Incidence and neighborhood-level determinants of child welfare involvement

Sarah C. Lotspeich [a,*], Ryan T. Jarrett [a], Richard A. Epstein [b], April M. Shaffer [c], Kathy Gracey [c], Michael J. Cull [d], Rameela Raman [c]

[a] Vanderbilt University, Nashville, TN, USA
[b] Chapin Hall at the University of Chicago, Chicago, IL, USA
[c] Vanderbilt University Medical Center, Nashville, TN, USA
[d] University of Kentucky, Lexington, KY, USA

ABSTRACT

Background: Child maltreatment is a global public health issue that has been linked with multiple negative health and life outcomes.
Objective: This study evaluates the association between children placed in out-of-home care and neighborhood-level factors using eight years of administrative data.
Participants and setting: Between 2011–2018, 33,890 unique instances of child welfare involvement were captured in a department of child and family services database in a southern state in the United States.
Methods: Removal addresses were geocoded and linked to the U.S. Census Bureau's American Community Survey to obtain census tract socioeconomic factors. Incidence overall and stratified by individual and neighborhood-level factors was computed. Rate ratios, relative indexes of inequality, and concentration curves quantified disparities in incidence of child welfare involvement by neighborhood-level factors.
Results: Incidence of children less than 19 years old placed into out-of-home care was 255 per 100,000 person-years (95 % CI: 252, 258). At the individual level, incidence was highest among children <5 and 15–17 years old, comparable between male and female children, and higher among Black children. At the neighborhood level, incidence was highest in census tracts with lower median household incomes, higher percentages of households below poverty or of female-headed or single-parent households, higher unemployment rates, and fewer residents with some college education or health insurance.
Conclusions: Incidence of children placed into out-of-home care is disproportionally higher for those who live in disadvantaged communities. Understanding neighborhood-level risk factors that may be linked to child welfare involvement can help inform policy and target prevention efforts.

1. Introduction

Child maltreatment is a public health issue globally and has been linked with multiple negative health and life outcomes (Gilbert et al., 2009). The etiology of child maltreatment functions at many levels (Belsky, 1980). It is known that broader societal structures

---

contribute to child-level outcomes through community health (Butchart, Harvey, Mian, Fürniss, & Kahane, 2006; Belsky, 1993; National Research Council, 1993), but the mechanisms by which the health and structure of a child's community can impact wellbeing are varied, interacting in complex ways that are not yet fully understood (Butchart et al., 2006; Fresithler & Maguire-Jack, 2015). Economic factors in the household such as poverty, income inequality, and unemployment may directly affect child and family health outcomes through substandard living conditions and reduced access to education or medical services. In addition, these factors can have indirect effects through forms of social dysfunction, such as greater stress, social isolation placed on the caregivers, housing instability, or perpetuation of social norms surrounding the acceptability of violence toward children (Ben-Arieh, 2010; Coulton, Korbin, & Su, 1999; Ernst, 2001; Fong, 2017; McLoyd, 1990; National Research Council, 1993).

To date, a number of studies have supported the hypothesis that community-level risk factors are associated with child maltreatment. Economic factors such as poverty, income, and unemployment can affect children from outside as well as inside their home. Specifically, economic disadvantage, exhibited by greater rates of poverty, lower incomes, and higher unemployment, respectively, has been seen studied at the community level and found to be positively associated with rates of child maltreatment (Ben-Arieh, 2010; Coulton, Korbin, & Su, 1999; Eckenrode, Smith, McCarthy, & Dineen, 2014; Gracia, López-Quílez, Marco, & Lila, 2017; Gracia, López-Quílez, Marco, & Lila, 2018; Kim & Drake, 2018; Lindo, Schaller, & Hansen, 2018; Maguire-Jack, 2014; Merritt, 2009; Spearly & Lauderdale, 1983). Related to economic disadvantage, the percentages of single-parent or female-headed households have been positively associated with rates of child abuse and maltreatment; these households are believed to be more sensitive to access or absence of child care services in their community (Ben-Arieh, 2010; Cherry & Wang, 2016; Ernst, 2001; Merritt, 2009; Paxson & Waldfogel, 1999, 2003; Spearly & Lauderdale, 1983; Weissman, Jogerst, & Dawson, 2003).

Eckenrode, Smith, McCarthy, & Dineen (2014) examined U.S. county-level data between 2005 and 2009, noting a positive association between income inequality and child maltreatment rates which was moderated by child poverty level such that the effects of income inequality were more pronounced in high poverty areas. Similar observations have been made between referrals to child protective services (Kim & Drake, 2018) or placements in foster care (Wulczyn, Gibbons, Snowden, & Lery, 2013) and child poverty rates, with the magnitude of the effect moderated by race. It has been suggested that the disparity between rates of referrals in the White and Black communities can be explained largely by the disparity in the rate of poverty between them (Kim & Drake, 2018). In a multi-national study in the U.K., Bywaters, Scourfield et al. (2018) found that the neighborhood-level rates of children in out-of-home care in each of the countries had strong, positive associations with the level of deprivation, a surrogate measure for family socioeconomic status based on publicly available data on income and employment (Bywaters, Scourfield et al., 2018; Payne & Abel, 2012). This study built upon the longstanding belief that neighborhood-level deprivation is key in explaining area-based differences in child welfare involvement in England (Bywaters, Brady et al., 2018; Bywaters, Brady, Sparks, & Bos, 2016; Bywaters, 2013; Bebbington & Miles, 1989; Dickens, Howell, Thoburn, & Schofield, 2007; Oliver, Owen, Statham, & Moss, 2001). The availability and extent of government assistance such as welfare payments have also been associated with maltreatment (Albert & Barth, 1996; Spearly & Lauderdale, 1983), but there is some evidence that the direction of the association depends on the type of community (i.e., urban, suburban, or rural). Evaluating the impact of gender-specific labor conditions (e.g. unemployment, mass layoffs, and predicted employment) on child maltreatment using California county-level data between 1998 and 2012, Lindo, Schaller, & Hansen (2018) found a modest relationship between overall economic conditions and child maltreatment; a much stronger effect was seen when this relationship was moderated by gender. Under poor economic conditions that mainly affected men, child maltreatment rates increased substantially, but under poor economic conditions that mainly affected women, the same rate decreased.

