Child Abuse & Neglect 84 (2018) 170–181

Contents lists available at ScienceDirect

Child Abuse & Neglect

journal homepage: www.elsevier.com/locate/chiabuneg

Understanding trends in neighborhood child maltreatment rates: A three-wave panel study 1990–2010

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ARTICLE INFO

Keywords:
Maltreatment
Panel study
Neighborhood

ABSTRACT

This study examines how changes in the social and economic structure of neighborhoods relate to changes in child maltreatment report rates over an extended period. The panel study design allows us to partition the changes in child maltreatment report rates into a portion associated with how the levels of socio-economic risk factors have changed over time, and a portion related to how the relative importance of those factors in explaining maltreatment report rates has changed over time. Through the application of fixed effects panel models, the analysis is also able to control for unmeasured time-invariant characteristics of neighborhoods that may be a source of bias in cross-sectional studies. The study finds that increases in vacant housing, single parent families and unemployment rates are strongly associated with increases in child maltreatment report rates. Changes in racial/ethnic composition did not produce changes in maltreatment report rates except when they reached extreme levels of segregation. Although poverty rates were predictive of cross-sectional variation in child maltreatment, increases in neighborhood poverty became less associated with increases in child maltreatment report rates over time.

1. Introduction

It has long been observed that child maltreatment reports tend to be clustered geographically. Many researchers have examined these patterns, focusing mainly on urban neighborhoods. Generally, these studies have explored whether aspects of social and economic structure explain the variation in child maltreatment rates across neighborhoods at a single point in time. What is less commonly evaluated is how neighborhood socio-economic conditions change over time and how these changes relate to rates of child maltreatment. Nevertheless, urban areas are dynamic and neighborhoods change in response to a variety of forces, suggesting that the conditions that have been associated with child maltreatment may change as well.

This study examines how changes over several decades in the social and economic structure of neighborhoods are associated with changes in the geographic distribution of child maltreatment reports in a large urban area. A neighborhood panel study design allows us to partition the changes in child maltreatment report rates into a portion associated with changes in the levels of socio-economic risk factors and a portion related to changes in the relative importance of those factors in explaining maltreatment report rates over time. We also estimate neighborhood - fixed effects panel models of child maltreatment report rates in order to control for

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https://doi.org/10.1016/j.chiabu.2018.07.025
Received 20 April 2018; Received in revised form 15 July 2018; Accepted 22 July 2018
Available online 10 August 2018
0145-2134/

unmeasured time-invariant characteristics of neighborhoods that may be a source of bias in cross-sectional studies.

2. Background

Child maltreatment is estimated to affect 1 in 4 children in the USA (Finkelhor, Turner, Shattuck, & Hamby, 2013), often with long-term adverse effects on health and development. More than a quarter century ago, the National Academy of Sciences convened an expert panel that put forward a developmental-ecological model for child maltreatment research. This model considered risk and protective factors for maltreatment as part of a system interacting across four nested levels including the individual or ontogenic, the family or microsystem, the exosystem (which includes neighborhoods), and the social or macrosystem. (National Research Council, 1993). Similarly, Belsky's (1993) developmental-ecological framework as well as Cicchetti and colleagues' (Cicchetti & Lynch, 1993; Cicchetti & Rizley, 1981) ecological/transactional model posited the complex interplay or reciprocal transaction of characteristics and forces across multiple ecological levels, including neighborhoods, to influence the etiology and sequelae of child maltreatment. Since then, there has been growing research interest in neighborhood environments as contributing factors to the incidence of child maltreatment (Coulton, Crampton, Irwin, Spilsbury, & Korbin, 2007; Freisthler, Merritt, & LaScala, 2006; Maguire-Jack, 2014) and promising platforms for its prevention (Kimbrough-Melton & Melton, 2015; Molnar, Beatriz, & Beardslee, 2016). The National Academy of Sciences convened a second expert panel on child maltreatment (Petersen, Joseph, & Feit, 2014) that again pointed to the need for better research on the causes and consequences of maltreatment and longitudinal perspectives.

2.1. Neighborhoods and child maltreatment

Research on neighborhoods and child maltreatment fits into a larger tradition of efforts to understand the relationship between urban settlement patterns and social problems. Going back many decades ago, social workers and sociologists have documented the association between locations of social problems and socio-economic characteristics of households (Shaw & McKay, 1942). Social disorganization theory evolved as an explanation for these patterns, suggesting that the social structure in neighborhoods undermined social control through weakening network ties, shared norms, collective efficacy, and institutional resources (Sampson, Morenoff, & Gannon-Rowley, 2002). Research following in this tradition has produced consistent evidence of such neighborhood structure as a source of disadvantage for families and children (Brooks-Gunn & Duncan, 1997; Furstenberg, Cook, Eccles, Elder, & Sameroff, 1999; Sampson, Raudenbush, & Earls, 1997; Sampson, 2012) and there is evidence that the negative effects of such conditions are becoming more intractable (Sampson, Sharkey, & Raudenbush, 2008; Sharkey, 2013; Sharkey & Elwert, 2011). Moreover, research finds racial discrimination in the housing market and society as a cause of persistent neighborhood disadvantage (Boustan, 2011; Dawkins, 2004).

There have been several comprehensive reviews of the literature on neighborhoods and child maltreatment (Coulton et al., 2007; Freisthler et al., 2006). Much of this research has focused on socio-economic characteristics of neighborhoods as explanatory factors for child maltreatment rates, consistent with the social disorganization theoretical framework described above. There is considerable agreement in study findings despite differences in study populations and measures. The most consistent results across these studies point to associations between child maltreatment rates and indicators of the socio-economic status of neighborhoods including: poverty rate (Coulton, Theodos, & Turner, 2012; Decca, Horner, & Wilson, 1994; Drake & Pandey, 1996; Ernst, 2000; Freisthler, 2004; Freisthler, Midanik, & Gruenewald, 2004; Gilham et al., 1998; Zuravin, 1989), household income level (Decca et al., 1994; Garbarino & Crouter, 1978), unemployment rate (Decca et al., 1994; Freisthler, 2004; Freisthler et al., 2004; Freisthler, Needell, & Gruenewald, 2005; Gillham et al., 1998; Young & Gately, 1998), female headed households (Freisthler et al., 2004; Gillham et al., 1998) residential instability (Coulton et al., 2012; Decca et al., 1994; Ernst, 2000, 2001; Garbarino & Crouter, 1978; Molnar, Buka, Brennan, Holton, & Earls, 2003; Young & Gately, 1998; Zuravin, 1989), and vacant housing (Decca et al., 1994; Zuravin, 1989).

