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Effects of Proximate Foreclosed Properties on Individuals' Systolic Blood Pressure in Massachusetts, 1987–2008

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Abstract

Introduction—No studies have examined the effects of local foreclosure activity on neighbors' blood pressure, despite the fact that spillover effects of nearby foreclosures include many known risk factors for increased blood pressure. We assessed the extent to which living near foreclosed properties is associated with subsequent systolic blood pressure (SBP).

Methods and Results—We used geocoded 6,590 observations collected from 1,740 participants in the Framingham Offspring Cohort across five waves (1987-2008) of the Framingham Heart Study to create a longitudinal record of exposure to nearby foreclosure activity. We distinguished between Real Estate Owned foreclosures (REOs), which typically sit vacant, and foreclosures purchased by third party buyers, which are generally put into productive use. Counts of lender-owned foreclosed properties within 100 meters of participants' homes were used to predict measured SBP and odds of being hypertensive. We assessed whether self-reported alcoholic drinks per week and measured BMI helped explain the foreclosure activity-SBP relationship. Each additional REO located within 100 meters of a participant's home was associated with an increase in SBP of 1.71 mm/hg (p=.03; 95%CI = 0.18 - 3.24) after adjusting for individual- and area-level confounders, but not with odds of hypertension. The presence of foreclosures purchased by third party buyers was not associated with SBP nor with hypertension. BMI and alcohol consumption attenuated the effect of living near REOs on SBP in fully adjusted models.

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Conclusion—Real Estate Owned foreclosed properties may put nearby neighbors at risk for increased SBP, with higher alcohol consumption and body mass index partially mediating this relationship.

Keywords

Blood pressure; epidemiology; risk factors; stress

Introduction

Social epidemiologists have identified the neighborhood environment as an important social determinant of cardiovascular health,[1–4] including blood pressure.[5–7] To date, none have examined the effects of local foreclosure activity on blood pressure, despite the fact that spillover effects of nearby foreclosures include many known risk factors for increased blood pressure. Specifically, declines in nearby property values, degradation of the neighborhood environment, residential turnover, and other social mechanisms such as stress[8] could result in coping behaviors and physiological stress responses among neighbors that increase blood pressure.[7,9,10] Further, safety,[11] retail environment, and built environment impacts of foreclosure could reduce access to healthy foods or opportunities to be physically active, thereby increasing blood pressure via weight gain.[7,12]

The scale of the recent housing crisis has prompted some in the public health community to call for a better understanding of how foreclosure activity might impact population health.[13–15] In fact, home mortgage foreclosure affected over 6 million mortgages between 2007 and 2010,[16] and more than 1.8 million U.S. homes (1.5% of all housing units) in 2011 alone.[17]

This paper uses detailed temporal and geographic information about foreclosures in Massachusetts between 1987-2008 to provide the first empirical evidence on the effects of living near foreclosed properties on neighbors' systolic blood pressure. We fit a series of three-level, cross-classified linear regression models to test the hypothesis that living within 100 meters of a foreclosed home is associated with higher measured systolic blood pressure. Non-hierarchical multilevel models account for the fact that observations are clustered within both individuals and cities or towns, and simultaneously allow for the fact that participants move over time. We explore possible mechanisms linking exposure to nearby foreclosures and systolic blood pressure, and differentiate between different types of foreclosure activity in order to isolate the most deleterious aspects of the foreclosure process on neighbors' health.

Methods

Study Population

This analysis is based on 6,590 observations collected from 1,740 participants in the Framingham Offspring Cohort. Respondents were geographically dispersed across the Commonwealth, specifically residing in 196 of Massachusetts' 351 municipalities (56%) throughout the course of the study. Approximately 63% of observations were taken from residents of the MetroWest region of the Commonwealth,[18] located west of Boston, which includes Framingham and neighboring municipalities. Municipalities serve as the most important level of local government in Massachusetts, and may operate as a city or a town. About three quarters of the data for this study came from towns, with 2010 populations as low as 1,200, and the remaining observations were taken from respondents living in cities, with populations as high as 617,000.

