

Housing Deterioration Contributes to Elevated Lead Levels and Lower Kindergarten Readiness Scores in Cleveland¹

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A retrospective analysis of the housing histories of more 13,000 entering kindergartners in 2007-10 in Cleveland demonstrates the role that housing plays in early childhood development. Children who spent more time living in or near properties that had signs of deterioration and disinvestment were more likely to have elevated lead levels and to have low scores on a kindergarten readiness assessment. Nearly 40 percent of the entering kindergartners tested above the public health threshold for lead exposure (i.e. blood lead level >5mg/DL). Each year from birth to kindergarten approximately one-third of the children spent time either in or near properties that were in poor condition or showed signs of disinvestment.

Children in many big cities in the US are already at an educational disadvantage when they enter kindergarten, presenting a major challenge for public education systems. In fact, socio-economic inequalities in children's cognitive skills at school entry are significantly higher in the US than in the UK, Canada or Australia². Though it is generally acknowledged that the environment in which children spend their early years is crucial, little is known specifically about how housing conditions, both in children's own family homes and the immediately surrounding areas, factor into disparities in early development and kindergarten readiness. This housing context for children can be a major influence on early development and requires coordinated efforts to address potential risks.

HOW HOUSING PROBLEMS MIGHT AFFECT SCHOOL READINESS

Poor housing conditions can undermine children's early school success by contributing to a number of negative factors, such as parental stress³, triggering unplanned residential moves⁴ or by increasing the chances that the young child will be exposed to harmful substances in the home environment⁵. Housing that has been

vacant or subject to disinvestment tends to have serious maintenance deficiencies that can pose significant risk for such hazards⁶.

Lead exposure is one of the consequences of housing deterioration that has shown clearly negative effects on early cognitive development. Studies show that young children with elevated blood lead levels consistently score lower on school readiness and developmental assessments compared to their unexposed peers⁷. Prolonged disinvestment and lack of maintenance in the affordable housing stock are key factors that persist in explaining economic disparities in lead exposure among young children⁸.

In Cleveland, housing vacancy and disinvestment have been on the rise since the city was hit by the foreclosure crisis more than 10 years ago. In the ensuing years, the city experienced exponential growth in properties that were mired in the foreclosure process, remained vacant for extended periods, were sold at low prices through bulk sales, and suffered serious deterioration⁹. These trends raise concerns about the possible impact of deteriorating properties and lead exposure on the school readiness of Cleveland kindergartners.



THE STUDY DESIGN

We undertook a study of Cleveland kindergartners to examine how the housing conditions that they were exposed to during their early childhood may have contributed to their kindergarten readiness. In particular, we evaluated a variety of markers of disinvestment in the children's residences as predictors of low scores on the kindergarten readiness assessment and of the risk of elevated blood lead levels. We used rigorous research methods to control for bias due to endogenous selection over time and assess the cumulative influence of housing problems at crucial stages of child development.

The study population included all children that entered kindergarten for the first time in the Cleveland Metropolitan School District (CMSD) during the 2007-2010 academic years (N=13,762). The study drew on two integrated data systems maintained by the Center on Urban Poverty and Community Development. The ChildHood Integrated Longitudinal Data (CHILD) system is a secure computing environment that links administrative records on children from multiple agencies that are de-identified for research purposes. NEO CANDO links together historical and current property records from numerous public data sources¹⁰. We compiled monthly address histories for the children in the study from a combination of administrative records, which allowed for the assessment of the timing and duration of numerous measures related to their housing conditions (see table 1), the conditions of the properties within the surrounding 500 feet, the socio-economic composition of their neighborhoods and their levels of residential mobility. Other records supplied data on maternal and child characteristics, any child maltreatment investigations, and the results of blood lead screening tests. The outcome, kindergarten readiness, was

measured by the KRA-L test administered by CMSD¹¹.

STUDY FINDINGS

The kindergartners in this study had a mean KRA-L score of 15.8 out of 29, well below state averages. Only 18 percent had scores in the top band (24-29) width which is considered indicative of not in needing special supports for language and literacy development. Thirty-nine percent of the kindergartners tested positive for lead (>5mg/DL) at some point in early childhood. Prior to entering kindergarten, the children in this study were cumulatively exposed to a number of adverse economic, neighborhood and housing conditions. On average, they spent about three-quarters of their early childhood months in poverty and 66 percent of their time in disadvantaged neighborhoods. However, there was much more variation in housing experiences. The typical child in this study relocated approximately 3 times between birth and kindergarten. Each year, from birth to entering kindergarten, approximately one-quarter of the children lived in units with one or more signs of disinvestment such as foreclosure, tax delinquency or in housing owned by speculators. The average yearly occupancy of houses in poor condition was 18 percent and of low market value was 31 percent.