Although many studies have looked at the relationship between child maltreatment and neighborhood composition by race, ethnicity or immigrant status, these factors have shown a less consistent relationship with child maltreatment rates than the other socio-economic factors mentioned above. For example, although much of the research has found that neighborhoods where a large proportion of the population is African American or Hispanic have elevated rates of child maltreatment, these effects are weak or insignificant when economic factors are controlled (Coulton et al., 2007). In this regard, it should be noted that many cities have high levels of segregation by race and income due to patterns of housing discrimination and racial exclusion. The confluence of these racial and income disparities can be seen most clearly for African American children, who in 1990 and 2000 had a 14 times greater risk of living in an extreme poverty neighborhood than their White counterparts (Drake & Rank, 2009). While the combination of extreme poverty and racial isolation characterizes many neighborhoods with historically high maltreatment rates, more recently there is some evidence that neighborhoods that are increasing in racial and ethnic heterogeneity may also be experiencing higher maltreatment rates than those dominated by a single group (Klein & Merritt, 2014). This points to the need for studies to evaluate how changing neighborhood racial and economic composition relate to child maltreatment over time.

2.2. Dynamics of neighborhood change

To date, studies of the linkages between neighborhood socio-economic factors and child maltreatment have relied mainly on cross-sectional designs. Thus, we know little about the effects of changing neighborhood socio-economic conditions on maltreatment report rates, or if the strength and direction of the correlations change over time. However, a number of trends suggest the possibility that neighborhood conditions have been changing in ways that might be associated with changes in child maltreatment report rates.

The rate of single parent households has climbed over the past several decades and reached extremely high rates in poor neighborhoods (Mather, 2010). Economic segregation has worsened and poverty has become more geographically concentrated in recent years (Bishaw, 2014). At the same time, many places have experienced increasing ethnic diversity, resulting in a greater number of heterogeneous neighborhoods in contrast to those dominated by a single race or ethnic group (Iceland, 2017). Another source of neighborhood change has been the housing bubble and foreclosure crisis of the mid-2000s that created new pockets of vacancy and disinvestment in hard hit cities (Schuetz, Been, & Ellen, 2008; Whitaker & Fitzpatrick, 2013), while other neighborhoods saw significant economic upgrading or gentrification (Ellen & Ding, 2016). Moreover, the prolonged recession towards the end of the last decade (2007–2010) lowered family incomes and has been linked to increases in harsh parenting practices (Brooks-Gunn, Schneider, & Waldfogel, 2013). Additionally, residential mobility and population decline in disenfranchised neighborhoods are important manifestations of neighborhood dynamics that may associate with changes in child maltreatment rates.

It is important to note that neighborhood-level associations may change as demographic and socio-economic factors reach certain thresholds. Thus, it is essential that research on neighborhood conditions and child maltreatment rates investigate two sources of change: One due to increases or decreases in the level of a risk factor and another resulting from changes in the direction or strength of the association of a risk factor and maltreatment rates over time.

2.3. The current study

The current study investigates how neighborhood child maltreatment report rates in one region have changed over three waves from 1990 to 2010 in relation to changes in neighborhood demographic and socio-economic conditions. This longitudinal panel design enables us to decompose or partition the sources of temporal variation in neighborhood child maltreatment report rates into changes in levels and changes in association strength (i.e. coefficients) of each risk factor over time. Moreover, with the panel design, we are also able to estimate a fixed-effects model that partially addresses selection bias by holding constant time invariant, unmeasured characteristics of neighborhoods that may jointly affect households' locational choices and maltreatment report rates. Specifically, we hypothesize that increases in neighborhood risk factors (i.e. those found in previous cross-sectional studies) are associated with increases in child maltreatment report rates over time. Additionally, we hypothesize that there have been shifts in the strength of the association of some neighborhood risk factors and their relative importance over time.

Cuyahoga County (Cleveland), the location for the current study, is a metropolitan area where the demographic, economic and market forces described above have affected many neighborhoods and families (Coulton, Schramm, & Hirsh, 2010; Whitaker & Fitzpatrick, 2013). Cleveland is ranked as one of the poorest cities in America, although the surrounding county includes many middle-income and affluent communities. The Cleveland area is also highly segregated by race, which is most severe for the separation of African-Americans from Whites (Logan & Stults, 2011). Foreclose filings in the Cleveland area grew exponentially from 2003 to 2007, and housing vacancy rose at the epicenter of the foreclosure crisis. Like many other regions, the Cleveland area also saw a trend towards the suburbanization of poverty along with the return of the middle class to some central city neighborhoods. Thus, the region reflects the types of changes that were occurring in many cities during the past several decades, and as such, provides an exemplary case on which to evaluate the effects of shifting socio-economic conditions on the geographic distribution of child maltreatment.

3. Methods

3.1. Sample and procedures

This is a three-wave panel study (1990, 2000, 2010) of neighborhoods in all of Cuyahoga County, which includes the city of Cleveland. As a proxy for neighborhood, we use the census tract as the unit of analysis (N = 475). Since tract boundaries can change each decade, we standardize all years to the 2000 boundaries. We have chosen census tracts as proxies for neighborhoods for several reasons. They are the most commonly used geographic unit in research on neighborhoods and child maltreatment. The social, economic, demographic and housing variables that are used in the analysis are available for census tracts across all three time periods. The geographic size of the typical urban census tract is more similar to the typical neighborhood size reported by residents than alternative units such as block groups, which are smaller, or zip codes, which are larger (Coulton, Jennings & Chan, 2013). It should be noted, however, that individuals' perceptions of their neighborhoods vary and it cannot be assumed that all residents of a census tract share identical experiences of those surroundings.

