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ORIGINAL PAPER

Broken Neighborhoods: A Hierarchical Spatial Analysis of Assault and Disability Concentration in Washington, DC

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Abstract
Objective This study seeks to better understand the relationship between neighborhood disability concentration and police calls for assault with a deadly weapon. Is this relationship the result of neighborhood concentrated disadvantage, or does disability act independently of other ecological characteristics associated with high crime rates?
Methods The authors combine Census and other neighborhoodlevel data from Washington, DC to test a one-level random intercept hierarchical multiple regression model using Census tracts as a grouping variable. Disability concentration is measured by the percent of disabled residents living in a block group. Concentrated disadvantage is a composite measure including percent households below poverty line, percent families on public assistance, percent African American, percent female-headed households with children, and percent unemployed. Assault with a deadly weapon is a rate per 1,000 of police calls for assault in 2005–2006.
Results The effect of disability concentration is partially mediated by other ecological factors, but remains a significant predictor of neighborhood rates of reported assault. Each one-unit increase in percent disabled increased police calls for assault by 0.14 %.
Conclusions The results of the analyses suggest that although concentrated disadvantage does affect the relationship between disability concentration and crime, it exerts an independent effect on neighborhood rates of assault with a deadly weapon.

Keywords Disability · Assault · Concentrated disadvantage · Neighborhood · Ecology

Introduction

Compared to the non-disabled, the disabled are more likely to experience criminal victimization. Harrell (2012) finds that the disabled are over twice as likely to experience

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violent victimization, about three times as likely to be sexually victimized, four times as likely to be robbed, three times as likely to experience aggravated assault, and twice as likely to suffer a simple assault as someone without an impairment. Furthermore, disabled victims most often report that their victimization was caused by their impairment (Grattet and Jenness 2001; McMahon et al. 2004; Marge 2003; Perreault 2009). Considering that the disabled are one of the largest minority groups in America, comprising approximately 19 % of the population, these statistics illustrate a serious problem for a population already experiencing a number of hardships (Brault 2012). Additionally, because medical advances allow more sick and/or injured people to survive than ever before, a greater portion of the population will suffer from a disability at some point in their lives (Guralnik et al. 1996). Despite the consistency of the link between disability and victimization, the mechanisms driving this relationship remain unclear. Is the relationship between crime and disability simply the result of residing in disadvantaged, high crime neighborhoods, or is there something about disability concentration itself that increases the risk of victimization?

The definition of disability often varies according to the context of study. Disabilities scholars employ a social model that separates the physiological impairment from the social disadvantage known as disability (Goodley 2001; Oliver 1992; Brault 2012), while medical researchers generally do not separate the social from the physical effects of disability. For the purposes of this study, disability is defined as a range of conditions that limit daily activities and are associated with multiple forms of social disadvantage. Although this definition more closely resembles the medical conceptualization of impairment, the social impact of disability will play a key role in this study and its findings.

Disability tends to be concentrated in specific locations due to factors such as high rates of poverty among the disabled and a need to live close to medical services (Wolch and Philo 2000; Dear and Wolch 1987). Prior work suggests that elderly disabled men and women are concentrated in neighborhoods characterized by poverty, residential instability, and other indicators of disadvantage (Beard et al. 2009; Pruchno et al. 2012; Freedman et al. 2008). Each of these studies finds a weak association between neighborhood disability concentration and crime, but because these were descriptive studies aimed at depicting the characteristics of neighborhoods with high concentrations of disabled residents, none of them actually tested *how* neighborhood conditions affect the relationship between disability concentration and crime. Because disabled populations are overrepresented in disadvantaged neighborhoods and suffer high rates of victimization, this relationship may simply be the product of neighborhood conditions other than disability concentration.

Prior work suggests two possible hypotheses explaining the relationships among neighborhood conditions, disability concentration, and crime. First, neighborhood conditions could produce both disability concentration and crime. Areas with greater concentrations of disabled residents could experience higher rates of victimization simply because the disabled are more likely to inhabit neighborhoods that have higher crime rates. In this case, the connection between disability concentration and victimization is a spurious byproduct of other ecological factors. Alternatively, neighborhood effects may account for some of this relationship, but disability remains a salient signifier of vulnerability and "defeat" (McMahon et al. 2004). In other words, disability concentration may convey to potential offenders that residents of these neighborhoods lack the collective efficacy, the necessary will, and/or the ability to maintain order and prevent crime. In this case, disability concentration acts much like an indicator of social disorder by projecting a sense that few residents are willing, or able, to fight crime in an already marginalized area. This research tests these two competing hypotheses using Washington, DC as a case study with Census block groups as the unit of analysis.

Literature Review

Neighborhood Effects

In 1942, Shaw and McKay's *Juvenile Delinquency and Urban Areas* introduced the concept of criminal spaces to a field that had traditionally focused on individual-level explanations for criminal behavior. The authors found that despite changes in ethnic minority concentration over time, high levels of delinquency, unemployment, disorder, family disorganization, infant mortality, and mental disorder clustered in specific areas of Chicago. The strong relationship between geography and negative life outcomes suggested that researchers should consider the possibility that neighborhoods themselves may have certain characteristics that increase or decrease criminal activity. Neighborhood effect studies have increased our knowledge of crime by identifying specific conditions that are correlated with high rates of crime and other social problems (Sampson et al. 2002). Key neighborhood traits associated with high crime rates are summarized below, including a history of crime, concentrated disadvantage, low levels of collective efficacy, alcohol concentration, and physical/social disorder.

