Community change and resident needs: Designing a Participatory Action Research study in Metropolitan Boston

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ABSTRACT

The health implications of urban development, particularly in rapidly changing, low-income urban neighborhoods, are poorly understood. We describe the Healthy Neighborhoods Study (HNS), a Participatory Action Research study examining the relationship between neighborhood change and population health in nine Massachusetts neighborhoods. Baseline data from the HNS survey show that social factors, specifically income insecurity, food insecurity, social support, experiencing discrimination, expecting to move, connectedness to the neighborhood, and local housing construction that participants believed would improve their lives, identified by a network of 45 Resident Researchers exhibited robust associations with self-rated and mental health. Resident-derived insights into relationships between neighborhoods and health may provide a powerful mechanism for residents to drive change in their communities.

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1. Background

Convincing evidence links many of the neighborhood changes sought by healthy community development initiatives (Williams and Marks, 2011; Rogerson et al., 2014) to better health. Exposure to lower neighborhood-level poverty has been shown to reduce the risk of diabetes and extreme obesity (Ludwig et al., 2011), fewer vehicles miles traveled have been linked to reductions in childhood asthma episodes (Friedman et al., 2001), and more walkable built environments may promote lower body mass index (Arcaya et al., 2014a), among other examples (Kawachi and Berkman, 2003). Further, Health Impact Assessments predict that health improvements are likely to follow the construction of urban development projects that provide affordable housing, improve transit-access, improve air quality and reduce injury risk by decreasing vehicle miles traveled, and promote economic stability (Metropolitan Area Planning Council, 2013).

However, despite a large and growing body of work (Arcaya et al., 2016; Oakes et al., 2015) showing observational associations, and in rare cases causal estimates of neighborhood effects on health (Ludwig et al., 2011), there is limited evidence on how to effectively promote health through urban development, or how to mitigate health risks associated with urban development projects. Efforts to promote health through changing the neighborhood environment could fail if health benefits depend on specific contextual mediators, or only operate within certain populations. Additionally, poorly understood, unintended consequences of development, including the potential for accelerated gentrification and associated displacement, could overwhelm any salutary effects of what is intended to be "healthy development" (Cole et al., 2017).

For example, development that lowers neighborhood poverty rates, improves housing quality, and provides access to green space could also help drive up rents, putting existing residents at risk of higher housing cost burden, crowding, displacement, and dislocation from neighborhood-based social and material resources (Aboelata et al., 2017). Given the growing interest in neighborhood effects on health, there are surprisingly few studies that evaluate the benefits and risks of urban development efforts to make residents healthier (Oakes et al., 2015).

In part, this gap in the research reflects a paucity of wellness-based development projects to evaluate. Centering real estate investment and development decisions on the goal of improving health is a relatively new phenomenon (Pastor and Morello-Frosch, 2014). An example of one such effort is the Healthy Neighborhoods Equity Fund (HNEF), a $23 million private equity fund created to support healthy neighborhood development by investing in mixed-income, mixed-use transit-oriented development (TOD) real estate projects in urban areas across Massachusetts that exhibit poor health outcomes and demonstrate a need for economic growth (HNEF and Home Internet, 2017). TOD includes a mixture of housing, office, retail, and other amenities integrated into a walkable neighborhood, and located within a quarter to a half-mile of public transportation. HNEF finances projects that improve neighborhood conditions and support the community's vision for growth in neighborhoods that are in the early stages of economic and social change. The Fund was co-founded by the Conservation Law Foundation in partnership with the Massachusetts Housing Investment Corporation.

This paper reports study design and baseline results from the Healthy Neighborhoods Study (HNS), an investigation into how transit-oriented developments supported by HNEF and other funding sources affect health and wellbeing. We note that HNEF has no financial stake in the outcome of HNS, which is independently funded by the Robert Wood Johnson Foundation. HNEF investments are not tied to, nor dependent upon, the results of the HNS. A Participatory Action Research (PAR) (Baum et al., 2006; Cornwall and Jewkes, 1995) approach grounds the HNS in the insights and lived experiences of community residents, involving residents in all aspects of study design and analysis (Wallerstein et al., 2017).

PAR, like Community Based Participatory Research (CBPR) (Wallerstein et al., 2017) and "popular epidemiology" (Brown, 1993), falls within the family of participatory epidemiology practices. At the foundation of participatory epidemiology are equitable research partnerships, often comprising academic, community-based, public agency, non-profit, and other traditionally silent stakeholders (Bach et al., 2018), that integrate diverse perspectives on health and its determinants. The novel, multifaceted insights such partnerships uncover can extend modern epidemiology's (Rothman et al., 2008) ability to investigate complex, interacting determinants of health at the individual-, neighborhood-, and policy-levels (Bach et al., 2018; Krieger, 1994). As such, participatory research is a well-recognized best practice for exploring links between neighborhoods and health, and for understanding neighborhood-level interventions (Minkler et al., 2008).