3.2. Measures and data

The dependent variable for this study is the *child maltreatment report rate.* Child maltreatment reports were obtained from the Department of Children and Family Services under a strict data use agreement and approval by our university's Institutional Review Board. The reports were geocoded based on the child's home address at the time when the incident was investigated. We use all reports that were the subject of an investigation rather than just substantiated incidents for several reasons. Studies have shown that unsubstantiated reports have similar chances as substantiated reports of resulting in out of home placements and re-reports (Kohl, Jonson-Reid, & Drake, 2009) and that child maltreatment investigations are a better predictor of adverse outcomes for victims than are substantiations (Hussey et al., 2005). Based on such findings, researchers argue that allegations accepted for investigation are a reasonable measure of maltreatment rates because they reflect serious concerns about parents' ability to care for children (Stith et al.,

2009). Nevertheless, reliance on agency records is a limitation of our study since some incidents of child maltreatment may not be reported to the authorities or may be screened out without an investigation. Alternatively, some incidents may be over-reported by heightened scrutiny of neighbors.

We calculate the annual child maltreatment report rate for each census tract based on an unduplicated count of the children that were the subject of at least one investigated maltreatment report in a given year. We divide these counts by the population ages 0–17 according to the decennial census and produce a rate per-thousand. To reduce error due to small child population in some census tracts, we average three consecutive annual rates, providing a more stable rate for each of the three time periods in our study.

We were guided in our selection of independent variables by our earlier study of Cuyahgoa County neighborhoods (Coulton, Korbin, Su & Chow, 1995), studies of neighborhoods and child maltreatment that have appeared in the literature (Coulton et al., 2007; Freisthler et al., 2006) and the requirement that we have comparable census tract data over all three time points of the study. The 1990 and 2000 data come from the decennial census, both the complete count and the 15 percent sample (commonly referred to as the long-form and short-form respectively). By 2010 the Census Bureau had replaced the long-form with the American Community Survey. The ACS collects data on a rolling basis and releases census tract level data after accumulating 5-years of surveys. Thus, our 2010 socio-economic variables come from the ACS five-year estimates (2008–2012). It should be noted that ACS estimates are in some instances less reliable than those based on the previous census long-form samples (Folch, Arribas-Bel, Koschinsky, & Spielman, 2016).

We include the following variables for each census tract: *poverty rate* is the percentage of persons in households with income below the poverty thresholds; *female headed households* is the percentage of households with children that have female heads; *public assistance* is the percentage of households with public assistance income (AFDC in 1990 and TANF afterwards); *unemployment rate* is unemployed persons as a percentage of the civilian labor force; *vacant housing* is the percentage of housing units that are vacant; *owner-occupied housing* is the percentage of occupied housing units that are occupied by a homeowner; *race/ethnicity* includes the percent of the population that is Hispanic, and the percent of the population that is not Hispanic and classified as African American/Black or White. Other race categories are left out due to very small numbers in any census tract.

3.3. Analytic approach

The aim of our analysis is to examine the relationship between child maltreatment report rates and neighborhood characteristics across space and time. Recognizing the challenges of ecological inference, we do not attempt to make individual-level inferences regarding the effect of neighborhood characteristics on child maltreatment (often termed neighborhood effects). Rather, with the neighborhood as unit of analysis, we draw insights about the ecology of child maltreatment using two approaches: (1) We estimate cross-sectional associations of neighborhood characteristics and child maltreatment for each year. Then, we partition or decompose the decade-to-decade changes in estimated report rates to reflect the contributions of changes in the levels of the associated variables versus changes in the model parameters (e.g. regression coefficients) over each decade. Changes in the model parameters correspond to changes in the strength of the association that each of the neighborhood characteristics has in explaining child maltreatment report rates at a given point in time. (2) We then estimate a neighborhood fixed effects model of child maltreatment report rates to assess the association of neighborhood characteristics over time with maltreatment, accounting for potential unmeasured confounders.

We begin by estimating cross sectional linear regression models for each decade: 1990, 2000, and 2010. We also estimate models that are adjusted for spatial autocorrelation using Spatial Error Models ($Y = X\beta + \in + \lambda W\varepsilon$) with spatial correlation parameter λ and a neighborhood-contiguity matrix W. These latter models are estimated via Maximum Likelihood methods (MLE).

In order to decompose the changes in the estimated maltreatment report rates over the decades, we adopt a technique that was originally used to analyze wage differentials across men and women (Blinder, 1973; Oaxaca, 1973). In that study, the wage gap was decomposed into three components. The first is due to differences in the levels of various attributes (referred to as Endowments) across sexes (e.g. educational attainment, years of experience). A second component of the wage gap is due to differences in model parameters (referred to as Coefficients) in the men-only and women-only regression models. These disparities can reflect differences in the way society values labor supplied by men versus women. Finally, the remaining portion of outcome differences is due to the interaction of level and parameter differences. More recently, the Blinder-Oaxaca decomposition (B-O) method has been used to analyze differences in health and education outcomes across different time periods (García-Altés, Pinilla, & Ortún, 2011) as well as the changing influence of segregation on the concentration of poverty over time (Iceland & Hernandez, 2017).

Similar to these later models, we use the B-O method to decompose changes in child maltreatment report rates over time. In Model (1), $\bar{Y}_t$ is the mean maltreatment report rate indexed by time period t, X is a vector of neighborhood characteristics, and β a vector of estimated OLS parameters, both corresponding to a given time period. Specifically, we decompose the mean difference in report rates ($\bar{Y}_1$-$\bar{Y}_2$) between each pair of time periods into three components: (1) the Endowments component measures the change in report rates due to changes in neighborhood characteristics between time periods, holding coefficients or model parameters as they are in the second period. (2) Holding neighborhood characteristics as they are in the second period, the Coefficients component represents the change in report rates due to changes in model parameters over time. (3) Finally, the remainder is the Interaction component, representing the simultaneous changes in levels and model parameters.

$$\begin{aligned} \overline{Y}_1 &= \overline{X}_1'\hat{\beta}_1 \\ \overline{Y}_2 &= \overline{X}_2'\hat{\beta}_2 \\ \overline{Y}_1 - \overline{Y}_2 &= \underbrace{(\overline{X}_1' - \overline{X}_2')\hat{\beta}_2}_{\Delta\text{ Endowments}} + \underbrace{\overline{X}_2'(\hat{\beta}_1 - \hat{\beta}_2)}_{\Delta\text{ Coefficients}} + \underbrace{(\overline{X}_1' - \overline{X}_2')(\hat{\beta}_1 - \hat{\beta}_2)}_{\text{Interaction}} \end{aligned} \quad (1)$$