Child maltreatment is a difficult outcome to define and measure directly. One of the major challenges to defining child maltreatment, especially in cohorts crossing large geographic areas, is that legal definitions vary. In the United States, for example, each state has its own definition (Institute of Medicine, & National Research Council, 2014). In addition, it is expected that not all cases are reported to child welfare officials because (1) most non-homicide crimes go unreported, (2) children do not recognize what happened to them was wrong, so they do not report it, and (3) fear of retaliation, rejection, or other negative consequences (Institute of Medicine, & National Research Council, 2014; Langton, Berzofsky, Krebs, & Smiley-McDonald, 2012). Therefore, the outcome most often collected in administrative databases is child welfare involvement, which is expected to capture a subset of children in the underlying population who may be experiencing maltreatment or neglect.

In this paper, we examine the relationship between individual-level and neighborhood-level socioeconomic factors and incidence of one type of child welfare involvement, placement in out-of-home care, through a state child welfare agency in the southern United States. Throughout this paper, the term "children" refers to children and youth up to 19 years old in the child welfare system. We use out-of-home care placements from the child and family services database from January 1, 2011 – December 31, 2018 and investigate associations with individual- and neighborhood-level factors. Our study includes a large cohort of 33,890 cases of children in out-of-home care over a period of eight years and covers a large geographic area in the United States at the granular geographical level of the census tract, which contain homogeneous populations and hence is most attuned to capturing economic deprivation (Krieger et al., 2002). Via geocoding, we linked administrative data to census data, which enabled us to incorporate indicators of socioeconomic status, most notably the percentage of households below the poverty line, which are not routinely captured in administrative databases (Krieger, Williams, & Moss, 1997). Lastly, we use several unique statistical measures that are commonplace in studies of health disparities, specifically the relative index of inequality, concentration index, and concentration curve, to quantify the variation in incidence of out-of-home care among children residing in areas from different socioeconomic backgrounds. An improved understanding of the landscape leading up to a child being placed in out-of-home care may help identify avenues for prevention. Allowing the agencies tasked with child welfare to better allocate their resources can further ensure that children receive the services that they need to maintain a healthy environment and to best foster their well-being.

2. Methods

2.1. Data sources and study population

Data capturing child-, placement- and geographic-level information were obtained from the state child welfare agency's administrative database for a state in the southern United States. Date of out-of-home placement was used to identify children with a child welfare involvement event between January 1, 2011 and December 31, 2018. For children with multiple out-of-home placements, the analysis included only the first event during the eight-year period. We note that this is not necessarily these children's first ever instance of being placed in out-of-home care by child welfare officials, but rather the first instance observed during the study period.

Each child's removal address (i.e., their residential address at the time of welfare involvement) was geocoded to a latitude and longitude and then linked to a census tract using Google Maps in R Statistical Software (Kahle & Wickham, 2013). Using the linked census tracts, geocoded data on cases of child welfare involvement were merged to the U.S. Census Bureau's American Community Survey (ACS) to obtain census tract-level socioeconomic factors (U.S. Census Bureau). The ACS, which is aggregated over the five-year period 2012–2016, was used to obtain population denominators as well as denominators stratified by census tract-level factors. Census tracts are defined by the U.S. Census Bureau as small geographic subdivisions that are based on permanent, visible features (e.g., streets, roads, highways, rivers, canals, railroads, and power lines); by design, the average population across census tracts in the United States is around 4000 people (US Bureau of the Census, 1994).

Removal addresses that could not be geocoded to rooftop-level accuracy (the most precise level of geocoding accuracy) were imputed with the address of the associated removal court who handled the child's placement (15 % of cases), meaning they were assigned to the neighborhood of the court; each county has a removal court and the children are assigned to one nearest to their residence. Since only 15 % of cases had to have their census tract imputed, this should not noticeably bias our analysis. There was only a small amount of missing demographic information in the child and family services dataset: less than 1 % of cases were missing gender information and 5% were missing race. In the ACS, some census tracts were missing one or more variables, but when matched with removal address, less than 1 % of children had missing neighborhood-level information. For each individual- and neighborhood-level determinant, cases with complete data were included in the calculations. Since the frequency of missing data was so low, excluding children with missing data should not have statistically biased our results.

