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Social disparities in health: Disproportionate toxicity proximity in minority communities over a decade

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ABSTRACT

This study employs latent trajectory models measuring the level of toxic waste over a decade in the cities of six highly populated, ethnically diverse, counties in southern California from 1990 to 2000 in 3001 tracts. We find that tracts with 15% more Latinos are exposed to 84.3% more toxic waste than an average tract over this time period and tracts with 15% more Asians are exposed to 33.7% more toxic waste. Conversely, tracts with one standard deviation more residents with at least a bachelor's degree (15.5%) are exposed to 88.8% less toxic waste than an average tract. We also found that these effects were considerably weaker when using the raw pounds of toxic waste rather than the toxicity-weighted measure, suggesting that future research will want to account for the toxicity of the waste.

1. Social disparities in health: disproportionate toxicity proximity to hazardous exposures in minority communities over a decade

Substantial disparities in health status persist among minority populations, and the siting of toxic waste in low income communities with high proportions of minority residents is a significant Public Health problem facing the United States. In the United States, African-Americans, Latinos, American Indians/Alaska Natives, Asians, and Native Hawaiian or other Pacific Islanders bear a disproportionate burden of disease (Centers for Disease Control and Prevention, 2004). There is increasing evidence that minority and low income populations are burdened with a disproportionate share of residential proximity to hazardous substances such as lead, PCBs, wood dust, and air pollutants (Agency for Toxic Substances and Disease Registry, 2006; Centers for Disease Control and Prevention, 2005) as well as toxic waste (Been, 1995; Bolin et al., 2002; Downey, 1998; Hite, 2000; Hockman and Morris, 1998; Krieg, 1995; Mohai and Saha, 2006; Pastor et al., 2001). This puts those living in such communities at risk for exposures that may be related to numerous diseases and disabilities.

The extensive literature studying possible disproportionate proximity among racial and ethnic minority populations to toxic waste largely employs cross-sectional designs and analyses (Anderton et al., 1994; Baden and Coursey, 2002; Been, 1995; Bolin et al., 2002; Downey, 1998; Hite, 2000; Hockman and Morris, 1998; Krieg, 1995; Mohai and Saha, 2006; Pastor et al., 2004; Sadd et al., 1999; Stretesky and Hogan, 1998). Furthermore, this literature focusing on the potential for possible disproportionate proximity to hazardous wastes based on race and socioeconomic status yields mixed findings: whereas several studies suggest a positive relationship between the proportion minority in a neighborhood (i.e., usually measured as tracts, a Census Bureau defined unit of approximately 4000 persons) and the number of toxic waste sites (Been, 1995; Bolin et al., 2002; Downey, 1998; Hite, 2000; Hockman and Morris, 1998; Krieg, 1995; Mohai and Saha, 2006; Pastor et al., 2001), some studies have not detected such a relationship for African-Americans specifically (Anderton et al., 1994; Baden and Coursey, 2002; Sadd et al., 1999; Stretesky and Hogan, 1998) or minorities more generally (Bowen et al., 1995). Likewise, whereas some studies find a negative relationship between a neighborhood's economic resources and the presence of toxic sites (Bolin et al., 2002; Downey, 1998; Hockman and Morris, 1998; Krieg, 1995; Mohai and Saha, 2006), others have failed to find such a relationship (Baden and Coursey, 2002; Boer et al., 1997; Davidson and Anderton, 2000).

Cross-sectional studies have limited ability to ascertain the causes of such proximity to toxic exposures among minority populations given that they only provide a snapshot of the process

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(Northridge et al., 2003). Indeed, there are competing viewpoints as to why minorities' disproportionate proximity to toxic sites is frequently observed in cross-sectional studies. Initiatives at both the federal and community level address the burden of environmental injustice in the low income communities in which minorities reside. Despite these efforts, more research is warranted to understand the differential burden of environmental hazards in minority and low income communities, as well as the *determinants* of these existing environmental inequities (Northridge et al., 2003).

2. Explanations of disproportionate proximity

Although studies are generally limited to cross-sectional data, it is nonetheless the case that numerous theories have arisen to explain disproportionate proximity to toxic waste. One perspective argues that minority members may suffer disproportionate proximity to toxic waste due to their limited neighborhood options (Massey and Denton, 1987; Massey et al., 1994), relegating them to the highest toxicity neighborhoods. Beyond these more limited options, if such individuals (i.e., particularly immigrants with language barriers) are less aware of the health risks posed by such sites in these neighborhoods, they may be less averse to entering such neighborhoods.

A second perspective argues that toxic waste sites are disproportionately placed into neighborhoods that already have a high percentage of minority residents. This may be because such neighborhoods experience potential obstacles to residents' banding together to prevent the placement of such plants in their neighborhoods. One study explored this question explicitly with data from Los Angeles County and indeed found evidence that toxic sites were more likely to be placed in minority neighborhoods with high percentages of minority residents than in non-minority neighborhoods (Pastor et al., 2001).