All observations included in this study were collected during exam waves 4-8 (1987-2008), the time period for which detailed housing data were available. We excluded all observations taken on participants who lived outside the Commonwealth of Massachusetts at the time of their exam because housing data were not available for those observations, which resulted in a dataset that included participants whenever they lived in Massachusetts across the five waves. We also excluded observations missing blood pressure, home address latitude/longitude, or covariate information. Observations have been geocoded to their address at each wave, creating a record of residential moves participants have made over time.[19]

Geocoded and dated Massachusetts foreclosure deed data from 1987-2008 allowed us to construct time-varying measures of proximity to foreclosed properties for all observations in our study. Our main exposure of interest was proximity to foreclosed properties that were transferred back to a bank or other lending institution after homeowner default. Though we refer to these homes simply as “foreclosures” throughout the paper, they are more formally known as *Real Estate Owned*, or lender owned, properties among housing experts. In sensitivity analyses, we also examine proximity to foreclosed properties that were purchased by new buyers, for example at foreclosure auctions, and refer to these new owners as *third party buyers*. Third party buyers might be new families hoping to move into foreclosed homes quickly, or real estate investors hoping to improve and resell property for a profit. We differentiate Real Estate Owned foreclosures, which typically sit vacant for extended periods of time, from foreclosures purchased by third parties because we expect them to have different effects on neighbors. Because they typically remain vacant, foreclosures owned by banks may produce undesirable impacts, or disamenities, by degrading the appearance of a neighborhood or making neighbors feel unsafe. They also increase real estate supply and compete with nearby properties for sale, which can lower local home values. Both these disamenity and supply-side impacts have been shown to lower nearby home values.[20] While foreclosure deeds are part of the public record, the Warren Group, a private Boston-based real estate research company compiled data on these deeds into an electronic data base. The Federal Reserve Bank of Boston geocoded and provided access to these data.

This research received Institutional Review Board exemption from the Office of Human Research Administration at the Harvard School of Public Health.

Proximity to Foreclosures

We used the number of Real Estate Owned foreclosures located within 100 meters of a participant's home in the year leading up to his/her exam as our primary exposure variable. Real estate finance studies documenting the negative effects of foreclosures on neighborhoods have shown effects within 100 meters,[20–23] which is the approximate length of a standard block.[24,25] Based on local zoning data, which was available for over 90% of observations in our study, a 100 meter buffer roughly encompasses two properties on either side of a participant's home, as well as those directly behind and across the street from it, in average neighborhood conditions.[26] We calculated distances between participants and foreclosures in SAS 9.2. Because the goal of this analysis was to examine the effects of nearby foreclosures, rather than individual foreclosure experiences, we excluded foreclosures that were geographically matched to participants.

Systolic Blood Pressure

The outcome of interest was physician-assessed sitting systolic blood pressure, taken after a period of rest, measured using a mercury column sphygmomanometer.

We defined hypertension as a measured SBP greater than or equal to 140 mm/hg,[27] diastolic blood pressure greater than or equal to 90 mm/hg, or being on antihypertensive treatment.

Covariates

Adjusted models controlled for participants' age, race, sex, individual income category (12 categories), and years of education reported in 1983-1987 prior to this study's observational period. We also adjusted for foreclosure counts within .2 - .5 kilometers from participants' homes, counted in 100 meter distance bands, and for total foreclosure counts within a kilometer of participants' homes. Including these variables reduced the risk of confounding by general neighborhood distress. Because broader municipal conditions could also be related to both blood pressure and risk of living near foreclosures, we also adjusted for annual municipal-level foreclosure rates and municipal-level poverty rate. Foreclosure rates were calculated as the percentage of housing units with any foreclosure sales deed that year. Foreclosure sales counts came from our Warren Group data set and annual housing unit counts from the Massachusetts Department of Revenue. Poverty data came from the US Census. Because urbanicity could also confound the relationship between proximate foreclosure counts and blood pressure, we controlled for the number of housing units per residential acre for each municipality. This density measure was based on land use information provided by the Metropolitan Area Planning Council, Greater Boston's regional planning agency, and processed in ESRI's ArcMap 9.3.

Variables representing potential pathways from foreclosure exposure to systolic blood pressure included a count of self-reported number of alcoholic drinks per week, collected at each wave, and body mass index, calculated from height and weight measured at each exam wave (weight (kg)/height (m)^2).