The primary outcome variable was cases of children placed out-of-home through the state child welfare agency between 2011–2018. The indicator of children placed outside of their home is common among studies in social policy and research, particularly in child welfare (Alastalo & Pösö, 2014). Individual-level covariates included child age at the time of the out-of-home placement (<5, 5–9, 10–14, 15–17, 18–19 years), gender, and race (White, Black, other). Census tract-level factors used in the analysis were median household income ($4999–$26,471, $26,472–$33,162, $33,163–$39,286, $39,287–$47,124, $47,125+), percent of households below poverty (0.0–4.9, 5.0–9.9, 10.0–19.9, 20.0+), percent of college-educated residents (0.0–39.9, 40.0+), percent of female-headed households (0.0–19.9, 20.0–39.9, 40.0+), percent of single-parent headed households (0.0–19.9, 20.0–39.9, 40.0+), percent of residents with private or public health insurance (0.0–79.9, 80.0+) and percent of total population employed (0.0–36.9, 37.0–41.9, 42.0–45.9, 46.0–49.9, 50.0+). All categorizations were adopted based on previously published standards by the Harvard Public Health Disparities Geocoding Project, which are based on the quintiles of the variables along with a priori considerations to ensure that the cutoffs are meaningful, if available (Krieger, Chen, Waterman, Rehkopf, & Subramanian, 2003). The same cutoffs were applied to percentages of female-headed and single parent households, as these variables are expected to be highly correlated. Percent of total population employed did not have recommended cutoffs in the literature, so it was categorized based on the quintiles across all census tracts in the state. These neighborhood-level factors were chosen *a priori* based on subject matter knowledge and existing literature on child maltreatment risk factors.

2.2. Data analysis

Incidence of children placed in out-of-home care was quantified as the proportion of children up to 19 years of age who were placed in out-of-home care per 100,000 person-years. Incidence rates were also stratified by individual-level and census tract-level factors. Rate ratios (RR) with 95 % confidence intervals were computed to compare the incidence rates between the levels of the individual- and neighborhood-level factors (Rothman & Greenland, 2008). For census tract-level factors, disparities in incidence rates were quantified using the relative index of inequality (RII), concentration index (CI), and concentration curve (CC). These measures - which are used to compare disparities between the least and most disadvantaged groups - are not included for individual-level variables because factors such as gender and race do not naturally lend themselves to ordering. The relative index of inequality, interpreted similarly to a rate ratio, compares the incidence rates between the lowest and highest levels of a socioeconomic factor. The concentration curve helps visualize disparities by socioeconomic factors, plotting the cumulative percentage of children in out-of-home care against the cumulative percentage of the 19 years old or younger population, ranked from low to high socioeconomic status. The perfect diagonal on the plot represents the expected curve if no disparities are present (i.e. equal proportions of children placed in out-of-home care to the proportions of the population). If the CC falls above the diagonal, it indicates that there is a higher concentration of out-of-home care placements in the most disadvantaged group. The concentration curve index quantifies the disparity from the concentration curve and is computed as twice the area between the curve and the diagonal line. A negative CCI indicates that a disparity in child welfare involvement is associated with the census tract-level factor; if no inequality is present the CCI is zero (Wagstaff, Paci, & Van Doorslaer, 1991). R Statistical Software was used for all computation and visualization (R Core Team, 2019). This study was approved by the Vanderbilt University Institutional Review Board and the state child welfare agency's research review

committee.

3. Results

3.1. Descriptive statistics of children placed in out-of-home care

From January 1, 2011 – December 31, 2018, there were a total of 36,776 cases of children under 19 years old placed in out-of-home care in the state. Some children had multiple placements during the eight-year period and only the first event during the study period (i.e., the event with the earliest date of welfare involvement) was included in the analysis. Ultimately, our analysis included 33,890 unique instances of a child placed in out-of-home care.

Children placed in out-of-home care through the state child welfare agency during the study period resided in 1409 of the 1497 census tracts and had a median age of 8 years old (interquartile range: 2–14 years old). There were 17,416 (51 %) males, 23,263 (72 %) were White, and 7280 (23 %) were Black. In juvenile and family court, an adjudicatory hearing assesses whether a child has been maltreated or if legal basis exists for further intervention (Office of Children & Families in the Courts, n.d.). Of the children in this analysis, 32,984 (97 %) were adjudicated to be dependent/neglect cases: a "dependent child" is placed in out-of-home care due to the family being unwilling or unable to adequately care for them, and "neglect", which can be physical, education, or emotional, is characterized by a failure to provide for the child's basic needs (Office of Children & Families in the Courts, n.d.). The remaining 906 children (3%) were deemed "unruly", which includes truancy from mandatory attendance in school, runaways, and habitual disobedience that threatens the child's health or safety (TN Code § 37-1-102(b)(32)). Demographics of these children are provided in Table 1. For census tract-level characteristics, counts of cases in each category are included in Table 2.