The notion that some neighborhoods may lack the political willpower to resist such sitings suggests that the social disorganization model from criminology may be insightful for explaining this political tussle leading to toxic waste site placement. This model posits that neighborhoods with more economic resources, residential stability, and ethnic homogeneity have greater ability to collectively combat crime and social disorder when it appears (Sampson and Groves, 1989; Shaw and McKay, 1942). This model naturally extends to the question of toxic waste siting: neighborhoods with more poverty, residential instability and ethnic heterogeneity are likely least able to collectively resist the placement of such sites in their neighborhood, or to pressure owners to reduce the toxic waste emitted from existing plants (Hamilton, 1993; Pastor et al., 2001). Building on these ideas, one study which examined neighborhoods in Los Angeles County found that neighborhoods with more *ethnic churning* (i.e., racial/ethnic transition) were *least* able to collectively resist the placement of such sites in their neighborhood (Pastor et al., 2001). It is possible that such neighborhoods also lack the ability to pressure existing plant operators to reduce the toxic waste emitted from existing plants.

Whereas the social disorganization model posits that neighborhoods with few economic resources will lack the political ability to resist sitings of toxic waste plants, the economic disadvantage perspective argues that those with the fewest economic resources will be *pushed into* the least desirable neighborhoods, which will tend to have the greatest proximity to toxic waste. Although some research has found that tracts with higher levels of income indeed have less proximity to such toxic sites (Bolin et al., 2002; Downey, 1998; Hockman and Morris, 1998; Krieg, 1995; Mohai and Saha, 2006), others have failed to find such a relationship (Baden and Coursey, 2002; Been, 1995; Boer et al., 1997; Davidson and Anderton, 2000). As a consequence, a more nuanced viewpoint argues that the political power of high-income neighborhoods will allow them to resist toxic waste site placement, while the lowest income neighborhoods will also have few toxic waste sites due to their undesirable work force (Boer et al., 1997; Pastor et al., 2001; Sadd et al., 1999). This viewpoint suggests that working-class neighborhoods will have the greatest number of toxic waste sites.

Finally, while studies have focused on whether the economic resources of a neighborhood can help resist such sitings, prior research has rarely considered the possibility that residents' education level has important implications for weighing the risks of living close to a toxic waste site. The motivating insight here is that there is no reason to assume that perceptions of risk regarding toxic waste siting are both similar and high across population groups. Although most residents prefer not to live in a neighborhood with a plant emitting waste products, residents likely do not weight this risk equally. For instance, one study found that minority residents, specifically African-Americans, were less likely than whites to move out of an area once a toxic waste plant had been sited there (Bullard et al., 2007). Hence, it is possible that there are differences in how those in various communities perceive the risks of living close to a hazardous waste site, and that the education level of residents may be a factor amplifying or attenuating risk perceptions of living close to waste sites.

Although it is important to understand the placement of toxic sites and the consequent exposure to toxic waste in a longitudinal framework, most studies utilize cross-sectional data. There are only a few exceptions to the general trend. For instance, by employing a case study of Los Angeles, Pulido (2000) argued that systematic racism operating through residential mobility patterns could explain disproportionate toxic exposure. Likewise, Bolin et al., (2005) described a historical process that gave rise to segregation and environmental injustice in Phoenix, AZ. Such historical case studies provide a theoretical framework suggesting how such change might occur over time, but are limited by their single cases to making more generalizable claims. Likewise, a study providing descriptive information on how census tracts in Houston changed over time moves beyond a static perspective, but the lack of statistical modeling prevents firmer conclusions (Liu, 1997). One study with longitudinal data on toxic sites did not actually estimate longitudinal statistical models, but instead focused on individual cases over time (Been, 1994). One rare study attempting to tease out the causal direction between the placement of toxic sites and the presence of racial/ethnic minorities focused on tracts within the city of Los Angeles over three decades (Pastor et al., 2001). This limited literature suggests an important need for further longitudinal studies.

Our study addresses the following questions: (1) what is the relative proximity to toxic waste sites for minority groups over a 10-year period from 1990 to 2000; (2) do neighborhoods with more highly educated residents experience less proximity to toxic waste sites; and (3) do these effects differ if we take into account the toxicity of the emitted wastes (Ash and Fetter, 2004; Brooks and Sethi, 1997; Neumann et al., 1998; Sicotte and Swanson, 2007). Beyond our longitudinal approach, we assess the impact of toxic sites on neighborhood residents by measuring the pounds of release weighted by a measure of its toxicity, and apportioning this value to a one-mile circle around the site rather than simply attributing it to the census tract in which the site is located (other studies using this approach include Bolin et al., 2002; Mohai and Saha, 2006). This third question is particularly important, as the actual toxicity of the waste is likely more highly correlated with the degree of health risk it poses. The present study focuses on six