Statistical Analysis

Participants moving across neighborhoods throughout the study created a non-hierarchical, multi-level data structure. We fit a series of three-level cross-classified models with the following specification to account for this structure:[28] systolic blood pressure measured at each wave was conceptualized at Level-1 and indexed by i, nested within both individuals, indexed as $j1$, and municipalities, indexed as $j2$, at Level-2.[29] We used an unstructured covariance matrix to freely estimate statistical dependence among observations within individuals. A random intercept was allowed to vary over every individual-municipality combination, and a fixed linear time effect accounted for secular trends in systolic blood pressure. The covariance matrix used to estimate municipal-level random featured a variance components structure.

The first model in our series examined age-adjusted associations between exposure to proximate foreclosures and systolic blood pressure, modeling time as a linear function after exploring alternative specifications that included a quadratic time term and fixed effects for study wave. Our second model further adjusted for potential individual-level and neighborhood-level confounders. Because our dataset included married couples who would share proximate foreclosure counts as well as other unmeasured environmental determinants of blood pressure, we also fit this fully adjusted model with a random intercept for each married couple. The goal of including a couple-level random effect was to ensure that statistical dependence created by shared household environment did not artificially narrow the confidence interval around our foreclosure exposure parameter estimate.

We added variables that we suspected might lie on the causal pathway between proximate foreclosures and systolic blood pressure, specifically body mass index (BMI) and alcohol consumption, in a third series of models.

As a sensitivity analysis, we fit a two-level growth trajectory model with municipalities as fixed effects and random slopes that could vary for each individual over time, allowing for individual weight trajectories. In addition to accommodating individual trajectories, moving municipalities to the fixed part of the model helped reduce the threat of residual confounding by unobserved municipality factors within waves. We also employed this approach to model odds of becoming hypertensive, defined as a systolic blood pressure ≥ 140mm/hg, diastolic blood pressure ≥ 90 mm/hg, or on antihypertensive treatment, as a second sensitivity analysis.

As a third robustness check, we refit the second model described above, which was a three-level cross-classified model adjusted for individual and neighborhood covariates but not BMI or alcohol consumption, this time using future rather than recent foreclosure activity to predict systolic blood pressure. If our main models did not control for general neighborhood distress at a small enough scale, it would be possible to see effects of proximate foreclosures on blood pressure even if foreclosure activity was just a marker of particularly neglected or dangerous blocks. We were able to exploit the temporal specificity of our data to explore this possibility because foreclosure counts should not vary in relation to participants' exam dates. If observed relationships were causal, we would expect prior, but not future, foreclosures to predict blood pressure. If observed effects were due to confounding by street-level conditions, foreclosure counts taken the year before and after exam dates would be similarly useful in explaining systolic blood pressure.

Our final sensitivity analysis also refit the fully adjusted three-level cross-classified model used for our main analysis but assessed the relationship between systolic blood pressure and foreclosed properties that were sold to third party buyers, rather than transferred back to lenders, after default. Crucially, whether a foreclosed property is purchased by a third party or taken back by the lender is largely independent of local neighborhood environment and condition of the home. Lending institutions handle foreclosed properties (e.g., deciding whether to accept low bids at auction or market properties aggressively) based, in part, on factors such as their overall portfolio of properties and staff available to unload those homes.

We hypothesized that if proximity to foreclosure was causally related to systolic blood pressure, we would find stronger associations between exposure to Real Estate Owned foreclosures and blood pressure than between exposure to foreclosures bought by third parties and blood pressure. If foreclosure activity were simply a marker of neighborhood decline, we would not expect to see differentiation between the two ownership categories because the processes that give rise to foreclosure are consistent regardless of who owns the property after foreclosure.

All models were fit in SAS version 9.2.

Results

Sample characteristics

The sample was overwhelming white, 53% female, and had completed an average of 14 years of schooling at baseline (Table 1). Only 1.6% of participants had previously suffered a myocardial infarction, .4% had previously experienced a cerebrovascular accident, and 3% had secondary cardiovascular disease at the start of the study. Mean systolic blood pressure was 124.3, and prevalence of hypertension was 18.5% at the start of the study, 1987-1991. By the end of the study in 2003-2008, mean systolic blood pressure had increased to 129.2, and 26.5% of participants were hypertensive. Foreclosures were observed within 100 meters of participant homes on 153 occasions (2.3%) in 133 unique participants (7.6%), distributed across 41 municipalities (21%). Due to Massachusetts' early 1990s housing crisis, participants' exposure to foreclosure activity peaked in 1991-1995 as measured by municipal-level foreclosure rates, the number of participants exposed to foreclosures near their homes, and by the mean distance to those foreclosures (Table 2). We found no differences in time-invariant sociodemographic covariates nor baseline systolic blood pressure between those ever versus never exposed to proximate foreclosures (p=.54), or ever versus never exposed to foreclosures within 1 km of their homes (p=.47) (Table 1).