When it comes to the relationship between neighborhoods and crime, the past is often predictive of the future, as high neighborhood crime rates tend to remain stable over time (Shaw and McKay 1969; Morenoff and Sampson 1997). Crime also tends to cluster in specific places or "types" of places, such as entertainment and low-income areas (Brantingham and Brantingham 1984; Chainey and Ratcliffe 2005; Eck and Weisburd 1995). Because of this spatial relationship between neighborhoods and crime, law enforcement regularly tracks crime within cities using "hotspots" to determine the best way to prevent, police, and contain criminal activity (Ratcliffe 2004). Most hotspots remain stable over time, or at least do not become displaced into adjacent areas when police crackdown on illegal activity (Weisburd et al. 2006; Green 1995; Taniguchi et al. 2009). However, if left unchecked, high crime areas do tend to spread. Hotspots can be divided into hotpoints, specific areas that remain consistent over time, and hotbeds, which spread out into neighboring areas from an origin point (Ratcliffe and McCullagh 1999). Although crime can spread and dissipate over time, spatial crime patterns tend to be highly dependent on local factors, such as offender mobility, risk, and environmental conditions (Short et al. 2010).

Concentrated disadvantage refers to high levels of poverty, percent of families receiving public assistance, unemployment levels, percent female-headed households with children, and percent African American (Morenoff et al. 2001; Sampson et al. 1997). Using exploratory factor analysis, researchers consistently find that these five variables are highly interrelated and load on a single factor. Concentrated disadvantage has been linked to homicide (Morenoff et al. 2001), violent crime (Kelly 2000; Fowles and Merva 1996; Sampson et al. 1997), and crime in general (Peterson et al. 2000; Sampson 2001; Miethe and Meier 1994). It has also been linked to individual outcomes such as lower levels of IQ, and higher rates of teen births, dropping out of school, infant mortality, accidental injury, suicide, and child maltreatment (Brooks-Gunn et al. 1993, 1997a, b; Almgren et al. 1998; Sampson 2001). From a theoretical standpoint, concentrated disadvantage increases crime by segregating the most disadvantaged members of society in deteriorated ecological conditions.

Collective efficacy, which is defined as "social cohesion among neighbors combined with [a] willingness to intervene on behalf of the common good" (Sampson et al. 1997: 918), is a neighborhood-level mechanism that controls crime. High levels of collective

efficacy have been shown to decrease robbery, assault, burglary, delinquency, and homicide (Bellair 1997; Sampson et al. 1997; Morenoff et al. 2001; Markowitz et al. 2001; Sampson and Raudenbush 1999). Several neighborhood characteristics appear to decrease collective efficacy. Collective efficacy is influenced by residential instability, which prevents residents from forming tight bonds and decreases familiarity with individuals in the area (Miethe and Meier 1994). Concentrated disadvantage also decreases collective efficacy and neighborhood level social control, intensifying the effects of inequality (Costa and Kahn 2003; Alesina and La Ferrara 2000). The effects of collective efficacy on neighborhood crime rates are rooted in perceptions of fellow residents as either potential offenders or enforcers of social order. The appearance of neighborhoods can promote the idea that residents are resistant to crime, or that they admit defeat (Whitley 2011).

Rates of alcohol consumption affect crime at both the individual and neighborhood level. At the individual level, alcohol lowers inhibitions (increasing the likelihood that a motivated offender will act on his/her impulses) and decreases target guardianship. In many assault cases, the victim and/or the offender is under the influence of alcohol (Gidycz et al. 1995; Norris 1994; Champion et al. 2004). At the neighborhood level, the effects of concentrated disadvantage on crime are partially mediated by the presence of bars in low-income neighborhoods (Peterson et al. 2000). Alcohol distribution sites often form the center of criminal hotspots by concentrating lower levels of guardianship and increased opportunities to offend (Sherman et al. 1989; Block and Block 1995; Roman et al. 2008). Areas containing high concentrations of both onsite and offsite alcohol distributors are at increased risk for violent crime. Scribner et al. (1995) find that in Los Angeles County, the addition of each new liquor store produced an increase in assault rates in that area by 3.4. Additionally, alcohol concentration is highest in disadvantaged neighborhoods, particularly African American neighborhoods (Romley et al. 2007). Alcohol concentration can also increase the risk of crime by acting as an indicator of social disorder that adds to the perception that an area is vulnerable.

According to broken windows theory, observable signs of disorder increase crime in neighborhoods by communicating to potential offenders that residents have seceded control over the area to criminals. Physical disorder, including graffiti, litter, abandoned cars, and empty houses provide visible signs that no one is looking after public spaces (Kelling and Coles 1996; Sampson and Raudenbush 2004; Wilson and Kelling 1982). Neighborhood residents can also broadcast disorder by tolerating open-air drug markets, prostitution, intoxication, loitering, and other forms of social disorder. Disorder is also affected by collective efficacy, which mediates the relationship between broken windows and crime (Sampson and Raudenbush 1999; Markowitz et al. 2001). Although disorder (or just the perception of disorder) can increase anxiety and crime (Cutrona et al. 2000), the effects of broken windows are strongest in disadvantaged neighborhoods (Sampson and Raudenbush 2004).