Housing predictors of lead exposure and kindergarten readiness

The statistical analysis evaluated the cumulative effects of housing problems on the chances that children would have elevated blood lead levels and do poorly on kindergarten readiness assessments, controlling for time-varying housing and neighborhood selection and other childhood risk factors such as poverty and child maltreatment. We focused on estimating the effects of housing attributes that could be

found in public records to develop these predictive models (see table 2 on page 3). We found that the cumulative number of months children lived in housing classified as in poor condition and with estimated market value below \$30,000 (in 2010 dollars) were predictive of an elevated lead test. Moreover, time spent in properties that had markers of disinvestment was an even stronger predictor of lead exposure. These markers included properties that were in the process of foreclosure, had prolonged tax delinquency or had been purchased at very low prices by speculators. Even after accounting for neighborhood and housing selection, these housing market distress factors also had direct negative effects on kindergarten readiness scores and indirect

Table 1. Housing measure and source

Concept	Measure (Unit)	Source
Neighborhood quality		
Concentrated disadvantage	Factor score of six items ^a (Rank, 0-100)	N
Housing characteristics		
Housing condition	Poor condition	H1
Low market value	Market value below \$30,000 (in 2010 dollars)	H1
Public/subsidized housing	Public housing or project based Section 8	H4,H5
Housing market distress		
Tax delinquency	Parcel with tax delinquency	H1
Foreclosure	Parcel in foreclosure	H2
Speculator owned	Parcel owned by speculator ^b	H3

Source:

H1: Cuyahoga County tax assessor
H2: Cuyahoga County Sheriff's department
H3: Cuyahoga County recorder deed transfers
H4: Cuyahoga Metropolitan Housing Authority (CMHA)
H5: Department of Housing and Urban Development (HUD)

N: 2000 Decennial Census and 2009 American Community Survey (ACS)-5 year estimates (www.census.gov)

^a Variables were interpolated between 2000 and 2010. Six items are comprise of individual poverty, unemployment, children, African-American, single-householder, and welfare receipt

^b Real estate owned (REO) sales deeds applied text recognition to identify individuals, companies and LLCs with pattern of buying REO at low values including bulk and individual purchases.

Table 2. Marginal Structural models (MSM) predicting KRA-L and elevated lead levels

Variable	KRA-L model						Lead model		
	Model I			Model II			b*	se	
	b	se		b	se				
Neighborhood quality^a									
Concentrated disadvantage ^b	-0.71	0.20	***	-0.74	0.22	***	0.09	0.01	***
Housing characteristics^a									
Poor condition housing	-0.43	0.23	†	-0.13	0.24		0.04	0.01	**
Low value housing ^c	-0.13	0.20		-0.25	0.20		0.05	0.01	***
Public housing or project based Section 8				-0.15	0.29		-0.01	0.02	
Housing market distress^a									
Parcel with tax delinquency				-0.52	0.29	†	0.06	0.01	***
Parcel in foreclosure				-1.01	0.44	*	0.05	0.02	*
Parcel owned by speculator				-1.25	0.39	**	0.05	0.03	†
Buffer 500ft- Avg. number of parcels									
With tax delinquency				0.05	0.02	*	0.00	0.00	***
In foreclosure				-0.11	0.05	*	0.01	0.00	**
Owned by speculator				0.03	0.05		0.00	0.00	
Mediators									
Child neglect/abuse investigation ^a				-2.21	0.34	***			
Residential moves (average per year)				-0.45	0.17	*			
Lead level in blood >5µg/dL(Ref: Negative)									
(Positive)				-0.84	0.14	***			
(Not tested)				-0.78	0.20	***			

Note †p<.10, *p<.05, **p<.01, ***p<.001. Multiple imputation (m=30). ^a Share of years up to k entry exposed to each condition. ^b Score>70th percentile. ^c <\$30,000 inflation adjusted.

MSM are weighted by the inverse probability of treatment.

KRA-L models (N=13,689) are linear specifications including dummy variable for the year of entry into kindergarten and controlling for family and child background characteristics (not shown). Lead model (N=13,681) is a multinomial logit specification on a three-leveled variable (not tested, tested negative, tested positive) including dummy for year of birth. We present the marginal effects for testing positive. Coefficients b represent the change in the KRA-L score due to a change in the independent variables. Coefficients b* represent the change in the probability of testing positive due to a change in the independent variables.

effects on KRA-L through lead exposure. Additionally, we found that the markers of housing distress in properties within a 500-foot buffer around children’s own homes had spillover effects on increasing children’s risk of lead exposure and poor performance on KRA-L. Living in a neighborhood that was socio-economically disadvantaged was also predictive of lead exposure and low scores on the kindergarten readiness test. However, our analysis shows that the housing problems within these neighborhoods are arguably proximate triggers for some of these apparent neighborhood effects.