Although we included a measure of housing unit density in adjusted models, it was not correlated with exposure to proximate, recent foreclosures (r = .013, p = .26), suggesting that urbanicity[30] was an unlikely confounder of the systolic blood pressure-foreclosure relationship in this sample. Municipal-level foreclosure rates were not highly correlated with housing unit density nor with poverty rates in this sample (r = 0.12 and 0.19, respectively, p <0.001).

Main models—Each additional foreclosed property located within 100 meters of a participant's home was associated with an increase in systolic blood pressure of 1.71 mm/hg (p=.03; 95%CI = 0.18 - 3.24) after adjusting for individual- and area-level confounders (Table 3). A sensitivity analysis that incorporated a random intercept for each married couple yielded consistent results, with each foreclosed property located within 100 meters of a participant's home associated with an increase in systolic blood pressure of 1.66 mm/hg (p=.04). Foreclosures located more than 100 meters from participants' homes had no effect on systolic blood pressure.

Body mass index and weekly alcohol consumption were both associated with increased systolic blood pressure in fully adjusted models. Both attenuated the relationship between proximate foreclosures and systolic blood pressure, though the effect of foreclosure persisted when body mass index and alcohol consumption were included in separate models. When body mass index and alcohol consumption were included simultaneously, the association between proximate foreclosures and systolic blood pressure decreased in magnitude and became statistically insignificant ($\beta_{foreclosure}$ =1.39 mm/hg (p=.07; 95%CI = -0.09 - 2.86).

Sensitivity analyses—Because the specification of our main models above could not accommodate individual systolic blood pressure trajectories, and in order to rule out uncontrolled confounding by shared municipal environment, we fit a simplified two-level growth trajectory model, moving municipalities from the random to fixed portion of the model (Table 4). Results from this analysis were statistically insignificant, though consistent in direction with the main models ($\beta_{foreclosure}$ = 1.1, p = .15; 95%CI = -0.39 - 2.6). We found no relationship between exposure to each additional foreclosure within 100 meters and odds of being hypertensive (p=.2).

Results from sensitivity analyses meant to rule out uncontrolled confounding by general neighborhood distress, which controlled for neighborhood and area-level covariates, showed no relationship between future foreclosure activity and systolic blood pressure ($\beta_{future\ foreclosure}$ = 0.85 mm/hg (p=.36; 95%CI = (-0.96 - 2.65)). We did not refit this model with controls for alcohol consumption and BMI because initial results were null, obviating the need to explore possible causal pathways from future foreclosure to SBP. Foreclosure sales to third parties were observed within 100 meters of participants' homes on 50 occasions and did not predict systolic blood pressure ($\beta_{3rd\ party\ foreclosure}$ = 0.31 mm/hg (p=. 87; 95%CI =(-3.51 - 4.13)).

Disccusion

The presence of Real Estate Owned foreclosed properties near participants' homes predicted higher measured systolic blood pressure in a large cohort. The observed relationship appears to have been masked in age-adjusted models. The addition of individual-level demographic and socioeconomic covariates did not change results from age-adjusted models; rather, adjustment for neighborhood indicators of urbancity and economic distress did reveal an association between proximate foreclosure count and SBP. The fact that individual-level predictors did not confound observed associations likely reflects the fact that exact date-referenced proximate foreclosure count is largely random within a given neighborhood environment and timeframe. The finding that proximate foreclosures only affect blood pressure conditional on neighborhood urbancity and economic distress is aligned with a relative deprivation understanding of how socioeconomic exposures affect health.[31] The observed null associations between more distant foreclosures and SBP provide additional support for the interpretation that being "singled out," or particularly exposed to foreclosure activity, compared to other nearby neighbors puts individuals at risk of health effects regardless of general economic conditions.