3.2. Incidence of child welfare involvement and disparity measures

Incidence of child placements in out-of-home care was 255 per 100,000 person-years (95 % CI: 252, 258) for the state; all placement rates are included in Table 2. Based on individual-level factors, children <5 years old had the highest incidence rate of 378 per 100,000 person-years (95 % CI: 372, 385), followed closely by children 15–17 years old (RR = 0.93, 95 % CI: 0.91, 0.96). Incidence was nearly equal for children 5–9 and 10–14 years old at 210 (95 % CI: 205, 215) and 209 (95 % CI: 205, 214) per 100,000 person-years, respectively. There were noticeably fewer cases in the 18–19-year-old age group with an incidence rate of only 35 per 100,000 person-years (95 % CI: 32, 38). Male and female incidence were approximately equal (RR = 1.01, 95 % CI: 0.99, 1.04). Compared to White children, incidence was higher among Black children (RR = 1.28, 95 % CI: 1.25, 1.32) and lower among other race children (RR = 0.92, 95 % CI: 0.87, 0.96).

With increasing median household income, the observed incidence of children placed in out-of-home care decreased (RII = 10.03, 95 % CI: 9.62, 10.45). A RII = 10.03 indicates that the risk of being placed into out-of-home care for children living in census tracts with the lowest income is 10.03 times the risk for children living in census tracts with the highest income. Incidence was highest for children in census tracts with the greatest percentage of households below poverty (RII = 8.43, 95 % CI: 8.06, 8.81) and lower percentage of college-educated residents (RII = 3.49, 95 % CI: 3.34, 3.64). Elevated incidence was also observed for children living in census tracts with higher percentages of female-headed households and single-parent headed households (RII = 3.59, 95 % CI: 3.45, 3.74 and RII = 4.02, 95 % CI: 3.85, 4.19, respectively). Children residing in census tracts with fewer residents with health insurance had higher risk of being placed into out-of-home care (RII = 2.08, 95 % CI: 1.95, 2.22). Risk of child welfare involvement was lower for those living in census tracts with more of the total population employed (RII = 6.11, 95 % CI: 5.87, 6.36). The concentration curves for each of the census tract-level factors are presented in Fig. 1, all of which curved above the diagonal line of equality, further indicating a

Table 1
Demographics of children placed in out-of-home care between January 2011 and December 2018 (N = 33,890). Categorical variables are described as frequency (percentage).

Variable	Level	Out-of-home placements, N (%)
Age (years)		
	<5	12,173 (36 %)
	5–9	6987 (21 %)
	10–14	7074 (21 %)
	15–17	7189 (21 %)
	18–19	467 (1 %)
Gender		
	Female	16,462 (49 %)
	Male	17,416 (51 %)
Race		
	White	23,263 (72 %)
	Black	7280 (23 %)
	Other	1570 (5 %)
Adjudication status		
	Dependent/Neglect	32,984 (97 %)
	Unruly	906 (3 %)

Table 2

Incidence rates of child out-of-home care placements (N = 33,890) by individual-level and neighborhood-level measures, January 2011–December 2018.

Characteristic	Cases, N (%)	Incidence/100,000 yrs (95 % CI)	Rate ratio (95 % CI)	RII[a] (95 % CI)
Age (years)				
<5	12,173 (36 %)	378 (372, 385)	REF	
5–9	6987 (21 %)	210 (205, 215)	0.55 (0.54, 0.57)	
10–14	7074 (21 %)	209 (205, 214)	0.55 (0.54, 0.57)	
15–17	7189 (21 %)	353 (345, 361)	0.93 (0.91, 0.96)	
18–19	467 (1 %)	35 (32, 38)	0.09 (0.08, 0.10)	
Gender				
Female	16,462 (49 %)	253 (249, 257)	REF	
Male	17,416 (51 %)	257 (253, 261)	1.01 (0.99, 1.04)	
Race				
White	23,263 (72 %)	231 (228, 234)	REF	
Black	7280 (23 %)	296 (289, 303)	1.28 (1.25, 1.32)	
Other	1570 (5%)	211 (201, 222)	0.92 (0.87, 0.96)	
Median household income ($)				10.03 (9.62, 10.45)
4999–26,471	7810 (23 %)	680 (665, 695)	REF	
26,472–33,162	6515 (19 %)	419 (409, 429)	0.62 (0.60, 0.64)	
33,163–39,286	6480 (19 %)	330 (322, 338)	0.48 (0.47, 0.50)	
39,287–47,124	5980 (18 %)	248 (242, 254)	0.36 (0.35, 0.38)	
47,125+	7091 (21 %)	115 (113, 118)	0.17 (0.16, 0.18)	
Households below poverty (%)				8.43 (8.06, 8.81)
20.0+	19,209 (57 %)	420 (414, 426)	REF	
10.0–19.9	11,480 (34 %)	236 (231, 240)	0.56 (0.55, 0.57)	
5.0–9.9	2665 (8 %)	103 (99, 107)	0.24 (0.23, 0.25)	
0.0–4.9	524 (2 %)	43 (39, 47)	0.10 (0.09, 0.11)	
Residents w/ some college (%)				3.49 (3.34, 3.64)
0.0–39.9	13,684 (40 %)	387 (380, 393)	REF	
40.0+	20,205 (60 %)	207 (204, 210)	0.54 (0.52, 0.55)	
Female-headed households (%)				3.59 (3.45, 3.74)
40.0+	12,076 (36 %)	414 (407, 421)	REF	
20.0–39.9	12,481 (37 %)	254 (250, 259)	0.61 (0.60, 0.63)	
0.0–19.9	9319 (28 %)	172 (169, 176)	0.42 (0.40, 0.43)	
Single-parent households (%)				4.02 (3.85, 4.19)
40.0+	16,868 (50 %)	369 (363, 374)	REF	
20.0–39.9	13,027 (38 %)	235 (231, 239)	0.64 (0.62, 0.65)	
0.0–19.9	3981 (12 %)	127 (123, 131)	0.35 (0.33, 0.36)	
Insured (public or private) (%)				2.08 (1.95, 2.22)
0.0–79.9	4006 (12 %)	354 (343, 365)	REF	
80.0+	29,872 (88 %)	246 (243, 248)	0.69 (0.67, 0.72)	
Total population employed (%)				6.11 (5.87, 6.36)
0.0–36.9	10,607 (31 %)	463 (454, 471)	REF	
37.0–41.9	9157 (27 %)	363 (355, 370)	0.78 (0.76, 0.81)	
42.0–45.9	6050 (18 %)	244 (238, 250)	0.53 (0.51, 0.54)	
46.0–49.9	4295 (13 %)	150 (146, 155)	0.32 (0.31, 0.34)	
50.0+	3780 (11 %)	1201 (117, 124)	0.26 (0.25, 0.27)	