As outlined above, neighborhood traits affect crime at both the individual and ecological level. Segregating low-income individuals in run-down communities intensifies disadvantage for a population already experiencing demoralization and lives at the margins of society. These conditions do little to raise the cost of offending, because people living in these neighborhoods experience high levels of strain and already have little to lose. Concentrated disadvantage also carries with it a social control dimension, as disorder limits the ability of residents to come together and fight crime. Abandoned buildings, open air drug markets, a high concentration of alcohol distributors, and litter clearly communicate vulnerability and a lack of social control, thereby encouraging crime. While research clearly states that neighborhood effects matter, little is known about how concentrated disadvantage affects the relationship between disability concentration and crime.

Disability Concentration and Crime

Disability is correlated with several measures of disadvantage. Compared to the non-disabled, the disabled have lower levels of education and higher levels of unemployment (Brault 2008; Seff et al. 1992; Charles and Stephens 2004). Because of these deficits, the disabled are more likely to live in poverty (Thompson-Hoffman and Storck 1991; Neufeldt 1991). Over half of all severely disabled Americans age 25–64 receive some form of government assistance and 28 % have individual monthly incomes of less than $500 (Brault 2008). Conversely, only 7.3 % of non-disabled men and women receive public assistance, while 17.1 % earn less than $500 a month. Furthermore, 27.3 % of the severely disabled live below the poverty line compared with 9.1 % of the non-disabled. Both low levels of education (less than a high school diploma) and being unemployed are associated with higher rates of overall violent crime, robbery, and assault (Miethe and Meier 1994). Low socioeconomic status at the individual level predicts high levels of experiencing assault, but this relationship is mediated by neighborhood conditions (Miethe and Meier 1994). Individual characteristics associated with disability are important to consider because disabled populations tend to be concentrated in low-income areas. Msall et al. (2007) find that in Rhode Island, a higher proportion of disabled youth live in disadvantaged neighborhoods than in affluent communities. Massey (1980) states that in New Jersey, many of the most needy, elderly disabled are segregated into decaying inner city areas characterized by older, low-rent, high density housing. In New York, neighborhoods with a high proportion of elderly disabled residents have low socioeconomic status, high residential instability, low percent foreign born populations, a high percent of African Americans, and high levels of physical disorder (Beard et al. 2009).

Several explanations have been offered for why disabled populations tend to cluster in disadvantaged parts of cities. First, because impairment is associated with low education and income, the disabled have fewer housing options (Wolch and Philo 2000). Dear and Wolch (1987) refer to this inability to find quality housing as the "ghettoization" of disability. Second, life history accounts suggest that some disabled individuals engage in self-segregation as "a conscious strategy to manage an ableist society" (Solis 2006: 148). In this case, cumulative disadvantage could set in, as the choice to live near other disabled residents means electing to move into poorer neighborhoods. Third, disability concentration could be associated with proximity to care. For individuals that require frequent medical or psychological treatment, this restricts their housing options to neighborhoods near medical facilities (Wolch and Philo 2000; Metraux et al. 2007). This explanation accounts for group homes and populations that require full-time assistance, but does not explain why group quarters and care facilities would be located in disadvantaged areas. Fourth, poverty and disadvantage could actually have a causal effect on disability. Physical and mental health tend to be lower in disadvantaged neighborhoods, and individuals from lower class neighborhoods develop/sustain impairments at higher rates than the affluent (Msall et al. 2007; Kawachi 2003; Morgan et al. 2008; Wilkinson and Picket 2009; Whitley and McKenzie 2005; Marmot 2001). Accordingly, the relationship between disability and crime would then be the product of neighborhood conditions, because both outcomes are generated by inequality. All of these are plausible explanations for disabled concentration, but no one model has been fully validated.

While there is ample evidence that concentrated disadvantage directly increases crime, and that the disabled are clustered in low-income areas, impairment can also affect victimization through contextual mechanisms associated with neighborhood ecology. First, there is a strong relationship between disability and alcohol use (Heinemann et al. 1989;

Turner et al. 2006; Jones and Lollar 2008). This could confound the relationship between concentrated disadvantage and disability, since alcohol distribution sites tend to cluster in low-income areas. Second, the disabled are often divorced or never married (Thompson-Hoffman and Storck 1991; Booth and Johnson 1994; Goldman 1993), reducing their access to social capital and thereby increasing isolation and the risk of crime (Miethe and Meier 1994; Krotoski et al. 1996). If a significant proportion of community residents are isolated and cut off from meaningful contact with others in their neighborhood, then this affects collective efficacy by decreasing the likelihood that a neighborhood will be able to come together to fight crime and physical disorder. Whitley (2011) refers to this as social defeat.

Current Study

Past research demonstrates a strong correlation between disability and criminal victimization (Harrell 2012; Perreault 2009; Agnew and Powell 2004; Temkin 1994), but rarely have neighborhood conditions been taken into account when examining this relationship. Beard et al. (2009) find that higher neighborhood crime predicts a concentration of physical disability amongst the elderly in New York, but this effect disappears when misdemeanors are omitted. Using confirmatory factor analysis and structural equation modeling, Pruchno et al. (2012) find that violence is associated with elderly disabled neighborhoods in New Jersey, but crime is not an endogenous variable in this analysis. Freedman et al. (2008) find that crime does not adequately predict disability concentration for both men and women. While informative, the above research suffers from two weaknesses. First, researchers often only examine elderly disabled populations. This could affect the relationship between disability and crime because the disabled elderly could be long-term residents of neighborhoods who acquire impairment with age, and have very different risks of victimization than disabled young adults. Second, research typically seeks to explain the characteristics of disabled neighborhoods or predict disability using neighborhood effects. Consequently, we know very little about how disability concentration predicts crime.