When weekly alcohol consumption and body mass index were added to fully adjusted models, each attenuated the foreclosure-blood pressure relationship. Increased caloric and alcohol consumption are recognized stress coping behaviors that are also risk factors for increased blood pressure,[10,32] providing a plausible mechanism linking exposure to nearby foreclosures to systolic blood pressure. Our recent work shows that time lagged proximate foreclosure activity predicts higher body mass index in this sample,[12] and we also find that for each additional foreclosed property located within 100 meters of a participant's home, alcohol consumption increased by .55 drinks (p=.04; 95%CI = 0.015-1.08). Alcohol consumption did not predict body mass index, however, suggesting that other calorie consumption and/or physical activity patterns are important in helping to explain the foreclosure-blood pressure relationship. Neither alcohol consumption nor body mass index fully explained the effect of proximate foreclosures on their own, but modeling both simultaneously widened confidence intervals to include zero. However, the magnitude of the foreclosure effect remained similar to that detected in previous models and statistical significance was marginal (p=.07), suggesting that there may be an independent effect of proximity to foreclosures not explained by alcohol consumption nor body mass index that should be investigated in a larger sample. These findings should help inform a formal multilevel mediation analysis that identifies and properly accounts for potential confounders of the mediator-outcome relationships, which was beyond the scope of this paper.

Finally, we found null results when modeling municipalities as fixed effects, which could be interpreted as a sign that municipalities were uncontrolled confounders in main models, or that our sample size was not large enough to accommodate the addition of nearly 200 additional fixed effects. In support of the latter interpretation, main models that showed associations between nearby foreclosure activity and blood pressure did account for shared municipal environment through a random effects approach, and showed no association between municipal-level measures of housing or overall economic distress and blood pressure.

Despite the inherent limitations of observational studies for making causal inference, several aspects of our findings suggest that living near foreclosed properties might contribute to increases in systolic blood pressure.

Within a given study wave, proximate foreclosure counts are random with respect to participant exam dates. Constructing exposure variables centered on each participant's exam schedule, we observed that prior foreclosure counts strongly predict future systolic blood pressure, while future foreclosure counts are not associated with systolic blood pressure. If living on a "bad" block were the prior common cause of both foreclosure activity and increased blood pressure, we would not expect to see such temporal specificity. Rather, foreclosure activity as a marker of neighborhood conditions would have similar associations with blood pressure when measured recently before, and soon after, exams. Our finding that only prior foreclosures predicted systolic blood pressure suggests that it is the foreclosure activity itself that impacts participants' health.

Secondly, we found no association between foreclosure sales to third party buyers and systolic blood pressure (p=.87). While the likelihood of a property going into foreclosure is related to the quality of the local neighborhood environment, what happens to foreclosed property after homeowner default is less influenced by the local environment, after accounting for local real estate market. This is because lenders' overall portfolio of properties and their desired timing of losses and gains on balance sheets,[33,34] among other considerations, influence their decisions about repossessing, holding, and re-selling foreclosed homes. In other words, even desirable homes may not be sold at foreclosure auctions because of complex lender-level decisions. In our analyses, including a random effect for municipality, municipal-level covariates, and 1 kilometer foreclosure activity counts effectively controlled for real estate market and within-market neighborhood conditions that might influence whether foreclosures are sold at auction to third party buyers or held by lenders. We found that while proximity to lender owned foreclosures was related to systolic blood pressure, exposure to foreclosures sold to third parties was not. Uncontrolled confounding of the foreclosure-systolic blood pressure relationship by street-level factors would have manifested as spurious associations between exposure to both classes of foreclosures and systolic blood pressure, yet our findings differentiate the two, as hypothesized. With only 50 instances of foreclosures bought by third parties being located within 100 meters of participants' homes, compared to 153 instances of foreclosures owned by lenders, it is possible that a larger sample of foreclosures to third party buyers would have uncovered different results. Replicating these analyses in different settings and larger cohorts is crucial to understanding the relationship between nearby foreclosure activity and blood pressure.