[a] RII are not included for individual-level variables age, gender, and race because the levels of the variable do not lend themselves to natural ordering from least to most disadvantaged.

greater risk of children living in more disadvantaged communities being placed in out-of-home care. Accompanying concentration curve indexes were all negative, agreeing that disadvantaged groups had more out-of-home placements, with the highest observed for median household income (CCI= −0.34), percent below poverty (CCI= −0.29), and percent employed (CCI= −0.28).

A sensitivity analysis was conducted wherein the analysis above was carried out on the dataset where repeated out-of-home placement events for children were not removed during the study period (Table S1). As expected, there were more placements and thus higher incidence rates, but disparities with respect to each of the individual- and neighborhood-level risk factors were comparable in interpretation with those from the main analysis using first events only. Thus, the results and implications of our analysis are robust.

4. Discussion

In this study we analyzed 33,890 cases of children placed in out-of-home care from state level administrative child welfare data captured over an eight-year period. Both individual- and census tract-level factors were found to be associated with incidence of child welfare involvement, specifically child placements in out-of-home care. At the individual level, incidence was highest among children <5 and 15–17 years old, equal between male and female children, and higher among Black children. At the neighborhood level, out-of-home placements were most evident in census tracts with lower median household incomes; higher percentages of households below poverty, of female-headed households, or of single parent households; and lower percentages of residents with some college education, of residents with health insurance, and of total population employed. Based on the magnitude of the RIIs, the relative risk attributable
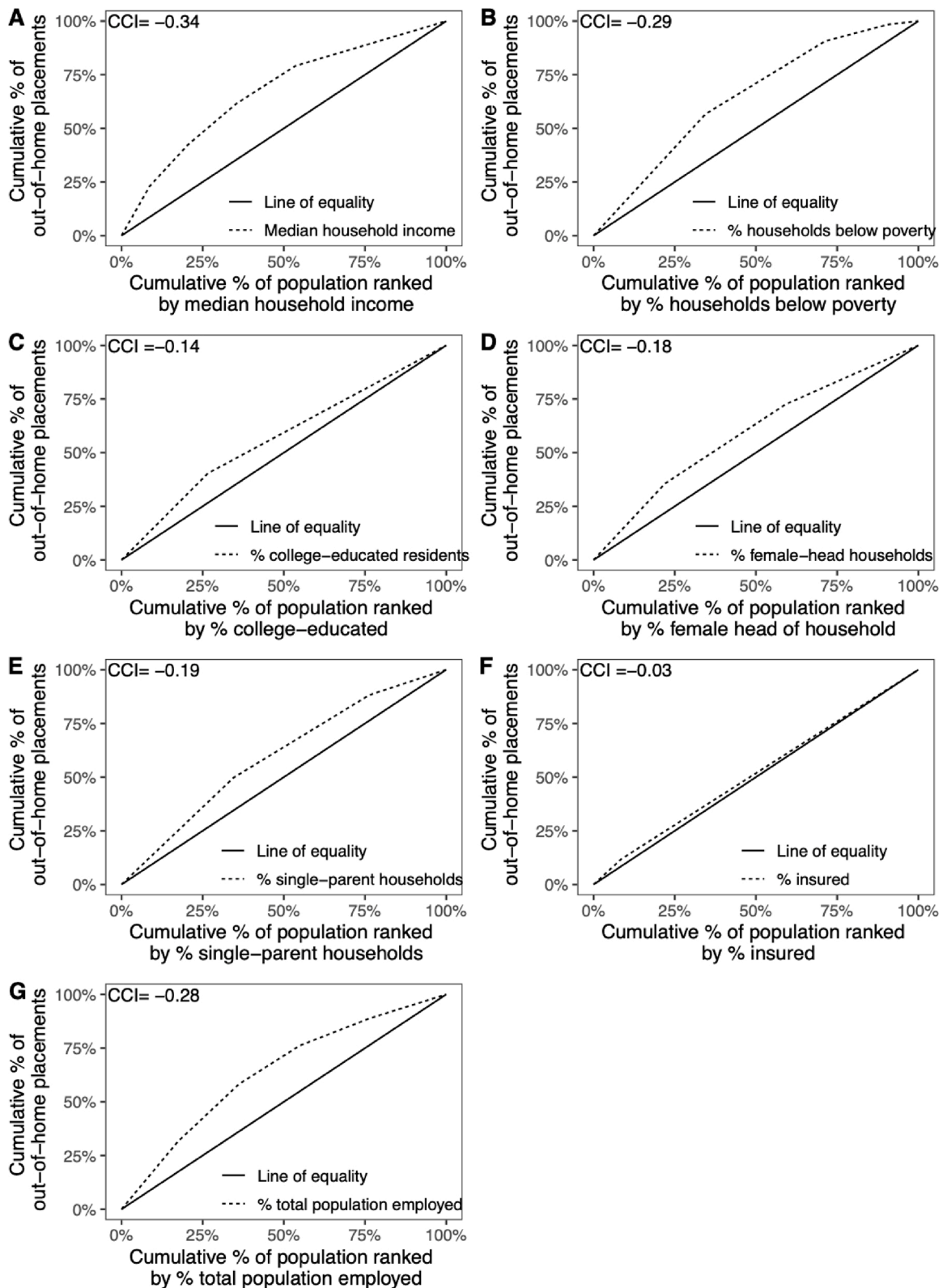
Fig. 1. Concentration curves of neighborhood-level factors and child out-of-home care placements from 2011–2018.

