiosity) (Dervic et al., 2004; Pesosolido & Georgianna, 1989; Rasic, Kisley, & Langille, 2011). However, the majority of these studies examine relationships with suicide risk factors as global effects that are consistent across an area of study. Those investigations that do use spatial methodologies to analyze suicide rates only account for the spatial nature of the suicide data itself, while continuing to assume that associations between risk factors and of suicide are spatially stationary (Baller & Richardson, 2002; Chang et al., 2011; Rezaeian et al., 2005; Rezaeian, Dunn, Leger, & Appleby, 2007a, 2007b). These models may mask differential spatial effects of factors associated with suicide incidence.

Variation in relationships between risk factors and suicide in one region vis-à-vis another needs to be further explored. Identifying localized patterns in those associations is important to community-oriented public health practitioners seeking to develop policy interventions and researchers attempting to understand the antecedents of suicidal behavior. However, privacy restrictions limit the availability of detailed national scale datasets tracking the incidence and antecedents of suicide, which in turn restricts our ability to examine regional variation. Without the detailed national scale personal histories or medical records necessary to establish localized causal connections between risk factors and suicide, an approach exploring regional variation in relationships identified in the literature is a productive way forward. Policy makers and public

* Corresponding author.
E-mail address: geosbs@buffalo.edu (S. Bagchi-Sen).

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health practitioners will be interested in the spatial patterning of suicidal risk factors as they work to identify which intervention strategies and resource deployments are most effective in alternative regional contexts.

Research context

The literature examining risk factors associated with suicide is extensive. Previously examined risks include temporal relationships (Chuanc & Huang, 1997; Kposowa & D'Auria, 2010), the natural environmental (e.g., altitude) (Brenner, Cheng, Clark, & Camargo, 2011; Selek, 2013), economic factors (e.g., foreclosure) (Classen & Dunn, 2012; Fowler, Gladden, Vagi, Barnes, & Frazier, 2014; Suzuki, Kashima, Kawachi, & Subramanian, 2014) and the proximity of health care providers (Wagenaar, Hagaman, Kaiser, McLean, & Kohrt, 2012; Windfuhr & Kapur, 2011). More commonly, a range of socioeconomic and demographic variables come to the forefront of these investigations (Rehkopf & Buka, 2005; Walker, 2009). Educational obtainment (Cutchin & Churchill, 1999; Denney, Rogers, Krueger, & Wadsworth, 2009; Kowalski et al., 1987; Kposowa, 2001; Kposowa & D'Auria, 2010), level of income, and poverty status (Kposowa & D'Auria, 2010; Lester, 1995; South, 1984) all correlate with suicide rate. Demographic variables such as age (Kposowa, 2001; Kposowa & D'Auria, 2010; Lester, 1988; McKeown, Cuffe, & Schulz, 2006), race (Cubbin, LeClere, & Smith, 2000; Denney et al., 2009; Kunce & Anderson, 2002; Wasserman & Stack, 1993), ethnicity (Baca-Garcia et al., 2011; Cubbin et al., 2000; Cutchin & Churchill, 1999; Denney et al., 2009; Hempstead, 2006), place of nativity (Kposowa, Breault, & Singh, 1995; Singh & Siahpush, 2001; Stack, 1980a, 1980b), housing stability (Lester, 1988; 1995; Stack, 1980a, 1980b), household type (Hempstead, 2006; Kowalski, Faupel, & Starr, 1987; Kposowa et al., 1995), and marital status (Breault, 1986; Denney, 2010; Kposowa, 2000; Kunce & Anderson, 2002; Lester, 1988; 1995; Smith, Mercy, & Conn, 1988) have also been utilized in statistical explanatory models.