The objective of this paper is to describe an innovative application of PAR to understand how urban development influences social determinants of health, and ultimately population health. We present our participatory research design, introduce study protocols that were developed by a community-centered research network, present baseline survey data, and examine associations between resident-prioritized health risk/protective factors and self-reported health metrics from the first year of the study.

2. Study methods

HNS examines: 1) health risks that could be effectively addressed through development activities, and 2) residents' complex relationship with neighborhood conditions and neighborhood change in order to identify health risks and protective factors introduced by new development. HNS is a multi-site, longitudinal PAR study that is centered on a network of 45 "Resident Researchers" working collaboratively with academic, non-profit, and public agency partners. The study team designed and collected baseline surveys on individual characteristics and neighborhood perceptions from respondents in nine low-income urban neighborhoods in the metropolitan Boston region (see Exhibit 1) that are experiencing rising real estate development pressures.

2.1. Study design

To capture a range of development contexts, nine neighborhoods in the greater Boston metropolitan area were selected for the study. These neighborhoods are places where large investments in TOD from HNEF or other public and private funding sources were likely to occur in the next five years, and which exhibit poor population health and economic disadvantage. Specific criteria for site selection included: 1) the presence of a walkable urban center located near public transit, 2) significant need, and opportunity for, economic growth, 3) early to mid-stage transformational growth, and 4) poor population health outcomes. We used these criteria to screen municipalities and neighborhoods across Massachusetts for inclusion, relying on grey and scholarly literature to understand local built form, development context, and health status (Arcaya et al., 2014b; Leinberger and Lynch, 2015). To select study sites within the sample of neighborhoods that met the criteria above, we focused on areas with the highest rates of the following health challenges, which were ranked by HNS research partners the Metropolitan Area Planning Council and Massachusetts Department of Public Health for the purposes of site screening: chronic heart disease, cardiovascular disease, chronic obstructive pulmonary disease, diabetes, hypertension, stroke, substance abuse, and asthma.

Within the least healthy quartile of sites that met the original screening criteria, we identified three communities expected to receive HNEF investments over the short term. These were matched to six otherwise similar control communities that lack planned investments (Exhibit 1). Matching relied on a multidimensional, demographic, socioeconomic, built form, and health community typology (Arcaya et al., 2014b), geographic proximity, and real estate development pressure,

Exhibit 1
Healthy Neighborhoods Study site.
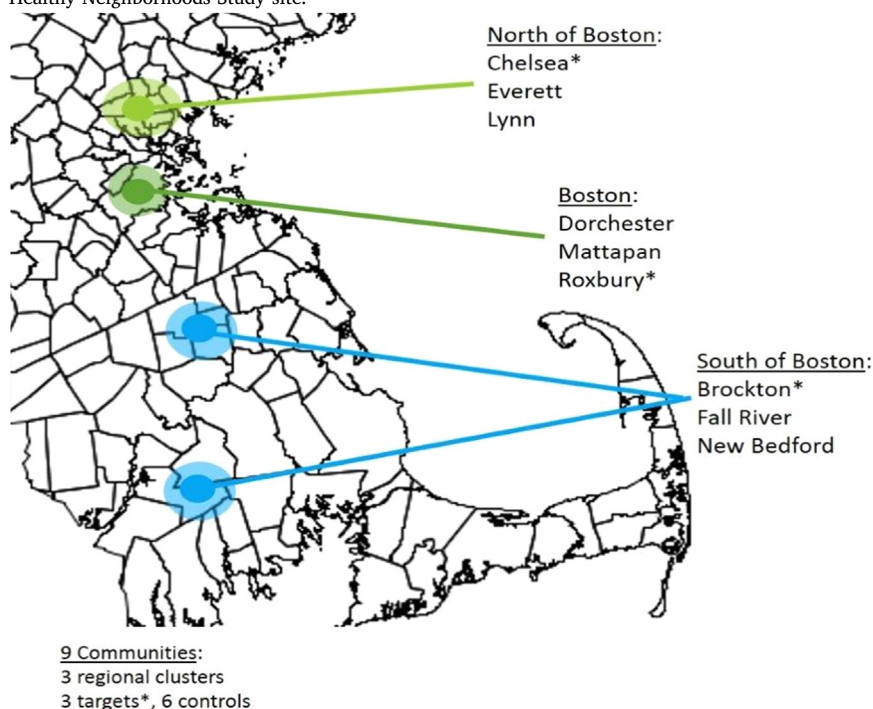
among other factors. This design will allow HNS to track changes in community composition and health as new development occurs, and to compare built environment and wellness outcomes in neighborhoods that did and did not experience transformative development. Within each selected community, we defined the HNS study area as within one-half mile of its most frequently used train, commuter rail, or bus transit hub.