Researchers have not explicitly tested how neighborhood conditions affect the relationship between disability and crime. However, one possible hypothesis would state that this relationship is a function of concentrated disadvantage, and that neighborhood conditions will completely mediate the effect of disability concentration on crime. Alternatively, disability could have an effect on crime independent of neighborhood conditions due to social beliefs about how disability broadcasts vulnerability (Allen 2005).

McMahon et al. (2004) state that vulnerability is composed of situational characteristics (poverty, unemployment, and other neighborhood characteristics), personal features (skills, speech, and behavior of the target) and societal factors (the resources a group has at their disposal, as well as beliefs about, and actions towards, a particular group). The disabled are often the targets of both violent and property crimes because of their impairment (Grattet and Jenness 2001; McMahon et al. 2004; Marge 2003; Perreault 2009). Offenders act on recognizable signifiers of vulnerability, increasing the risk of victimization for disabled individuals who broadcast their impairment through the use of a cane, crutch, or other prosthesis (Bones 2013). In fact, one out of every five disabled victims cites their impairment as the primary reason for their victimization (Rand and Harrell 2009). Disabled populations are also less likely than the non-disabled to report victimization to the police (Harrell 2012; Rand and Harrell 2009; Perreault 2009) because they do not believe that the criminal justice system cares about impaired victims (Grattet and Jenness 2001; Tyiska 2001; Marge 2003). It has even been suggested that the disabled are frequently targeted by

offenders because they know the criminal justice system is not interested in protecting this highly marginalized population (Neufeldt 1991).

Disabilities researchers have long recognized that disability has a very strong social component, and that people treat the disabled according to the low status that society assigns to them (Oliver 1992; Finkelstein 2001; Goodley 2001). Under this framework, the relationship between neighborhood levels of disability and crime may be partially mediated by neighborhood conditions, but disability still affects crime because it is a recognizable signifier of disadvantage and marginalization. Accordingly, disability concentration would act as a sign of disorder, similar to abandoned buildings and open air drug markets, which denote that a whole neighborhood is susceptible to crime.

Methods

The data used to test these hypotheses came from two sources. First, we used data collected for the "Alcohol Availability, Type of Alcohol Establishment, Distribution Policies, and Their Relationship to Crime and Disorder in the District of Columbia, 2000–2006" study, collected by Caterina Gouvis Roman and associates. This data set was created to investigate the spatial relationships among alcohol, neighborhoods, and crime in Washington, DC at the Census block group level of analysis. Block groups are the smallest geographic units included in Census data. Each block groups contains between 600 and 3,000 people and is typically defined by Census participants (U.S. Census Bureau 2001). The DC data also contained information on Census tracts, which we used as a cluster variable for regression. Second, we used Census 2000 data on disability concentration at the block group level. Merging these two sources resulted in a data set containing information on 428 of DC's 433 block groups (the first data set omitted the National Mall and Bolling Air Force Base, and there were three additional block groups that did not contain Census 2000 disability data and were therefore omitted from analysis).

The District of Columbia served as an appropriate setting for a case study for several reasons. First, DC had a higher concentration of disabled individuals than 75 % of US states, as well as the highest violent crime rate in the United States in 2000 (Waldrop and Stern 2003; Uniform Crime Reporting System 2013). This made DC an ideal case, where both the focal independent and dependent variables were high, allowing for a good baseline relationship to be established. Second, DC had the highest proportion of African Americans in the US (McKinnon 2001). A high proportion of African Americans has been shown to increase the effect of concentrated disadvantage on crime (Sampson and Raudenbush 2004; Morenoff et al. 2001), meaning that if disability concentration is able to maintain a significant independent effect on assault in this environment, then it should perform well in other contexts. Third, DC has sixteen hospitals (including the National Rehabilitation Hospital, Walter Reed Army Medical Center, and Washington, DC Veterans Affairs Medical Center), which increases the concentration of disability in specific tracts and block groups.

Measures

Descriptive data for all variables in analysis can be found in Table 1. All descriptives in the table are for unlogged variables in order to provide a more intuitive interpretation, although several variables are logged in analysis.

Table 1 Descriptive statistics for all variables in analysis ($N = 428$)

Variable (range)	Range	Mean	SD
Crime			
ADW 2005–2006 per 1,000	0 to 113.21	6.68	9.69
Disability			
Percent disabled	0 to 97.58	20.88	10.80
Concentrated disadvantage			
Concentrated disadvantage Index[a]	−1.15 to 3.03	−0.004	0.80
Neighborhood			
Population per square mile	201.6 to 80,480	15,737.04	11,196.68
Percent of commercial/retail parcels	0 to 0.62	0.04	0.06
Average calls for physical disorder 2002–2003 per square mile	1 to 668	164.54	105.43
Proportion male	34.65 to 85.77	47.12	5.15
Offsite alcohol distributers per square mile	0 to 200	14.91	23.14
Onsite alcohol distributers per square mile	0 to 650	23.62	67.31
Percent age 18–26	0.03 to 0.97	0.20	0.13
Number of vacant properties in block	0 to 207	23.92	30.84
Presence of public housing—yes	0 to 1	0.04	0.28
Residential instability	−2.32 to 1.93	0.007	0.86
Assault 2000–2001 per 1,000	202.25	7.70	12.40

[a] Concentrated disadvantage includes: % households below poverty line, % families on public assistance, % African American, % female headed households w/children, % unemployed

Assault

The *annual assault with a deadly weapon rate* (*ADW*) was derived from the yearly mean number of police calls for assault with a deadly weapon in 2005–2006. This variable was divided by the 2004 (the closest year available in the data set) population and multiplied by 1,000 to account for disparities in the size of Census block groups, and then logged to decrease its skew and kurtosis. ADW was the most severe form of crime included in the DC data set, and served as a measure of serious victimization. Prior studies have only observed a weak link between minor crime and disability concentration. Proof that a relatively rare but serious violent crime such as ADW is associated with disability would demonstrate the disadvantages associated with concentrated disability.