An overarching theme in many studies of suicide is a focus on social integration and fragmentation (Congdon, 1996; 2004; Kposowa, McElvain, & Breault, 2008; Tsai, Lucas, Sania, Kim, & Kawachi, 2014; Walker, 2009). This research builds on Durkheim's (1952) work, which demonstrated that suicide is an individual act grounded in social relationships and the melding of social integration and social regulation (Bearman, 1991). By implication this view suggests individualistic solutions to problems (e.g, suicide) may occur more frequently when people have weaker connections to society and lack adequate mechanisms of social support. Exploring suicide, Durkheim demonstrated consistency in suicide rates even as individuals entered and exited the risk pool. Building on Durkheim's hypothesis, Congdon (1996, 2004) linked areal indicators of social fragmentation with suicide in the city of London. Examining the city's boroughs, Congdon demonstrates that composite anomie scores generated by combining demographic variables associated with disconnection from society (e.g., non-married adults) are significantly associated with suicide. Focusing on social integration, Dorling and Gunnell (2003) identify three factors linked to social isolation as significantly related to the number of suicides across regions in England. Using a negative binomial regression for suicide date covering a 20-year period beginning in 1980, the authors found statistically significant positive associations between measures of social isolation and suicide within well-fit models.

Following these examples and the wealth of research into determinants associated with suicide, this study uses three measures of social isolation: (i) unemployment, (ii) separated/divorced marital status (SDMS), and (iii) interstate migration to examine regional variations in male suicide. Unlike Dorling and Gunnell, who estimate only a global model for the whole of England, this study's approach explicitly models spatial variation in model parameters.

With the recent rise in suicide rates among middle-aged males in the United States (CDC, 2013), understanding potential linkages between unemployment, the loss of job status, and suicide rates has moved to the forefront of suicide research. Prior studies of suicide use unemployment as an area-level indicator of material deprivation (Congdon, 2011; Middleton et al., 2004). The quantifiable effects of employment loss include a downturn in household finances and the loss of insurance (Classen & Dunn, 2012; Theodossiou, 1998; Vinokur, Price, & Caplan, 1996). For example, Middleton et al. (2004) include unemployment as part of a deprivation index, which they find to be associated with increased risk of suicide. The deprivation caused by unemployment has the potential to create more intangible isolating effects such as the disintegration of a marriage due to the disruption of domestic life (Bowlus & Seitz, 2006; Economou et al., 2013; Tauchen & Witte, 1995; Yamauchi et al., 2013). Further, the psychological shock, lack of self-worth, and perception of detachment from the community may lead to increased isolation (Classen & Dunn, 2012). Long term effects of persistent unemployment may include stagnation in career advancement or a permanent disruption in career path (Chan & Stevens, 2001; Jacobson, LaLonde, & Sullivan, 1993; Ruhm, 1991; Stevens, 1997). The question that remains unanswered is if there is contextual variation in the relationship between unemployment or job status and suicide rates.

A second line of inquiry into social isolation examines the relationship between marital status and suicide (Baller & Richardson, 2002; Gibbs, 2000; Jarvis, Ferrence, Whitehead, & Johnson, 1982; Wasserman & Stack, 1993). Aggregate suicide studies demonstrate that divorced individuals are 38% more likely to commit suicide than their married counterparts (Kposowa & D'Auria, 2010). In longitudinal studies, separated or divorced men were over twice as likely to die from suicide as married men, a relationship that is not found in women (Kposowa, 2000). Denney (2010, p. 204) notes: "… the person loses social ties and contacts through a divorce or spousal death—but also from a reduction in regulatory forces—the person no longer has the barriers and regulations placed on life that come from the marital union." The unanswered question from a geographical perspective is whether the effect of marital status is spatially stable.

A third factor used in analyses of suicide and social integration is residential stability (Schieman, 2005, 2009). Social cohesion is built through long-term communal relationships via kinship and friendship ties. High levels of migration inhibit formation of these relationships and impair maintenance of community integration (Breault & Kposowa, 1987). Transient populations are less effective at establishing and enforcing private behavioral norms. Failure to adequately prohibit suicide through a lack of normative pressure, or through the absence of social support brought on by residential change can lead to a significant relationship between the level of migration in a community and suicide (Breault, 1986).

Geography adds another layer of complexity to the investigation of suicide, and its relationship with levels of social integration. Prior geographic analyses of suicide find that associations between measures of social isolation and fragmentation vary in their sign and significance (Chang et al., 2011; Rehkopf & Buka, 2005). When examined in a geographical context, suicide rates in the United States have a distinct east-west pattern with higher rates generally occurring in the western portion of the country, a pattern that has persisted for well over a century (Lester, 1980, 1997). Prior to the development of more advanced spatial statistics, geographic variables such as longitude (Lester, 1995, 1997; Lester and Shepard,