Because the B-O decomposition is based on OLS models estimated for each year, it assumes unmeasured variables are uncorrelated with the observed explanatory variables. However, it is likely that many unmeasured neighborhood attributes that have not appreciably changed over time, such as public buildings, natural resources, proximity to public transportation, topography and air quality, are correlated with our measured neighborhood characteristics and child maltreatment report rates, violating the standard OLS assumptions. To relax this assumption, we also estimate a neighborhood fixed effects model of child maltreatment report rates (Model (2)), where Y again represents maltreatment rates, but the sub-indices represent neighborhood (i) and time period (t). By observing each neighborhood repeatedly over time, we are able to estimate the parameter vector β, free of biases due to the correlation of time-invariant unobserved neighborhood characteristics (u_i) with the error term (e_{it}). This model in essence compares the neighborhood with itself over time to estimate the relationship between neighborhood conditions and maltreatment report rates.

$$Y_{it} = X'_{it}\beta + u_i + e_{it} \quad (2)$$

4. Results

4.1. Description of variables

Table 1 shows marked increases in child maltreatment report rates over time, from 35 to 60 per 1000 children between 1990 and 2010. Poverty rates fell slightly between 1990 and 2000, but then increased in 2010 from 16% to 22%. The share of female headed households with children also experienced a sharp increase, from 29% to 42% over the 21-year period. The shape of the distribution (See Fig. 1) becomes clearly bimodal by 2010, reflecting the large number of neighborhoods with over 60% of households headed by women. Receipt of public assistance dropped markedly following welfare reform, from an average of 13% receipt in 1990 down to 5% in 2010. Unemployment and housing vacancy rates increased between 2000 and 2010, partly due to the foreclosure crisis and

Table 1
Descriptive statistics of study variables, Census tracts in [Cuyahoga] County, 1990–2010 (N = 1407).

	Mean	S.D.	% 25	% 50	% 75	Moran's I
1990						
Average report rate (per 1,000 children)	34.65	31.89	8.35	21.91	59.18	0.80
Poverty rate	16.75	18.55	3.50	7.54	27.54	0.83
% Female households	28.82	22.79	11.08	20.3	43.94	0.77
% Public assistance	12.95	14.99	2.46	4.90	21.22	0.82
% Unemployed	9.87	9.67	3.69	5.78	13.46	0.70
% Vacant housing	7.35	6.80	2.66	5.40	10.41	0.56
% Owner-occupied	60.71	25.34	41.08	61.72	83.86	0.61
% Black	27.95	38.48	0.58	4.06	55.45	0.84
% Hispanic	2.74	5.77	0.56	0.92	1.63	0.83
Child Population	715.78		479.00	693.00	914.00	
2000						
Average report rate (per 1,000 children)	50.80	42.68	15.56	35.67	84.97	0.81
Poverty rate	15.91	15.37	3.81	9.42	26.39	0.77
% Female households	33.35	22.46	14.33	27.94	48.81	0.74
% Public assistance	6.77	8.02	1.20	3.13	10.76	0.67
% Unemployed	7.99	7.18	3.14	5.12	11.21	0.62
% Vacant housing	8.00	6.19	3.44	5.64	11.24	0.68
% Owner-occupied	61.12	24.92	41.30	61.95	83.72	0.58
% Black	32.73	37.96	1.50	11.20	69.24	0.87
% Hispanic	3.98	7.57	0.82	1.32	2.59	0.86
Child Population	737.96		488.00	720.00	941.00	
2010						
Average report rate (per 1,000 children)	59.77	44.79	21.50	48.78	95.46	0.74
Poverty rate	22.13	17.5	6.67	17.09	36.49	0.75
% Female households	42.27	22.8	21.83	42.11	62.09	0.79
% Public assistance	4.91	4.62	1.47	3.50	7.23	0.49
% Unemployed	14.52	10.00	7.07	11.60	19.74	0.59
% Vacant housing	13.90	9.57	6.55	11.02	19.11	0.76
% Owner-occupied	57.67	24.21	39.10	57.56	79.22	0.59
% Black	38.02	37.16	3.93	20.55	77.61	0.88
% Hispanic	5.36	8.45	1.29	2.06	4.17	0.88
Child Population	615.51		389.00	592.00	787.00	