Disability

We used a simple Census 2000 measure of *percent disabled* living in a block group. This was derived from dividing the total number of residents with a disability living in an area by the total population of the block group, and logging it. *Percent disabled* includes non-institutional civilians that have a sensory, physical, mental, self-care, and/or go outside the home impairment.

Concentrated Disadvantage

Concentrated disadvantage was a composite measure that included percent of households living in poverty, percent of families on public assistance, percent of residents that are

African American, percent of households headed by a woman with children, and percent of population that is unemployed. These variables were transformed into z-scores and summed into an index in the original DC data set.

Neighborhood

We included twelve variables in order to control for other neighborhood effects on crime. *Population per square mile* controlled for the effect of crowding and increasing opportunity to offend. *Percent commercial/retail parcels* was included to account for the effect of commercial enterprise in bringing together motivated offenders and potential victims of crime. This variable was logged to improve its skew and kurtosis. *Physical Disorder* measured the number of calls for each block group complaining of abandoned vehicles, graffiti, illegal dumping, and streetlight repair. *Proportion Male* accounted for the concentration of males, who are generally more likely to commit crime than women (Steffensmeier and Allan 1996). The number of *offsite* and *onsite alcohol* distributors per square miles was included in the analysis to control for the opportunity structures surrounding drinking. Offsite alcohol distributers included liquor stores and any other venue that sells alcohol for consumption outside of the premises. Onsite distributors included nightclubs, bars, taverns, and restaurants that serve alcohol. Both of these measures were logged. *Percent age 18–26* was included to control for having a high percentage of young adults who may be predisposed to commit crime. This variable was also logged. *Number of vacant properties* provided a measure of disinvestment in the community, which can increase crime, and was logged. *Presence of public housing* was a dummy variable where block groups with public housing were coded as 1. *Residential instability* measured the percent of residents living in the same house since 1995 and the percent of homeowners. These two variables were reverse-coded to reflect a lack of residential stability, transformed into z-scores, and indexed in the DC data set. Finally, we included a measure of the *assault rate in* 2000–2001 in order to account for a selection effect presented by high crime neighborhoods. As with ADW, this variable was transformed into a rate per 1,000 and logged.

Analysis

Neighborhood composition and other ecological features are often non-random, in that geographic areas tend to be similar to their surroundings. This introduces autocorrelation that can bias standard OLS regression results. We began our analysis by testing to determine if there was significant geographic clustering of our focal independent variable (percent disabled) and our dependent variable (ADW). To do this, we computed Anselin's Local Indicators of Spatial Autocorrelation (LISA) using GeoDa. LISA uses spatial distance weights to provide measures of the extent to which a geographic unit is affected by its neighbors' scores on a particular variable, as well as if these clusters are significantly different from what would be expected if the variable was randomly distributed (Anselin 1995, 2005).

Figure 1 contains the significant clusters for percent disabled generated by LISA analysis. As the figure illustrates, there was a relatively high degree of spatial autocorrelation. There is very little disability concentration in north DC (areas marked "Low–Low"), while there are several clusters of disability in the southern regions of the area (marked "High–High"). The areas identified as "Low–High" and "High–Low" are regarded as outliers because they are bordered by block groups that are dissimilar to them. Figure 2 contains the significant clusters for ADW, and looks very similar to Fig. 1. Here we have a large area with an almost

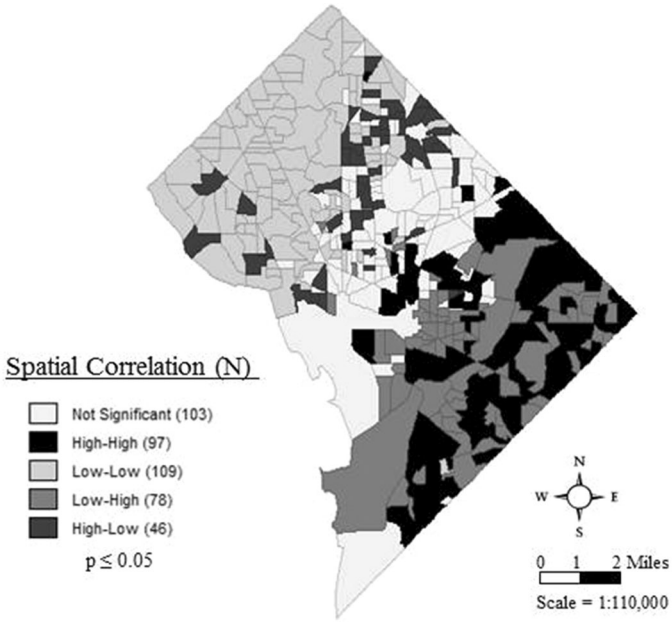

Fig. 1 LISA cluster map for significant block group clusters of disability in Washington, DC. *Source*: US Census Bureau, 2000

total lack of ADW in the north and large contiguous areas in the south. Furthermore, when we compare the two maps, we see that the areas of low disability concentration correspond to the block groups with low ADW, and the areas of highly concentrated disability also have high rates of ADW. All of the significant areas in both figures were computed at the $p \leq 0.05$ level, but it should be noted that since LISA computes all scores simultaneously, it can run into the problem of multiple comparisons, meaning it can falsely reject the null hypothesis (Anselin 2005). Additionally, LISA requires non-zero numbers to compute raw rates, which were used to compute disability concentration in GeoDa. To address this, we substituted 1 for the missing total population in three block groups. Although this biases our LISA analysis, we felt this was acceptable given that this was an initial, exploratory step. Missing data were omitted from all other statistical analyses.