HNS uses a combination of primary and secondary data. Primary data collection efforts are designed and led by Resident Researchers in each of the study neighborhoods, and focus on measuring resident experiences of their neighborhoods and health. HNS also partnered with local stakeholders to collect and centralize data from both publically available and proprietary secondary sources to track changes in neighborhood built environment, social conditions, and economic development.

2.2. Community Partnerships and Resident Researcher recruitment

We built a PAR network comprising Resident Researchers, local organizations, and academic and government institutions to design and carry out the study together. One high capacity community-based organization in each of the nine neighborhoods served as a Community

Partner Organization that recruited and managed a team of Resident Researchers, informed the research design, anchored HNS activities in the local community, and used lessons learned from the study to inform community development and organizing practices.

We used a two-step process to identify Community Partner Organizations: first, we generated a preliminary list of 60 potential partners across all study communities through a web search and based on recommendations from HNS partners in public agencies and academic institutions. We reviewed each organization's website to understand its mission, assess potential fit in the research consortium, and gauge its experience leading community organizing work. We further screened organizations according to four criteria:1) leading community-based work in the areas of community development, housing, health, or environmental justice; 2) a recognized history of active community presence; 3) capacity to engage at least 200 local residents in the project; and 4) an extensive and deep network of stakeholder relationships with local leaders and organizations. We made contact with all organizations that met screening criteria by email and phone to gauge their interest in participating in the study, and then met with interested organizations to further explore fit and capacity. We shared a final list of potential partners with long-standing community partners and residents who provided feedback on the potential partnerships with

Exhibit 2
HNS baseline community partners.

Community	Partner	Areas of Focus
Roxbury	Dudley Street Neighborhood Initiative	Community-based planning and organizing; development without displacement
Dorchester	Codman Square Neighborhood Development Corporation	Real estate development; economic development; community-building
Mattapan	Redefining Our Community	Neighborhood organizing; community development; advocacy
Chelsea	GreenRoots	Environmental justice; youth leadership; public health; climate resiliency
Everett	Everett Community Health Partnership	Healthy communities; community health planning; social determinants of health
Lynn	Lynn United for Change Empowerment Project	Anti-displacement organizing and advocacy; foreclosure and eviction support; economic justice
Brockton	CityLife/Vida Urbana	Tenant rights; Racial, social and economic justice; direct action; anti-displacement organizing and advocacy
Fall River	YMCA Voices for a Healthy South Coast	Healthy communities; physical activity and nutrition; coalition-building
New Bedford	YMCA Voices for a Healthy South Coast	Healthy communities; physical activity and nutrition; coalition-building

existing research consortium members. Based on these final re-commendations, we selected a final group of eight partners (Exhibit 2).

Each Community Partner Organization recruited a team of three to five community members familiar with the study neighborhood to be trained as Resident Researchers. Resident Researchers needed to be: 1) 16 years of age or older, 2) residents of the study neighborhood, or former residents who recently moved, 3) able to participate in work-shops in English, and 4) able to conduct surveys in English, Spanish, and/or Haitian Creole. Resident Researchers are diverse in terms of age, nationality, race, education, occupation, length of time in the neigh-borhood, experience with civic engagement, community service and research, and personal interests, but are unified by a shared commit-ment to improving the future of their communities. Resident Researchers were paid a living wage of $15 per hour for 70 hours the course of the baseline study year to participate in training (collabora-tive scoping and instrument design), data collection (survey adminis-tration), collaborative data analysis, and the dissemination of findings back to their communities through a resident-led action strategy.

2.3. PAR process

The HNS PAR process consisted of five phases: 1) scoping: building relationships, setting research goals and expectations; 2) knowledge exchange and research design: drawing on Resident Researchers' lived experiences to develop a theory of change, identify research domains and develop data collection tools and methods; 3) training: formal training to use the instrument for data collection and completion of Institutional Review Board-approved research ethics training modules; 4) data collection; and 5) data analysis: collaborative synthesis, ana-lysis, and interpretation of data results with Resident Researchers, Community Partner Organizations, and academic and institutional partners.