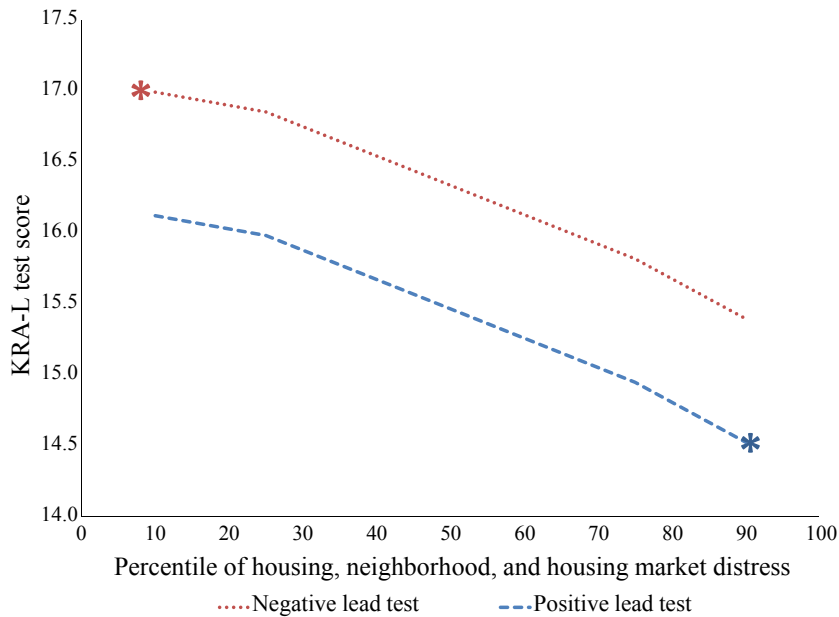
To illustrate the level of educational disadvantage that is likely to occur in children due to living in distressed housing and neighborhood conditions and being exposed to lead, we display estimates from our model in the **figure 1** (on page 4). The figure shows the predicted KRA-L score for children that experience a continuum of housing and neighborhood conditions from the

least disadvantage (10th percentile) to the most disadvantaged (90th percentile). These estimates are shown separately for children that experience an elevated blood lead level (>5mg/DL) and those who tested negative for lead. Comparing the two ends of the continuum, we see that children living in the most deteriorated housing and displaying elevated blood lead levels score 15 percentage points lower on the kindergarten readiness test than do children that live in housing that is not distressed and avoid exposure to lead, all else being equal. This is an educationally meaningful difference that can persist without compensatory intervention.

Geography of lead exposure risk for young children

If housing related lead exposure is to be prevented, we need to focus on the youngest children, prior to their environmental exposure to risk. Lead screening tests, however, are performed

Figure 1. Average predicted test scores for levels of housing and neighborhood distress



at various ages even though it is now recommended that they be done at ages 1 and 2, and are required for children on Medicaid at these intervals. Although the average age of testing for children in this population who tested positive for lead was 2, we present a map (see figure 2) that focuses on the residential location of the children at age 1, a peak period for lead exposure.

It can be seen that there are clear areas of density of positive lead test in particular sections of the city. It should be noted that the children in this study were age 1 in the years 2003-2006. The areas of geographic concentration of lead exposure are likely to vary over time related to changes in the levels of housing and neighborhood conditions in particular locales. Nevertheless, this study points to the importance of tracking linked housing and child-related data continually in order to plan prevention that is effectively targeted on the housing units that are occupied by young children and have markers of disinvestment.