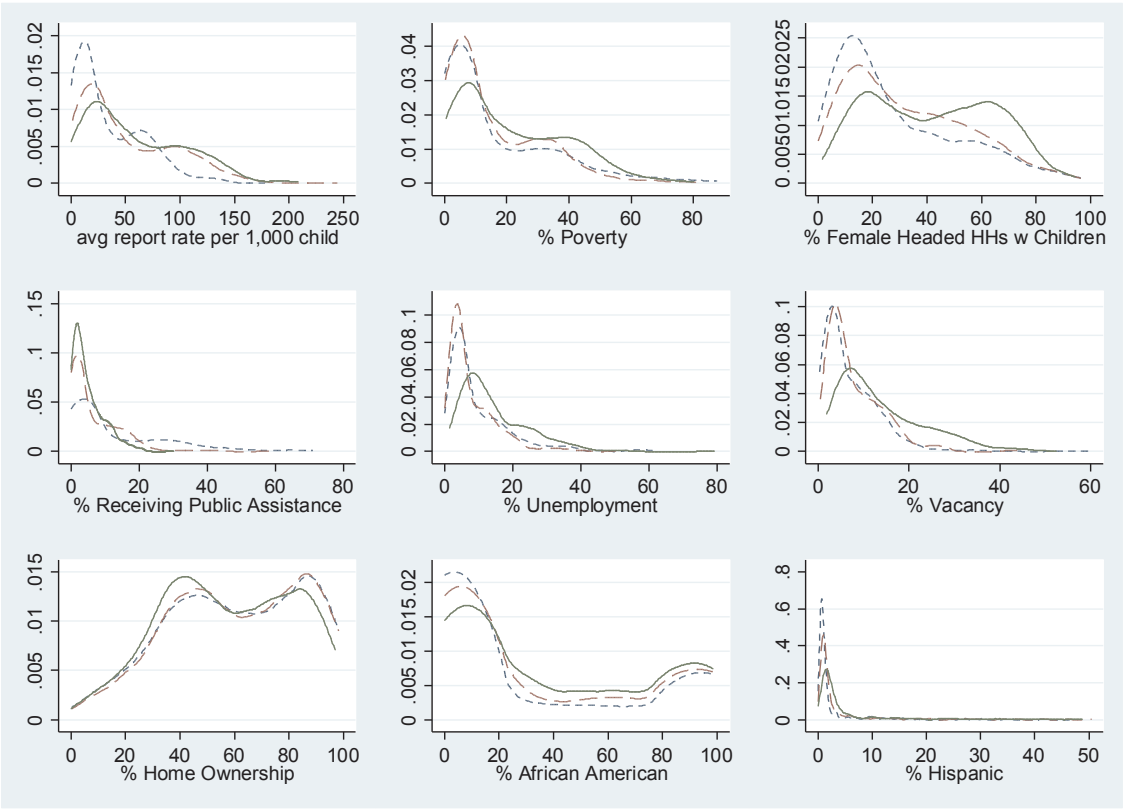

Fig. 1. Univariate distribution of model variables, 1990 (short dashed line), 2000 (long dashed line), and 2010 (solid line).

subsequent recession.

Worth noting is the gradual change in neighborhood racial concentration. The distribution of percent African American residents in a neighborhood shows three distinct patterns (see Fig. 1). During 1990, in most neighborhoods (68%), less than 25% of residents were African American. In another 22% of neighborhoods, more than 75% of residents were African American. By 2010, the share of neighborhoods where African American residents constituted less than 25% of the population declined from 68% to 54%, reflecting a growth in racially diverse neighborhoods. However, at the same time, the share of neighborhoods with more than 75% African American residents increased from 22% to 26%. The small share of Hispanic households in County neighborhoods grew from an average of 3% to 5% over this time period.

Finally, as shown in Table 1, we see that spatial correlation patterns have changed over the study period. Moran's I, a global measure of spatial autocorrelation, shows that the spatial clustering of child maltreatment remained about the same in the years 1990 and 2000, but declined by 2010. There was an increased spatial clustering of housing vacancy and race, while poverty, public assistance, and unemployment saw a reduction in spatial clustering.

4.2. Models of child maltreatment rates at the neighborhood level

From the series of cross-sectional models in Table 2, we are able to identify associations of the neighborhood predictors and child maltreatment report rates by comparing different neighborhoods at one point in time. We present decade-specific OLS models as well as models adjusted for spatial correlation in the error term. We find that for a given year, poorer neighborhoods and those with more housing vacancy tend to have higher rates of child maltreatment reports. While this is not a novel finding, it is worth paying attention to the year-to-year variation in the size and significance of the regression coefficients over the two decades. Importantly, the associations between maltreatment and poverty becomes weaker. At the same time, associations with the percent of female-headed households, unemployment rate and the receipt of public assistance become stronger.

The association of vacant housing rates and child maltreatment report rates sharply increases between 1990 and 2000, and then drops in 2010 yet it remains strong. When adjusting for spatial correlation in the error term, coefficient estimates for most variables are qualitatively the same as in the unadjusted model. Only in 2000, do we see that the coefficient on poverty rate becomes insignificant and the coefficient for percent of African American households becomes positive and significant. Also in 2000, the coefficient of spatial correlation of error terms ($\lambda_{2000} = 0.6$) is about twice as large the values in 1990 and 2010. This is not entirely surprising, as the variables of racial concentration and poverty have the highest spatial correlation coefficient, consistent with the patterns of concentrated racial distribution and poverty in the County.

Table 2
Regression of child maltreatment report rates on neighborhood social and economic conditions.

	Ordinary Least Squares		*Spatial Error Model*	
	Estimate	*S.E.*	*Estimate*	*S.E.*
1990				
Intercept	*8.17**	*3.92*	*10.57***	*4.03*
Poverty rate	*0.92****	*0.15*	*0.90****	*0.14*
% Female households	*0.41****	*0.08*	*0.37****	*0.08*
% Public assistance	*−0.04*	*0.18*	*−0.15*	*0.17*
% Unemployed	*−0.06*	*0.17*	*−0.11*	*0.17*
% Vacant housing	*0.36**	*0.16*	*0.35**	*0.15*
% Owner-occupied	*−0.06*	*0.04*	*−0.07*	*0.04*
% Black	*−0.01*	*0.03*	*0.04*	*0.04*
% Hispanic	*0.65****	*0.14*	*0.73****	*0.17*
Adjusted R^2	*0.81*			
Lambda			*0.34****	*0.06*
AIC (Spatial error, linear model)			*3793.4, 3809.2*	
2000				
Intercept	*−4.40*	*5.30*	*5.54*	*3.49*
Poverty rate	*0.52***	*0.18*	*0.24*	*0.16*
% Female households	*0.43****	*0.10*	*0.18**	*0.09*
% Public assistance	*0.49**	*0.23*	*0.55***	*0.21*
% Unemployed	*0.05*	*0.23*	*−0.01*	*0.20*
% Vacant housing	*2.70****	*0.22*	*2.60****	*0.20*
% Owner-occupied	*0.02*	*0.06*	*0.01*	*0.05*
% Black	*0.02*	*0.04*	*0.24****	*0.05*
% Hispanic	*1.38****	*0.13*	*1.31****	*0.20*
Adjusted R^2	*0.84*			
Lambda			*0.60****	*0.05*
AIC (Spatial error, linear model)			*3950.3, 4011.2*	
2010				
Intercept	*−12.83*	*6.68*	*−10.74*	*7.01*
Poverty rate	*0.40****	*0.12*	*0.31***	*0.11*
% Female households	*0.80****	*0.14*	*0.78****	*0.14*
% Public assistance	*0.81***	*0.27*	*0.82***	*0.27*
% Unemployed	*0.62****	*0.15*	*0.60****	*0.15*
% Vacant housing	*1.37****	*0.14*	*1.36****	*0.16*
% Owner-occupied	*−0.01*	*0.06*	*−0.02*	*0.07*
% Black	*−0.19***	*0.06*	*−0.15**	*0.07*
% Hispanic	*1.02****	*0.14*	*1.08****	*0.17*
Adjusted R^2	*0.83*			
Lambda			*0.26****	*0.07*
AIC (Spatial error, linear model)			*4071.2, 4081.00*	

*p < .05. **p < .01. ***p < .001.