In summary, our findings suggest that Real Estate Owned foreclosed properties may put nearby neighbors at risk for increased systolic blood pressure, with increased alcohol consumption and body mass index partially mediating this relationship. While our findings are based on observational data and have not been tested in other populations or time periods, potential confounders sensitive to both participant exam dates and to the fate of nearby properties are hard to identify. Sensitivity analyses that differentiate between Real Estate Owned foreclosures and those sold to third parties provide further insight into which specific aspects of foreclosure that may be most deleterious to health. Local residents may lose social ties or be called upon for social support when a neighbor goes into foreclosure regardless of whether the property is sold to a third party or repossessed by the lender after default. However, only Real Estate Owned foreclosures appear to impact systolic blood pressure. This suggests that spillover effects unique to lender owned foreclosures, including supply-side impacts on nearby home values and vacancy, may be most deleterious.

Health care providers, particularly those serving neighborhoods still recovering from the recent housing crisis, should be aware of foreclosures activity as a possible source of unhealthy stress for residents. Individuals personally affected by localized foreclosure activity may perceive their own properties to be less valuable, their streets to be less attractive or safe, and their neighborhoods to be less stable. Making these individuals aware that nearby foreclosures could prompt increased alcohol consumption or weight gain might help patients deliberately monitor their own health behaviors in the face of stress. Finally, policy makers should investigate prudent options for getting more vacant, lender owned foreclosures back into productive use in order to minimize the impacts of the recent housing crisis on public health.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Sample Characteristics by Exposure to Foreclosure Activity

Mean (SD)	All participants	Never exposed to foreclosures within 100 meters	Ever exposed to foreclosures within 100 meters	Never exposed to foreclosures within 1 km	Ever exposed to foreclosures within 1 km
Participants	1,740	1,607	133	347	1,393
Years of education (1983-1987)	13.9 (2.2)	13.9 (2.2)	13.8 (2.2)	13.9 (2.3)	13.9 (2.2)
Income category* (1983-1987)	6.4 (3.2)	6.5 (3.2)	6.1 (3.1)	6.1 (3.3)	6.5 (3.2)
Year of birth	1938.6 (9.3)	1938.6 (9.3)	1938.5 (9.5)	1938 (9.8)	1938.8 (9.2)
BMI (1987-1991)	26.7 (4.8)	26.7 (4.8)	26.3 (4.5)	26.9 (4.7)	26.7 (4.8)
Systolic Blood Pressure (1987-1991)	124.3 (17.5)	124.2 (17.6)	125.1 (17.2)	123.6 (18.4)	124.4 (17.3)
Municipal poverty rate (1987-1991)	5.3 (2.5)	5.3 (2.5)	5.7 (2.7)	5.9 (3.4)	5.2 (2.2)
Municipal foreclosure rate (1987-1991)	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)
Proportion hypertensive (1987-1991)	18.5%	18.7%	15.9%	19.3%	18.3%
Proportion White	99.5%	99.6%	99.3%	99.4%	99.6%
Proportion female	52.7%	52.8%	51.9%	55.0%	52.1%

* 1983-1987 income categories are as follows:

1. NO INCOME
2. LESS THAN $5,000
3. $5,000 TO $9,000
4. $10,000 TO $14,000
5. $15,000 TO $19,000
6. $20,000 TO $24,000
7. $25,000 TO $29,000
8. $30,000 TO $34,000
9. $35,000 TO $39,000
10. $40,000 TO $44,000
11. $45,000 TO $49,000
12. MORE THAN $50,000

Table 2

Exposure to Foreclosure Activity by Wave

	Wave				
	1987-1991	**1991-1995**	**1995-1998**	**1998-2001**	**2005-2008**
Sample size	1,711	1,706	1,677	1,648	1,547
No foreclosures present within 1 kilometer	1,665	570	832	1,165	1,202
Participants with foreclosures present within 1 kilometer “neighborhood”	46	1136	845	483	372
Mean distance to closest foreclosure within 1 kilometer “neighborhood”	0.52	0.48	0.52	0.59	0.57
Participants with foreclosures present within 100 meters	2	78	37	24	12
Mean assessed value of foreclosures within 100 meters of participants ($2011)	$244,450	$294,586	$241,186	$198,756	$229,475
Municipal-level foreclosure rate	0.04	3.04	1.64	0.65	0.52
Municipal-level poverty rate	5.35	4.52	4.57	4.83	5.62

Table 3

Associations between Recent Exposure to Proximate Real Estate Owned Property and Systolic Blood Pressure, Unadjusted and Adjusted Three-Level Cross-Classified Models