Overall, the results of LISA suggested that we needed to address spatial autocorrelation in our analyses due to a systematic relationship between disability concentration, assault, and space. To account for this autocorrelation, we decided to use hierarchical multiple regression (HMR).[1] HMR is similar to both hierarchical linear modeling and traditional OLS stepwise regression. The Census Bureau divides all geographic areas into block groups, which was used as a cluster variable to account for the spatial nature of both disability and assault. HMR also has an ANOVA element that allowed us to determine the extent to which the variance in our model was determined by larger geographic processes. The primary difference between a standard hierarchical model and HMR is the nature of

[1] Our first approach was first order spatial autoregressive modeling with first order autoregressive disturbances. Although this seemed like the ideal approach to address our research questions, this technique does not provide the best measure of how larger geographic units contribute to what goes on at the local level. Additionally, our final model controlled for all spatial error, leaving only a weak (1 %) spatial lag effect.

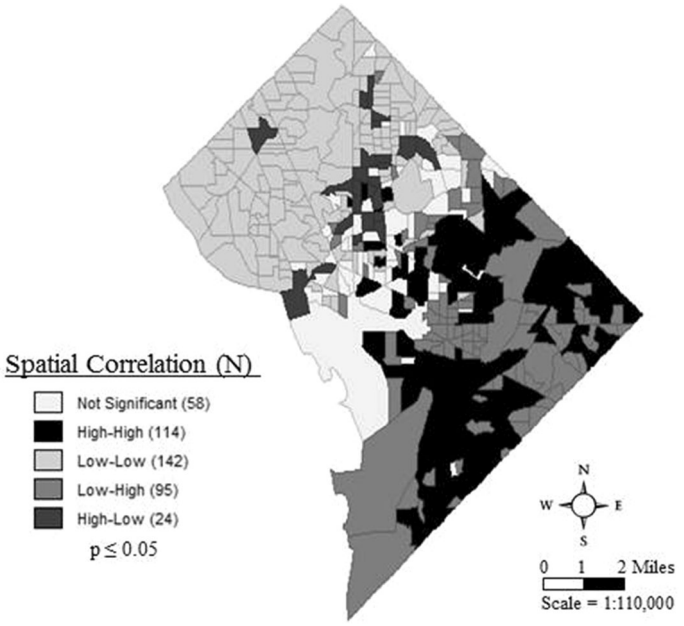

Fig. 2 LISA cluster map for significant block group clusters of average calls for assault with a deadly weapon in Washington, DC. *Source*: Washington, DC Metropolitan Police, 2005–2006

the nesting in the model. In traditional hierarchical models, smaller geographic units are nested in larger units (for example, Census block groups comprise Census tracts). Instead, HMR involves using theory to delineate a series of models nested in the "true" model, while fit statistics provide evidence that improvements to the intercept model are meaningful (Petrocelli 2003). We used Akaike information criterion (AIC) and Bayesian information criterion (BIC) to determine if the addition of variables improved the fit of the overall model and supported our hypotheses.

We conducted several diagnostic tests to ensure that our model met the assumptions of Ordinary Least Squares regression. When a Census tract variable was entered into the equation to partially account for the spatial nature of our data, a Breusch–Pagan test for heteroskedasticity showed that there was constant error variance ($\chi^2 = 0.21$, $p = 0.65$). There was no perfect multicollinearity (mean VIF = 2.15), but *concentrated disadvantage* did have a VIF of 4.14. This was not surprising, however, considering how closely related it is to virtually all predictors of neighborhood crime. We checked studentized residuals and Cook's D for significant influential outliers, and found none.

Results

Table 2 contains the results of HMR on Metropolitan Police calls for ADW. We began our analysis with an unconstrained model, which just contained ADW and our cluster variable (Census tract), in order to determine how much of the total variance in ADW occurs at the tract level. The inter-class correlation (ICC) was 0.73, indicating that 73 % of the variance in ADW occurs at the tract level. In Model 2, we added disability concentration, which had a significant positive effect on ADW. Since both the dependent and independent variable

Table 2 Hierarchical multiple regression for logged annual assault rate 2005–2006 ($N = 428$)