4.3. Decomposition of neighborhood change models

Table 3 displays results from the B-O decomposition of change for the 1990–2000, 2000–2010, and 1990–2010 time periods. We perform decomposition analyses for Period 1 (1990–2000), Period 2 (2000–2010) and Period 3 (1990–2010). For each period, the increases in maltreatment report rates can be decomposed into a component reflecting between-period changes in neighborhood endowments (i.e., changes in the level of neighborhood poverty and other factors), another component reflecting changes in the model coefficients over time, and a residual interaction term. Changes in model coefficients would be indicative of potential policy or structural changes taking place over each period that could have influenced the relationship between these neighborhood factors and maltreatment report rates.

The predicted maltreatment report rate between 1990 and 2000 (Period 1) increases from 35 to 51 reported children per 1000 children in the neighborhood. Between 2000 and 2010 (Period 2), the increase is less steep, from 51 to 60 reported children. In Period 1, part of the increase in predicted maltreatment report rates can be attributed to endowment changes; i.e. a sharp increase in the share of female-headed households and a decrease in public assistance receipt. But most of the change in predicted maltreatment report rates is due to changes in the parameters of the regression models, not to changes in the endowments. Most significant are changes in the parameters for poverty rate, vacancy rates and public assistance. According to the decomposition analysis, the positive association between poverty and maltreatment report rates becomes weaker, whereas that for vacancy and public assistance rates becomes stronger. For example, from 1990 to 2000 the coefficient for poverty falls from .92 to .52 and the coefficient for vacancy increases from .36 to 2.70. To be clear, the average levels of vacancy rates increased only slightly during Period 1 and the levels of public assistance actually fell, yet the relationship between vacancy rates and reporting rates became stronger between 1990 and

Table 3
Blinder-Oaxaca Decomposition.

	Year 1: 1990, Year 2: 2000		Year 1: 2000, Year 2: 2010		Year 1: 1990, Year 2: 2010	
	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.
Predicted Maltreatment Reporting Rate in Year 1	34.65***	1.47	50.80***	1.97	34.65***	1.47
Predicted Maltreatment Reporting Rate in Year 2	50.80***	1.97	59.77***	2.07	59.77***	2.07
Difference (Year1-Year2)	−16.16***	2.46	−8.96**	2.86	−25.12***	2.54
Endowments						
Poverty rate	0.42	0.58	−2.50***	0.81	−2.16**	0.76
% Female households	−1.88**	0.74	−7.26***	1.59	−10.94***	1.98
% Public assistance	3.08*	1.48	1.50**	0.61	6.52**	2.26
% Unemployed	0.12	0.42	−4.02***	1.02	−2.86***	0.79
% Vacant housing	−1.75	1.15	−8.08***	1.11	−8.97***	1.19
% Black	−0.12	0.21	1.00	0.56	1.90*	0.77
% Hispanic	−1.71**	0.63	−1.41**	0.57	−2.67***	0.61
Total	−1.85	3.12	−20.76***	2.85	−19.19***	3.96
Coefficients						
Poverty rate	7.53*	3.53	2.29	4.46	12.77**	4.03
% Female households	1.29	3.97	−16.82**	6.28	−15.18*	5.90
% Public assistance	−4.01*	1.98	−1.54	1.75	−4.45**	1.60
% Unemployed	−1.16	2.26	−8.01*	3.88	−10.13**	3.32
% Vacant housing	−18.12***	2.17	18.22***	3.54	−13.28***	2.96
% Black	−1.25	1.72	8.14***	2.83	6.69*	2.64
% Hispanic	−2.85***	0.81	1.93	1.05	−1.91	1.09
constant	5.43**	2.13	11.02***	2.83	16.45***	2.58
Total	−13.15***	1.67	15.23***	2.17	−9.04**	2.90
Interaction						
Poverty rate	0.40	0.56	−0.64	1.26	−3.11**	1.19
% Female households	−0.18	0.54	3.55**	1.45	4.83*	1.95
% Public assistance	−3.66*	1.86	−0.58	0.67	−7.28**	2.68
% Unemployed	−0.27	0.54	3.61*	1.77	3.24**	1.15
% Vacant housing	1.48	0.98	−7.74***	1.64	6.26***	1.48
% Black	0.18	0.27	−1.13	0.65	−1.77*	0.82
% Hispanic	0.89*	0.40	−0.50	0.33	0.94	0.55
Total	−1.16	2.14	−3.43	2.23	3.12	3.93

*$p < .05$. **$p < .01$. ***$p < .001$.

2000. Poverty levels fell during Period 1 along with a decrease in the strength of the relationship between neighborhood poverty and child maltreatment report rates.

In Period 2, we see a reversal of relative importance of contributions by endowments and model coefficients. Increases in the endowments or levels of key factors of neighborhood distress are the main contributors to increases in maltreatment report rates. Most notable are the increases in the levels of female headed-households, vacancy rates, unemployment rates and poverty rates. Changes in most model parameters between 2000 and 2010 would actually contribute to a reduction in maltreatment report rates, as poverty and vacancy become less associated with report rates during Period 2. However, at the same time the association between child maltreatment report rates and the share of female-headed households becomes stronger in 2010.

Overall, the decomposition analysis shows that increases in child maltreatment report rates between 1990 and 2000 were mainly driven by changes in model parameters, possibly reflecting structural changes in social welfare policy (e.g. welfare reform) and population loss and housing abandonment in distressed neighborhoods. Between 2000 and 2010, child maltreatment report rates continue to increase, although in this period, increases in the levels of factors signaling neighborhood distress are most relevant to explain this increase. It is worth noting that in this most recent period, the contribution of the share of female-headed households has become more relevant due not only to a significant increase in the levels but also due to an increase in the strength of the association with maltreatment report rates. Overall, this analysis is consistent with what we find when we perform the decomposition of the 1990–2010 changes (Period 3). Here we see that the main variables contributing to significant changes in maltreatment report rates – both through endowment and parameter changes – are the share of female-headed households and housing vacancy rates. This decomposition also highlights that poverty rates are less associated with child maltreatment report rates over time.