to living in census tracts with low median household income, more households living below poverty, or less of the total population employed were greater than that due to other neighborhood factors. Our results were consistent with nearly thirty years of studies that have noted the positive association between child welfare involvement and neighborhood-level poverty, low income, high unemployment rate, and female-headed households as well as greater risk in neighborhoods with low education status, emphasizing the need to geographically target neighborhood prevention efforts (Bywaters, Brady et al., 2018; Bywaters, Scourfield et al., 2018; Kim & Drake, 2018; Gracia, López-Quílez, Marco, & Lila, 2017; Maguire-Jack, Lanier, Johnson-Motoyama, Welch, & Dineen, 2015; Wulczyn, Gibbons, Snowden, & Lery, 2013; Ben-Arieh, 2010; Merritt, 2009; Coulton, Crampton, Irwin, Spilsbury, & Korbin, 2007; Freisthler, Merritt, & LaScala, 2006; Freisthler, 2004; Freisthler, Midanik, & Gruenewald, 2004; Ernst, 2001; Drake & Pandey, 1996; Deccio, Horner, & Wilson, 1994; Garbarino & Kostelny, 1992; Young & Gately, 1988).

Other studies on neighborhood-level risk factors for child maltreatment or welfare involvement have been limited in sample size, investigated factors over small geographic units such as a single metropolitan area (Ernst, 2001; Gracia, López-Quílez, Marco, & Lila, 2017, 2018; Merritt, 2009), or looked at broad geographic areas such as the United States using neighborhood-level factors at a higher levels of aggregation, such as a county (Kim & Drake, 2018; Maguire-Jack, Lanier, Johnson-Motoyama, Welch, & Dineen, 2015; Wulczyn, Gibbons, Snowden, & Lery, 2013). However, our study covers a large geographic area at the granular level of the census tract, captures data from a stable time period of eight years, and includes a sizable cohort of 33,890 instances of child welfare involvement. In addition, we report multiple unique disparity measures, taken from the health disparities literature, to evaluate consistency in directions of associations. Lastly, our study linked administrative data to census data via geocoding, enabling us to augment the available demographic information with key indicators of socioeconomic status, such as median household income or percentage of households below poverty in the child's neighborhood, which are not routinely captured in administrative databases (Krieger, Williams, & Moss, 1997). As systems and agencies with limited resources set out to identify where and how disparities are occurring, this stands as a promising approach to capture cases as well as identify risk factors that can help inform policy (Smith, Kay, & Womack, 2017).

There are also limitations to address. Secondary analysis of existing administrative data is limited by the potential for unmeasured confounding (Magura & Laudet, 1996; Wells, 2009). Continuous census tract-level factors were analyzed as categorical variables and thus some factors (especially percentage of residents with public or private insurance) had low numbers of events for some categories, leading to some unstable estimates of incidence rates. Since we used census tract-level factors as proxies for individual socioeconomic measures, we acknowledge the possibility of ecological fallacy and that these determinants provide information only regarding the neighborhood that are not reducible to the individual level. Our analysis included only cases from one state in the southern United States, and although disparities exist throughout the country our results may not be generalizable since the extent of disparities and the populations affected vary significantly across geographical locations, as can the policies in place. Lastly, only univariate associations between factors and incidence of out-of-home care are presented. Using more rigorous analytical approaches, future work should (1) consider multivariable or multilevel models to understand the complex relationships between these individual- and census tract-level factors and (2) harness the spatial correlation between census tracts and take a geospatial, or even spatio-temporal, approach.

In conclusion, incidence of children placed in out-of-home care was found to be strongly associated with both individual- and neighborhood-level factors. These neighborhood-level factors offer target areas for specific prevention and control interventions. These include efforts to address census tracts with higher rates of unemployment, to make education more accessible for parents, to provide childcare and support to neighborhoods with higher proportions of single-parent and female heads of household and reduce poverty. Our recommendations are in alignment with existing studies into reducing risk of child abuse that have advocated for more financial resources, educational opportunities, and childcare offerings (Ben-Arieh, 2010; Merritt, 2009).

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.chiabu.2020.104767.