	Age-adjusted[a]		Adjusted for SES and Demographics[b]		Adjusted for SES, Demographics, and BMI[c]		Adjusted for SES, Demographics, and Alcohol Consumption[d]		Adjusted for SES, Demographics, BMI, and Alcohol Consumption[e]	
	Coefficient (SE)	95% CI	Coefficient (SE)	95% CI	Coefficient (SE)	95% CI	Coefficient (SE)	95% CI	Coefficient (SE)	95% CI
REOs within 100 meters	1.12 (0.72)	(-0.29 - 2.52)	1.71 (0.78)*	(0.18 - 3.24)	1.52 (0.76)*	(0.04 - 3.01)	1.59 (0.78)*	(0.06 - 3.11)	1.39 (0.75)†	(-0.09 - 2.86)
Body Mass Index					0.81 (0.05)***	(0.7 - 0.91)			0.82 (0.05)***	(0.71 - 0.92)
Alcoholic Drinks per Week							0.19 (0.03)***	(0.13 - 0.25)	0.21 (0.03)***	(0.15 - 0.27)

*** p<.001,

** p<.01,

* p<.05,

† p<.1

[a] Model includes a linear time term and is adjusted for age.

[b] Model includes a linear time term and is adjusted for age; sex; race; education; income; municipal poverty rate; municipal foreclosure rate; housing unit density at the municipal-level; foreclosure count within 1 km of participants' homes; antihypertensive medication use; and counts of Real Estate Owned Property within 100 – 200 meters, 200 – 300 meters, 300 – 400 meters, and 400 – 500 meters of participants' homes.

[c] Model includes a linear time term and is adjusted for age; sex; race; education; income; municipal poverty rate; municipal foreclosure rate; housing unit density at the municipal-level; foreclosure count within 1 km of participants' homes; antihypertensive medication use; measured body mass index; and counts of Real Estate Owned Property within 100 – 200 meters, 200 – 300 meters, 300 – 400 meters, and 400 – 500 meters of participants' homes.

[d] Model includes a linear time term and is adjusted for age; sex; race; education; income; municipal poverty rate; municipal foreclosure rate; housing unit density at the municipal-level; foreclosure count within 1 km of participants' homes; antihypertensive medication use; number of alcoholic drinks consumed per week; and counts of Real Estate Owned Property within 100 – 200 meters, 200 – 300 meters, 300 – 400 meters, and 400 – 500 meters of participants' homes.

[e] Model includes a linear time term and is adjusted for age; sex; race; education; income; municipal poverty rate; municipal foreclosure rate; housing unit density at the municipal-level; foreclosure count within 1 km of participants' homes; antihypertensive medication use; measured body mass index; number of alcoholic drinks consumed per week; and counts of Real Estate Owned Property within 100 – 200 meters, 200 – 300 meters, 300 – 400 meters, and 400 – 500 meters of participants' homes.

Table 4

Associations between Recent Exposure to Proximate Real Estate Owned Property and Systolic Blood Pressure in Adjusted Three-Level and Two-Level Models

Municipalities Treated as Random Effects[a]		Municipalities Treated as Fixed Effects, Individual Systolic BP Trajectories[b]	
Coefficient (SE)	95% CI	Coefficient (SE)	95% CI
1.71 (0.78)*	(0.18 - 3.24)	1.1 (0.76)	(-0.39 - 2.6)

*** p<.001,

** p<.01,

* p<.05,

† p<.1

[a] Model includes a linear time term and is adjusted for age; sex; race; education; income; municipal poverty rate; municipal foreclosure rate; housing unit density at the municipal-level; foreclosure count within 1 km of participants' homes; antihypertensive medication use; and counts of Real Estate Owned Property within 100 – 200 meters, 200 – 300 meters, 300 – 400 meters, and 400 – 500 meters of participants' homes.

[b] Model includes a linear time term and is adjusted for age; sex; income; foreclosure count within 1 km of participants' homes; antihypertensive medication use; and counts of Real Estate Owned Property within 100 – 200 meters, 200 – 300 meters, 300 – 400 meters, and 400 – 500 meters of participants' homes. Race and education were excluded due to a lack of variability in these factors within municipalities, leading to convergence problems.