Model Variable	1 *B* (*SE*)	2 *B* (*SE*)	3 *B* (*SE*)	4 *B* (*SE*)
Intercept	1.69*** (0.07)	0.76*** (0.23)	1.31*** (0.23)	−0.31 (0.29)
Percent disabled (logged)		0.31*** (0.07)	0.12 (0.07)	0.14* (0.05)
Concentrated disadvantage			0.53*** (0.06)	0.16** (0.05)
Population per square mile				−0.00 (0.00)
Percent commercial (logged)				2.35*** (0.59)
Physical disorder 2002–2003				0.00* (0.00)
Proportion male				0.01** (0.01)
Offsite alcohol (logged)				0.02 (0.02)
Onsite alcohol (logged)				−0.03 (0.02)
Percent age 18–26 (logged)				−0.88* (0.36)
Vacant properties (logged)				−0.05 (0.03)
Public housing—yes				0.01 (0.09)
Residential instability				−0.04 (0.04)
Assault rate 2000–2001 (logged)				0.62*** (0.04)
Level 2 variance	0.68	0.54	0.29	0.02
Level 1 variance	0.24	0.25	0.26	0.18
χ^2	204.88***	140.56***	58.01***	4.29*
ICC	0.73	0.69	0.52	0.11
AIC	960.85	950.43	884.19	628.90
BIC	973.026	966.66	904.48	693.85

*** $p \leq 0.001$; ** $p \leq 0.01$; * $p \leq 0.05$

were logged, the coefficient is interpreted as a percent increase in the independent variable associated with a one percent increase in the independent variable. For a one percent increase in logged disability, logged ADW increased by 0.31 % ($p \leq 0.001$). In this model, 69 % of the variance occurred at the Census tract level. When concentrated disadvantage was introduced in Model 3, disability concentration was no longer significant. Since concentrated disadvantage was not logged, the coefficient is multiplied by 100 and then treated as a percent, so for each one-percent increase in concentrated disadvantage, ADW increased by 53 % ($p \leq 0.001$). The Level 2 (between Census tracts) variance component decreased in this model, while the Level 1 (within Census tracts) component increased, with a little over half of the overall variance in the model occurring at Level 2. Although

the results of Model 3 suggest that concentrated disadvantage fully mediates the effects of disability concentration on ADW, we know that there are many different neighborhood factors that can affect this relationship and are needed to explain the geographic distribution of crime. Model 4 adds these additional neighborhood traits.

Inclusion of other neighborhood characteristics in Model 4 increased the magnitude of the coefficient for percent disabled and returned it to statistical significance (although it was still less than half the size that it was in Model 2). A one-unit increase in logged percent disabled increased logged ADW by 0.14 % ($p \leq 0.05$). The coefficient for concentrated disadvantage decreased greatly in Model 4 and weakened in significance ($B = 0.16$, $p \leq 0.01$). This indicates that the effect of concentrated disadvantage is largely a product of other neighborhood characteristics. A one percent increase in logged commercial/retail parcels increased logged ADW by 2.35 % ($p \leq 0.001$). This indicates that land use plays a major role in assault and disorder. Commercial and retail lands offer a space in which offenders and targets can come together, thereby increasing the opportunity to offend. A one-unit increase in physical disorder increased logged ADW by 0.001 % ($p \leq 0.05$). Physical disorder increases assault by signifying that a particular neighborhood is not capable of maintaining order, thereby decreasing the perceived cost of offending. A one percent increase in the proportion of males in a block increased logged assault by 1 % ($p \leq 0.01$). This is expected since men are more likely to be perpetrators and victims of all crimes, particularly violent crimes like ADW (Steffensmeier and Allan 1996). A one percent increase in logged percent of the population age 18–26 decreased ADW by 0.88 % ($p \leq 0.05$). This is surprising, since one would expect young adults to present more opportunities for victimization than younger or older populations. Finally, a one percent increase in the logged assault rate in 2000–2001 increased ADW by 0.62 % ($p \leq 0.001$).

In Model 4, we saw a decrease in both variance components, as well as their significance. The between tract component decreased from 0.66 in Model 1 to 0.02 in Model 4. Substantively, this means that the final model accounts for virtually all of the geographic clustering that was present in the unconstrained model, and that we observed in the LISA map of ADW. Comparing the AIC and BIC values across models, we see that Model 4 had the least information lost compared to the "true" model that generated the data. Model 4 provides support for our second hypothesis, that concentrated disadvantage partially mediates the relationship between disability concentration and crime.

Figure 3 provides further evidence of the relationship between disability concentration and ADW. Using predicted values from the final regression equation, we generated a bar chart

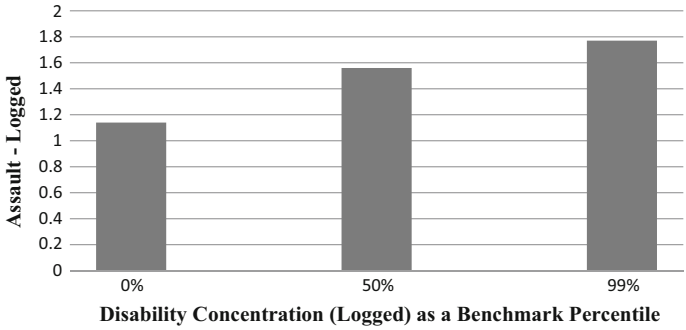

Fig. 3 Predicted values of assault for three disability percentiles

that displays the predicted ADW associated with 0, 50, and 99 % disability concentration percentiles based on descriptive statistics for this variable. Because we logged both percent disabled and average assaults per year, this affects the scale of these variables, resulting in a more narrow distribution. The range for logged percent disabled is 0–4.95 with a mean of 2.96 and a standard deviation of 0.23. The range for ADW is 0–4.74 with a mean of 1.62 and a standard deviation of 0.93. As you can see, when all other variables are held equal and the scale of the variables is kept in mind, disability has a strong effect on average assaults, and blocks with no disabled individuals have much less crime than those who fall in the 50th or 99th percentiles. We believe this demonstrates that disability concentration increases ADW by acting as a sign of social disorder; that the disabled are assumed to be defeated and vulnerable targets because of social beliefs about disability and disabled individuals.