References

Alastalo, M., & Pösö, T. (2014). Number of children placed outside the home as an indicator – Social and moral implications of commensuration. *Social Policy & Administration, 48*(7), 721–738.

Albert, V. N., & Barth, R. P. (1996). Predicting growth in child abuse and neglect reports in urban, suburban, and rural counties. *The Social Service Review, 70*, 58–82.

Bebbington, A., & Miles, J. (1989). The background of children who enter local authority care. *British Journal of Social Work, 19*, 349–368.

Belsky, J. (1980). Child maltreatment: An ecological integration. *The American Psychologist, 35*, 320–335.

Belsky, J. (1993). Etiology of child maltreatment: A developmental-ecological analysis. *Psychological Bulletin, 114*, 413–434.

Ben-Arieh, A. (2010). Localities, social services and child abuse: The role of community characteristics in social services allocation and child abuse reporting. *Children and Youth Services Review, 32*, 536–543.

Butchart, A., Harvey, A. P., Mian, M., Fürniss, T., & Kahane, T. (2006). *Preventing Child Maltreatment: A guide to taking action and generating evidence.* World Health Organization.

Bywaters, P. (2013). Inequalities in child welfare: Towards a new policy, research and action agenda. *British Journal of Social Work, 45*(1), 1–18.

Bywaters, P., Brady, G., Bunting, L., Daniel, B., Featherstone, B., Jones, C., et al. (2018). Inequalities in English child protection practice under austerity: A universal challenge? *Child & Family Social Work, 23*, 53–61.

Bywaters, P., Brady, G., Sparks, T., & Bos, E. (2016). Child welfare inequalities: New evidence, further questions. *Child and Family Social Work, 21*, 369–380.

Bywaters, P., Scourfield, J., Jones, C., Sparks, T., Elliott, M., Hooper, J., et al. (2018). Child welfare inequalities in the four nations of the UK. *Journal of Social Work, 20* (2), 193–215.

Cherry, R., & Wang, C. (2016). The link between male employment and child maltreatment in the U.S., 2000–2012. *Children and Youth Services Review, 66*, 117–122.

Coulton, C. D., Crampton, D. S., Irwin, M., Spilsbury, J. C., & Korbin, J. E. (2007). How neighborhoods influence child maltreatment: A review of the literature and alternative pathways. *Child Abuse & Neglect, 31*, 1117–1142.

Coulton, C., Korbin, J., & Su, M. (1999). Neighborhoods and child maltreatment: A multi-level study. *Child Abuse & Neglect, 23*, 1019–1040.

Deccio, G., Horner, W. C., & Wilson, D. (1994). High-risk neighborhoods and high-risk families: Replication research related to the human ecology of child maltreatment. *Journal of Social Services Research, 18*, 123–137.

Dickens, J., Howell, D., Thoburn, J., & Schofield, G. (2007). Children starting to be looked after by local authorities in England: An analysis of inter-authority variation and case-centred decision making. *British Journal of Social Work, 37*(4), 597–617.

Drake, B., & Pandey, S. (1996). Understanding the relationship between neighborhood poverty and specific types of child maltreatment. *Child Abuse & Neglect, 20*, 1003–1018.

Eckenrode, J., Smith, E. G., McCarthy, M. E., & Dineen, M. (2014). Income inequality and child maltreatment in the United States. *Pediatrics, 133*, 454–461.

Ernst, J. S. (2001). Community-level factors and child maltreatment in a suburban county. *Social Work Research, 25*, 133–142.

Fong, K. (2017). Child welfare involvement and contexts of poverty: The role of parental adversities, social networks, and social services. *Children and Youth Services Review, 72*, 5–13.

Freisthler, B. (2004). A spatial analysis of social disorganization, alcohol access, and rates of child maltreatment in neighborhoods. *Children and Youth Services Review, 26*, 803–819.

Freisthler, B., Merritt, D. H., & LaScala, E. A. (2006). Understanding the ecology of child maltreatment: A review of the literature and directions for future research. *Child Maltreatment, 11*, 263–280.

Freisthler, B., Midanik, L. T., & Gruenewald, P. J. (2004). Alcohol outlets and child physical abuse and neglect: Applying routine activities theory to the study of child maltreatment. *Journal of Studies on Alcohol, 65*, 586–592.

Fresithler, B., & Maguire-Jack, K. (2015). Understanding the interplay between neighborhood structural factors, social processes, and alcohol outlets on child physical abuse. *Child Maltreatment, 20*(4), 268–277.

Garbarino, J., & Kostelny, K. (1992). Child maltreatment as a community problem. *Child Abuse & Neglect, 16*, 455–464.

Gilbert, R., Widom, C. S., Browne, K., Fergusson, D., Webb, E., & Janson, S. (2009). Burden and consequences of child maltreatment in high-income countries. *Lancet, 373*, 68–81.

Gracia, E., López-Quílez, A., Marco, M., & Lila, M. (2018). Neighborhood characteristics and violence behind closed doors: The spatial overlap of child maltreatment and intimate partner violence. *PloS One, 13*(6), Article e0198684.

Gracia, E., López-Quílez, A., Marco, M., & Lila, M. (2017). Mapping child maltreatment risk: A 12-year spatio-temporal analysis of neighborhood influences. *International Journal of Health Geographics*, 16.