4.4. Neighborhood fixed effects panel models

The decomposition analysis presented in the previous section is based on regression models estimated for each year, which are susceptible to bias if the error term is correlated with explanatory variables that are not included in the model. One way to reduce the bias derived from unmeasured variables that are slow to change over our study period is using the three time points in the panel to estimate neighborhood fixed effects models of maltreatment report rates.

Table 4
Fixed effects models of child maltreatment report rates.

Regressions	Model 1		Model 2		Model 3	
	Fixed Effects		Fixed Effects, Race Interaction		Fixed Effects, Race Int., Spatial Error	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Poverty rate	−0.11	0.09	−0.12	0.09	−0.18*	0.08
% Female households	0.22**	0.07	0.22**	0.07	0.24***	0.06
% Public assistance	−0.56***	0.08	−0.63***	0.08	−0.54***	0.08
% Unemployed	0.36**	0.11	0.32**	0.11	0.28**	0.09
% Vacant housing	0.78***	0.11	0.75***	0.11	0.73***	0.09
% Owner-occupied	−0.37**	0.14	−0.36**	0.14	−0.33**	0.11
% Black	0.13	0.07				
% Hispanic	1.42***	0.20	1.46***	0.20	1.31***	0.19
Year = 2000	9.60***	1.16	9.19***	1.17		
Year = 2010	5.38**	1.65	5.44**	1.64		
$< 25\%Black_{1990}$* %Black			0.13	0.07	0.10	0.06
$[25,75]\%Black_{1990}$*% Black			−0.01	0.13	−0.01	0.11
$> 75\%Black_{1990}$*% Black			1.50***	0.39	1.14***	0.32
Mean of Fixed effects	43.09***	9.74	16.10	12.30	28.00	
Spatial lambda					0.27***	0.04
Error variance					128.6***	4.88
Adjusted R squared	0.26		0.27		0.48	
N	1407		1407		1407	

*$p < .05$. **$p < .01$. ***$p < .001$.
Note: 1990 is the base year.
Models 2 and 3 include a distinct coefficient for %Black by concentration of Black households in 1990.
Spatial Error models are estimated via MLE with year Fixed Effects.

Table 4 presents fixed effects models with maltreatment report rate in the neighborhood as the dependent variable. Explanatory variables are poverty rate, percent of female-headed households, share receiving public assistance, unemployment rate, the percent of vacant housing, share of owner-occupied housing, and percent of the population that is African American and Hispanic (Non-Hispanic white is omitted category). These models examine how changes in maltreatment report rates are related to *temporal* changes in neighborhood characteristics, holding the neighborhood fixed, and thus, can be described as a "within-neighborhood" in contrast to a "cross-neighborhood" analysis. Several other studies have also employed fixed effects models at an aggregated level of geography to study how changes in economic conditions and related parental resources are associated with changes in maltreatment rates (Paxson and Waldfogel, 2003; Raissian, 2015).

We find that neighborhoods that experienced increases in the share of female-headed households, unemployment, vacant housing and Hispanic population during the study period, saw increases in their child maltreatment report rates. A decrease in public assistance receipt and owner-occupied homes was also associated with an increase in child maltreatment report rates. However, controlling for all other variables, neighborhoods that became poorer between 1990 and 2010 did not demonstrate increases in maltreatment report rates during that time.

The relationship of maltreatment report rates and shares of African American population is tenuously positive in Model (1), Table 4, but hard to interpret at the mean, given the distinct non-Gaussian distribution of this neighborhood characteristic (See Fig. 1). Since the average share of African American population in our data is 33%, while the average share of Hispanic population is only 4%, further exploration of change in racial composition and reporting rates is focused on African American population only.

To better understand how changes in the racial composition of neighborhoods are associated with maltreatment report rates, we interact the share of African American population with a three-level categorical variable representing racial concentration or integration in 1990 (Model (2), Table 4). These categories align with the shape of the empirical distribution for the share of African American population seen in Fig. 1. Based on their 1990 composition, neighborhoods are categorized as predominantly White, with less than 25% African American population (68% of neighborhoods); predominantly African American, with more than 75% African American population (22%); and mixed, with 25%–75% African American population (10% of neighborhoods). Model 3 adds a correction for spatial correlation in the error term.

The interaction term in Models 2 and 3 allows us to see that an increase in the share of African American population in neighborhoods that were either predominantly White or mixed in 1990 (75% African American or less) is not associated with an increase in child maltreatment report rates. It is only for neighborhoods that were already predominately African American in 1990 (> 75% African American) where a further increase in racial concentration associates with an increase in maltreatment report rates. These neighborhoods were also those that saw the largest declines in population between 1990 and 2010. Their population dropped by about 30%, while population in integrated neighborhoods dropped 13% and those characterized by predominantly White population in 1990 saw only a 3% decline in population. These trends reflect a process of disinvestment and outmigration that has disproportionately affected some African American neighborhoods in the region.

5. Discussion

The current study advances the literature on neighborhood factors in child maltreatment because it evaluates change over a relatively long period from 1990 to 2010. During these decades, there were social, economic and policy trends that had the possibility of affecting neighborhood conditions that cross-sectional studies had found to be related to the geographic clustering of child maltreatment reports. The three-wave, panel design allowed the study to determine the relative importance of fluctuations in levels of neighborhood attributes and differences in the associations of these attributes with neighborhood maltreatment report rates. By decomposing the changes in parameters and levels from cross-sectional models across decades, we see that neighborhood poverty rates and rates of participation in public assistance programs became less important as predictors of maltreatment report rates. During this time, vacancy rates and the share of female headed-households became more important factors in explaining maltreatment report rates: neighborhoods not only saw increases in levels of these phenomena, but the size of their respective coefficients also increased, signaling a structural change in the relationship of these variables with child maltreatment report rates.