Conclusion

Disabled populations have often been referred to as crippled and thought of as defeated, but it is society that defines disability in opposition to capability. As our analyses showed, disability concentration maintains a significant, although partially mediated, positive effect on ADW; which answers our research question about the relationships among disability, neighborhood conditions, and assault. However, there are two possible explanations for our findings. The first explanation is that areas of high disability concentration increase ADW because as the number of disabled persons increases, so do the opportunities to offend against a population that is seen as an attractive target. This explanation makes intuitive sense, as there is such a strong individual-level relationship between impairment and vulnerability. The second option is that disability concentration acts as a marker of social disorder, signifying disinvestment in a community and that a neighborhood is vulnerable to crime. Both of these are excellent explanations for why disability concentration predicts high rates of ADW, net of other neighborhood correlates of crime, but because of the nature of the data, we cannot speak to who exactly is being victimized in these neighborhoods. Although it is likely that the disabled, who are more likely to be victimized at the individual and group level, are in fact the ones driving this block group-level relationship, we risk committing the ecological fallacy by making this assumption. Based on the available data, we must contain our conclusions to the neighborhood-level, which means we must conclude that there is something about disabled neighborhoods themselves that affects ADW rates. In light of this constraint, the best way to make sense of our findings is to refer to broken windows theory. As with prostitution, open air drug markets, loitering, and drunkenness, disability concentration at the neighborhood-level broadcasts an inability to combat assault.

This study offers several avenues for future research. One fact that stands out from the maps introduced earlier, is that while there were several clusters of high rate disability concentration and ADW, it may be more noteworthy that almost all of north DC had low levels of both disability and ADW. Perhaps instead of framing this relationship in terms of disability predicting assault we should consider how the lack of disability predicts the lack of assault. In other words, we should conceptualize this relationship as a product of concentrated *advantage* instead of disadvantage. To this end, future studies should examine positive neighborhood characteristics and how they affect ADW. Additionally, because neighborhood conditions are associated with ADW, and because disability tends to be framed as an individual trouble instead of a social problem, researchers should pursue

multi-level modeling to test how the relationship between disability and ADW at the individual level is affected by neighborhood conditions. It could be the case that individual impairment exerts an effect independent of disability concentration and neighborhood disadvantage. This would go a long way towards reconciling the two possible causes of the strong correlation between disability concentration and ADW mentioned at the outset of this section. It may be the case that disability concentration results in higher rates of victimization for both the disabled and the non-disabled because of increased opportunity *and* social disorder. Another possible avenue for future research is to explicitly test the explanation we have endorsed: that disability acts as a form of social disorder that is associated with concentrated disadvantage. This can be accomplished through confirmatory factor analysis to determine how well it loads on a common factor of either social disorder or concentrated disadvantage.

This study has several limitations. First, this is a case study based on a location that has a unique history and high levels of crime, disability, and African American residents. This limits the generalizability of our findings because what is true in DC may not apply in other metropolitan areas, much less suburban or rural areas. Second, we used police reports as a measure of ADW even though many assaults go unreported. This is especially true for the disabled, who have a very low rate of reporting victimization (Harrell 2012; Rand and Harrell 2009; Perreault 2009). However, a more conservative estimate of crime actually strengthens our claim since disability had a persistent effect on ADW even under these restricted conditions. This suggests that it may have an even stronger effect when all assaults are considered. Third, neither the Census nor police departments collect data on collective efficacy, in large part because this is a difficult mechanism to operationalize. Perhaps including prosocial institution concentration and educational achievement could clarify the relationships among disability, neighborhood conditions, and ADW. Fourth, as previously acknowledged, aggregate data prevent us from determining exactly who is perpetrating assault and who is being victimized. Inclusion of individual-level variables would help clarify the role of disability and disability concentration in offending and victimization. Finally, this study took place when DC was undergoing rapid change, and the time-lagged nature of dependent and independent variables could have been affected by this. Neighborhoods change over time, however, and homeostasis is rare in the real world. In this sense, the potential bias introduced by social change in this study replicates what actually happened in this area and could happen in others.

Despite these limitations, this study contributes to our understanding of the relationships among disability, neighborhood conditions, and assault. Previous studies attempted to determine the characteristics of disabled neighborhoods, not the effect of disability and ecology on crime. Additionally, these studies relied on elderly populations instead of describing how disability affects persons of all ages. By showing that disability carries with it a social component that extends beyond neighborhood disadvantage, hopefully we can begin to assess how we, as a society, view the disabled. When disability is defined as a liability, carrying with it perceived lack of guardianship, this further disadvantages a population that already contends with marginalization every day. We need to not just invest in the care of the disabled and prevent further victimization, but to challenge prominent social beliefs about one of America's largest minority groups. This needs to begin with mainstreaming in early childhood to show grade school children that impairment is not a signifier of vulnerability or difference, but an emblem of resilience. Until we begin to challenge how society perceives disability, the general public will regard the disabled as well-suited for victimization. This means that even individuals who are not disabled, but live in high disability concentrated areas, can be at increased risk for assault with a deadly weapon, and likely other crimes.

Although impairment can be considered a biological phenomenon, disability is primarily a social category, one that is associated with numerous hardships, including an increased risk of assault that extends beyond traditional measures of neighborhood disadvantage.

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