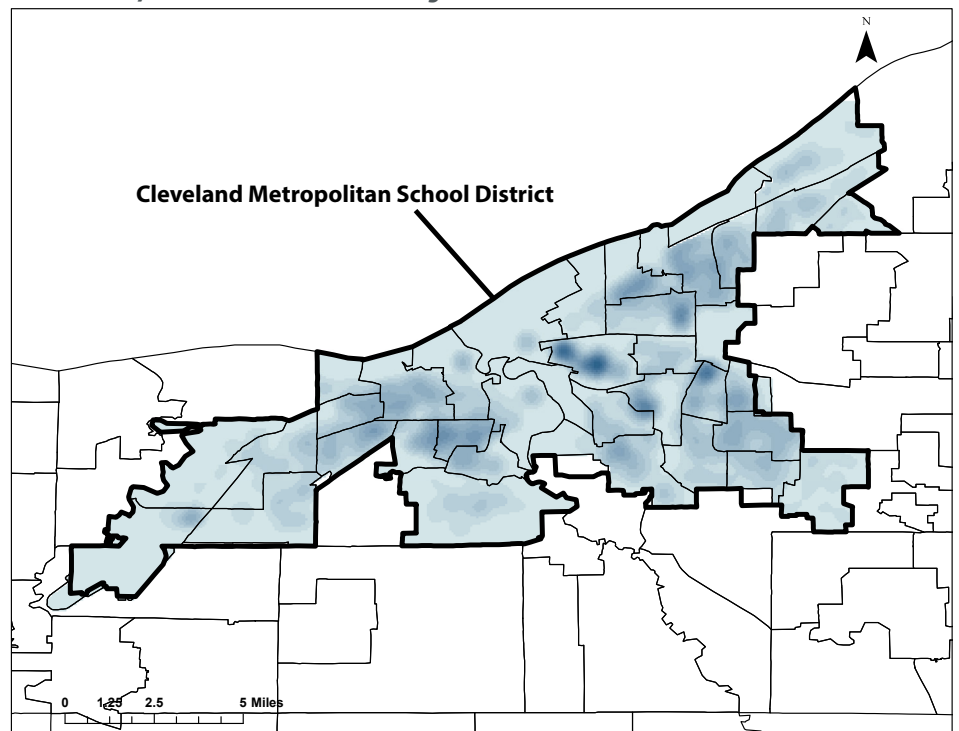
POLICY IMPLICATIONS

Young children are unique in the vital role that housing quality can play because they spend much of their time in the home setting and are quite vulnerable to housing problems that

raise risk of exposure to toxic substances and family distress. Young children are particularly at risk of lead exposure due to developmentally appropriate behaviors that increase their contact with lead and likelihood of ingesting it (e.g., crawling on tainted surfaces, placing fingers in mouth). Deterioration in housing units where young children reside, such as that resulting in elevated lead levels, set the stage for future development. Numerous studies have suggested the deleterious effects of neighborhood socio-economic disadvantage on early development, but this research shows that the state of repair of families' housing units within neighborhoods are a proximal influence that further impacts kindergarten readiness. We also demonstrate that housing market forces play a role in exacerbating housing problems and their effects on children, and that there are spillover effects on children from housing disinvestment in properties in the immediate area.

The findings of this study are pertinent to stimulating policy discussions that fully connect housing and neighborhood conditions to the well-being of young children in urban areas. In particular, current policies that address housing market stabilization and housing quality do not take into account children's housing experiences in their investment

Figure 2. Density map of ever tested positive blood lead levels (>5 µg/dL): By residential address at age 1 (N=5,309 out of 13,768 children)



strategies or allocation of resources. Similarly, policies directed at early childhood education and risk reduction do not incorporate neighborhood and housing conditions into their planning and implementation. Greater attention to the role of housing in educational success could lead to policies and programs to promote school readiness that involve school districts, municipal building and environmental health departments, early childhood programs, housing providers, and community development agencies. Lead exposure, which is exacerbated by housing problems, could be a target for early detection and prevention. Early care and education providers could potentially be a source of information to parents on the importance of housing quality and stability for their young children. Health and human service providers could also play a role in screening for housing problems and in referring at risk families for assistance.

Additionally, communities would benefit from establishing early warning data systems that track properties with characteristics that are high risk for children. Community-based organizations could use such information to prioritize outreach to families in these housing units, facilitating screening for very young children and information to help families evaluate the risk that they face. Working in collaboration with local government, community-based workers could update housing information, lead prevention efforts and the activities of other community development agencies. Supported by a collaborative data tool and an integrated property information system such as the one that was used in this research, community organizations could coordinate their efforts with health department and housing department responsibilities. Together they can reduce the negative impact of housing problems on young children and mitigate the resulting educational disparities.

A full report on this study can be found at povertycenter.case.edu.

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¹¹ For information on CHILD and NEO CANDO see <http://povertycenter.case.edu/data-systems/>

¹⁰ During the study period, Ohio utilized the Kindergarten Readiness Assessment-Literacy (KRA-L) to evaluate children entering school. The KRA-L, is a standardized screening instrument that measures early language and literacy skills. It consists of 25 items that include important subsets of literacy such as oral language, phonological awareness and print awareness (ODE, 2005).

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