Institute of Medicine, & National Research Council. (2014). Describing the problem. In A. C. Petersen, J. Joseph, & M. Feit (Eds.), *New directions in child abuse and neglect research* (pp. 31–62). Washington (DC): National Academies Press.

Kahle, D., & Wickham, H. (2013). Ggmap: Spatial visualization with ggplot2. *R Journal, 5*, 144–161.

Kim, H., & Drake, B. (2018). Child maltreatment risk as a function of poverty and race/ethnicity in the USA. *International Journal of Epidemiology, 47*, 780–787.

Krieger, N., Williams, D., & Moss, N. (1997). Measuring social class in US public health research: Concepts, methodologies and guidelines. *Annual Review of Public Health, 18*, 341–378.

Krieger, N., Chen, J. T., Waterman, P. D., Soobader, M. J., Subramanian, S. V., & Carson, R. (2002). Geocoding and monitoring of US socioeconomic inequalities in mortality and cancer incidence: Does the choice of area-based measure and geographic level matter?: The Public Health Disparities Geocoding Project. *American Journal of Epidemiology, 156*, 471–482.

Krieger, N., Chen, J. T., Waterman, P. D., Rehkopf, D. H., & Subramanian, S. V. (2003). Race/ethnicity, gender, and monitoring socioeconomic gradients in health: A comparison of area-based socioeconomic measures – The Public Health Disparities Geocoding Project. *American Journal of Public Health, 93*, 1655–1671.

Langton, L., Berzofsky, M., Krebs, C. P., & Smiley-McDonald, H. (2012). *Victimizations not reported to the police, 2006–2010.* Washington, DC: U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics.

Lindo, J. M., Schaller, J., & Hansen, B. (2018). Caution! Men not at work: Gender-specific labor market conditions and child maltreatment. *Journal of Public Economics, 163*, 77–98.

Maguire-Jack, K. (2014). Multilevel investigation into the community context of child maltreatment. *Journal of Aggression, Maltreatment & Trauma, 23*(3), 229–248.

Maguire-Jack, K., Lanier, P., Johnson-Motoyama, M., Welch, H., & Dineen, M. (2015). Geographic variation in racial disparities in child maltreatment: The influence of county poverty and population density. *Child Abuse & Neglect, 47*, 1–13.

Magura, S., & Laudet, A. B. (1996). Parental substance abuse and child maltreatment: Review and implications for intervention. *Child and Youth Services Review, 18*, 193–220.

McLoyd, V. C. (1990). The impact of economic hardship on black families and children: Psychological distress, parenting, and socioemotional development. *Child Development, 61*(2), 311–346.

Merritt, D. H. (2009). Child abuse potential: Correlates with child maltreatment rates and structural measures of neighborhoods. *Child and Youth Services Review, 31*, 927–934.

National Research Council. (1993). *Understanding child abuse and neglect* (Vol. 20447). National Academies Press.

Office of Children & Families in the Courts. (2020). *Glossary* (n.d.) http://ocfcpacourts.us/library/glossary/.

Oliver, C., Owen, C., Statham, J., & Moss, P. (2001). *Facts and figures: Local authority variance on indicators concerning child protection and children looked after.* London: Thomas Coram Research Unit.

Paxson, C., & Waldfogel, J. (2003). Work, welfare, and child maltreatment. *Journal of Labor Economics, 20*, 435–474.

Paxson, C., & Waldfogel, J. (1999). Parental resources and child abuse and neglect. *American Economic Review, 89*, 239–244.

Payne, R., & Abel, G. (2012). UK indices of multiple deprivation – A way to make comparisons across constituent countries easier. *Health Statistics Quarterly, 53*, 22–37.

R Core Team. (2019). *R: A language and environment for statistical computing.* Vienna, Austria: R Foundation for Statistical Computing.

Rothman, K. J., & Greenland, S. (2008). *Modern epidemiology.* Philadelphia: Lippincott Williams & Wilkins.

Smith, B. D., Kay, E. S., & Womack, B. G. (2017). How can county-level maltreatment report rates better inform child welfare practice? *Children and Youth Services Review, 79*, 341–347.

Spearly, J. L., & Lauderdale, M. (1983). Community characteristics and ethnicity in the prediction of child maltreatment rates. *Child Abuse & Neglect, 7*, 91–105.

US Bureau of the Census. (1994). *Census tracts and block numbering areas.* Washington, DC: Geographical Areas Reference Manual. Available at: http://www.census.gov/geo/www/garm.html. (Accessed August 31, 2020).

Wagstaff, A., Paci, P., & Van Doorslaer, E. (1991). On the measurement of inequalities in health. *Social Science & Medicine, 33*, 545–557.

Weissman, A. M., Jogerst, G. J., & Dawson, J. D. (2003). Community characteristics associated with child abuse in Iowa. *Child Abuse & Neglect, 27*, 1145–1159.

Wells, K. (2009). Substance abuse and child maltreatment. *Pediatrics Clinics of North America, 56*, 345–362.

Wulczyn, F., Gibbons, R., Snowden, L., & Lery, B. (2013). Poverty, social disadvantage, and the black/white placement gap. *Children and Youth Services Review, 35*, 65–74.

Young, G., & Gately, T. (1988). Neighborhood impoverishment and child maltreatment. *Journal of Family Issues, 9*, 240–254.