The three-wave panel design also allowed us to use fixed effects models to examine the association of social and economic changes in neighborhoods with maltreatment report rates while controlling for time-invariant unobserved confounders within neighborhoods. By focusing on within neighborhood change, we show that neighborhoods that increased in poverty did not experience much increase in child maltreatment report rates. Instead, increases in vacant housing, unemployment and female-headed households were associated with rising maltreatment report rates. Furthermore, our fixed effects models suggest that neighborhoods that saw increases in racial diversity did not see any increases in child maltreatment report rates. But maltreatment rates rose in neighborhoods that transitioned to extreme segregation of African Americans. Importantly, a decline in public assistance support in neighborhoods following welfare reform in the late 90 s also yielded higher rates of child maltreatment reports, perhaps due growing inability of families to meet basic needs. Similarly, an increased amount of vacant housing following the foreclosure crisis was associated with increased child maltreatment, possibly due to the destabilization of households that had to move as well as the fact that vacant housing often reflects population loss, neighborhood deterioration and can attract social disorder.

The role of unemployment is also illuminated by a comparison of the cross-sectional and fixed effects models. In the cross-sectional models, differences in unemployment rates across neighborhoods do not imply significantly different maltreatment report rates. However, in the fixed effects models, increases in unemployment rates within neighborhoods are shown to increase maltreatment. This may be a reflection that fixed effects models reduce estimation bias, making it clear that declining employment in neighborhoods is associated with increases in child maltreatment rates.

Taken together, these findings suggest that the spatial distribution of child maltreatment reports at the neighborhood level within a county takes place within the context of regional and macro influences that shape neighborhood conditions over time. This is consistent with other studies that find that child maltreatment rates are affected by overall trends such as housing market crises (Wood et al., 2012), employment and economic downturns (Paxson & Waldfogel, 2002) and restrictive social welfare policies and practices (Slack, Lee, & Berger, 2007). These patterns suggest that the predictive value of various neighborhood risk factors for child maltreatment at the ecological level, such as housing vacancy, public assistance cases or poverty rates are likely to change gradually over many years in response to changing structural or policy regimes.

5.1. Limitations

These study findings need to be interpreted in light of the ecological fallacy, which reminds us that it is mistaken to draw inferences about individuals from neighborhood level data (Greenland & Robins, 1994). As such, while this is a longitudinal study of neighborhoods and child maltreatment reports, it cannot be considered a causal test of neighborhood effects on individual families and children. By using a fixed effects panel model, we control for time-invariant unobserved characteristics of neighborhoods so we can isolate the effect of changing neighborhood socio-economic conditions on child maltreatment report rates. However, at the individual level, households move in and out of neighborhoods, and we are not able to control for neighborhood selection unless it is determined by those time-invariant characteristics.

As mentioned earlier, the reliance on census geography and available data are limitations of the study. Fixed geographic units such as census tracts cannot fully account for individuals' neighborhood experience since individuals are mobile and have agency with regards to their engagement with their local surroundings. Moreover, census data do not capture some of the social processes (e.g. collective efficacy) that are potential mediators between neighborhood socio-economic conditions and child maltreatment report rates or that might buffer the impact of neighborhood socio-economic distress on families.

Additionally, although the neighborhood patterns of child maltreatment reports are important to understand, they cannot be disentangled from place-based differences in the willingness of reporters to come forward or agency decisions to screen-in reports for investigation. If socio-economic characteristics of neighborhoods elevate either reporter or agency levels of suspicion regarding child maltreatment, neighborhood predictors may appear stronger in our models than they would be if there were no reporting or investigation bias. The relationship between neighborhood conditions and reporter behavior merits future research.

Finally, since this study focused on one metropolitan area, care needs to be taken in generalizing the findings to other locales. Cities differ in their physical and social structure, so factors such as housing vacancy and racial and ethnic diversity that were found to be important in this study may play out differently elsewhere.

5.2. Areas for further study

Additional research is needed on how the severity and persistence of place-based social stratification factors into the geographic patterns and racial disparities in child maltreatment. There is little overlap in the distributions of neighborhood socio-economic conditions for White as compared to African American populations due to the long history of housing discrimination and racial segregation. This is especially problematic in hyper-segregated cities, where about one-third of the African American urban population lives (Intrator, Tannen, & Massey, 2016), and the type of city where this study was conducted. In these cities, few White households, regardless of income, will face the extremes of neighborhood disadvantage encountered by the typical African American household. It is critical that we come to better understand the interplay of the racial and economic stratification of urban neighborhoods in the incidence child maltreatment and other adverse childhood events.

This study also raises the question of the possible role of adverse neighborhood conditions in the intergenerational cycle of child maltreatment. Parental history of being maltreated as a child increases the chances that offspring will be the subject of a child maltreatment report (Bartlett, Kotake, Fauth, & Easterbrooks, 2016; Berlin, Appleyard, & Dodge, 2011), but the role of neighborhoods in this transmission has not typically been evaluated. However, a follow-up study of adults who were maltreated in childhood showed them to be at higher risk than matched controls of living in distressed neighborhoods (Chauhan, Schuck, & Widom, 2017). It would be important for future research to investigate whether maltreated parents' adverse selection into disadvantaged neighborhoods accounts for some of the geographic patterns of child maltreatment. This line of research is consistent with calls to expand trauma informed care to consider both interpersonal and community level trauma (Quiros & Berger, 2015).

5.3. Implications for policy and practice

Knowing the set of neighborhood factors that are associated with child maltreatment clusters can form a basis for prevention or service efforts that are place-based. The most direct application is in targeting resources to support families and children in proximity to these locations, and designing programs to either protect from or reduce the impact of the social context factors that are predictive. So for example, areas where unemployment, vacancy and single parent households are increasing should be assessed to craft the types of family-supportive interventions that likely reduce the chances of child maltreatment under such circumstances.

This study should also point our attention to the social and human consequences of neighborhood disinvestment, racial segregation, and the forces that contribute to it. Neighborhoods in this study that saw increases in vacant housing and extreme concentration of African American households also saw a large uptick in maltreatment. Urban policies that affirmatively support fair housing, promote neighborhood stabilization and foster mixed income communities should be seen as important vehicles for reducing such adverse ecological conditions that contribute to child maltreatment.

Conflicts of interest

None.

Acknowledgements

This research was supported by the Eunice Kennedy Shriver National Institute of Child Health & Human Development, grant R01HD077002. Brian Allen, Brooke Jespersen, Jiho Park, and Megan Schmidt-Sane provided assistance with the data and manuscript preparation.

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