In phase 1, Resident Researchers and Community Partner Organizations identified learning and capacity-building goals for their participation in the study. Resident Researchers and Community Partner Organizations established the following as shared goals: 1) expanding local research capacity, and 2) using data to inform policy advocacy, regional community organizing strategies, community health improvement strategies, and affordable housing development and pre-servation campaigns.

In phase 2, we developed a theory of change which identified connections between mixed-income, mixed-use TOD and health. First, academic and public agency partners identified potential connections, including the directionality and strength of each connection, using a health impact assessment and related literature review (Metropolitan Area Planning Council, 2013). Then, in collaborative research design workshops, Resident Researchers used a combination of experiential observation, journaling exercises, storytelling, and community con-versations to identify additional connections between urban develop-ment and health, and to critically engage with and adapt the initial theory of change. This process identified ten key connections: housing, neighborhood fit, social support, local business, financial security, food security, ability to meet personal life priorities, experiences with ra-cism, physical health and mental health, and ownership of community change. The full research team then used the connections identified through both processes to produce a final theory of change (Exhibit 3) that integrated resident perspectives and emphasized resident in-volvement in and ownership of neighborhood changes, prioritized constructs to measure through primary data collection, and established consensus to collect said data using a survey instrument. Partners then worked together to co-design a survey tool as described in the "survey measures" section below.

In phase 3, Resident Researchers completed a series of training workshops on survey administration, data collection, and research ethics, and developed a sampling methodology and protocol to guide field data collection.

We used heterogeneous purposive sampling – convenience sampling with intentional selection of diverse respondents – designed to yield responses across the geographic, demographic, housing, and socio-economic strata of residents living in each research site (Cook et al., 2002). Resident Researchers from each community identified four po-pulation characteristics they felt were crucial to ensuring representa-tion of their community in the sample; for example, one community selected age, race, ratio of family income to rent burden, and neigh-borhood tenure. This strategy ensured the sample represented the neighborhood across characteristics identified as salient by community residents. Each team then mapped where in the community residents with different levels of the selected characteristics lived or spent time. Within the areas identified on the map, Resident Researchers identified participants using three different methods: public intercept surveying in public spaces such as libraries parks and sidewalks, recruitment at community events, and door knocking.

Resident researchers collected 305 survey responses across the nine neighborhoods between July 2016 and January 2017 (phase 4). Survey respondents were compensated with a $10 gift card to local businesses chosen by Resident Researchers or a transit pass of equivalent value. Halfway through data collection, we reviewed respondent character-istics by neighborhood and revised sampling plans as needed to ensure representativeness across community-determined characteristics.

In phase 5, the study team ran three collaborative data analysis workshops, offering one workshop in each regional cluster, to explore baseline data. Prior to the workshops, Resident Researchers reflected on their experiences collecting survey data to refine hypotheses about the relationships among constructs measured by the survey. Academic partners then ran preliminary analyses to explore and test these refined hypotheses. During the workshops, Resident Researchers and re-presentatives from Community Partner Organizations discussed the preliminary analysis, reviewed descriptive statistics from the sample, explored unexpected patterns in the data, and generated a new round of hypotheses about specific constructs and broader relationships between neighborhoods and health. In this article, we describe the key measures included on the baseline HNS survey and discussed during the colla-borative data analysis, and report univariate statistics and measures of association between resident-hypothesized health risk/protective fac-tors and both mental and self-rated health measures.

2.4. Ethics

Resident Researchers underwent *CIRTification*, a human subjects research ethics training designed for community-engaged research by the Center for Clinical and Translational Science at the University of Illinois at Chicago. Academic and other research team members af-filiated with institutional partners completed traditional human sub-jects research training through CITI. HNS was approved by MIT's Committee on the Use of Humans as Experimental Subjects.

2.5. Survey measures

The HNS baseline survey (Technical Appendix) was a multi-dimensional instrument that collected data in twelve domains including demographics, household composition, housing and neighborhood conditions, financial security, social support, health, food, transporta-tion, discrimination, life priorities, local businesses, and ownership of neighborhood change. We employed, or slightly modified, validated and reliable measures to capture commonly studied constructs, and added new supplementary questions on dimensions of constructs based on recommendations from Resident Researchers. Resident Researchers and other research team partners also developed and tested new questions to capture constructs that lacked good precedents in the lit-erature, including feeling ownership over neighborhood change. Re-sident Researchers piloted the baseline survey on family and friends residing in the study neighborhoods before questions were finalized.

Exhibit 3
HNS theory of change.
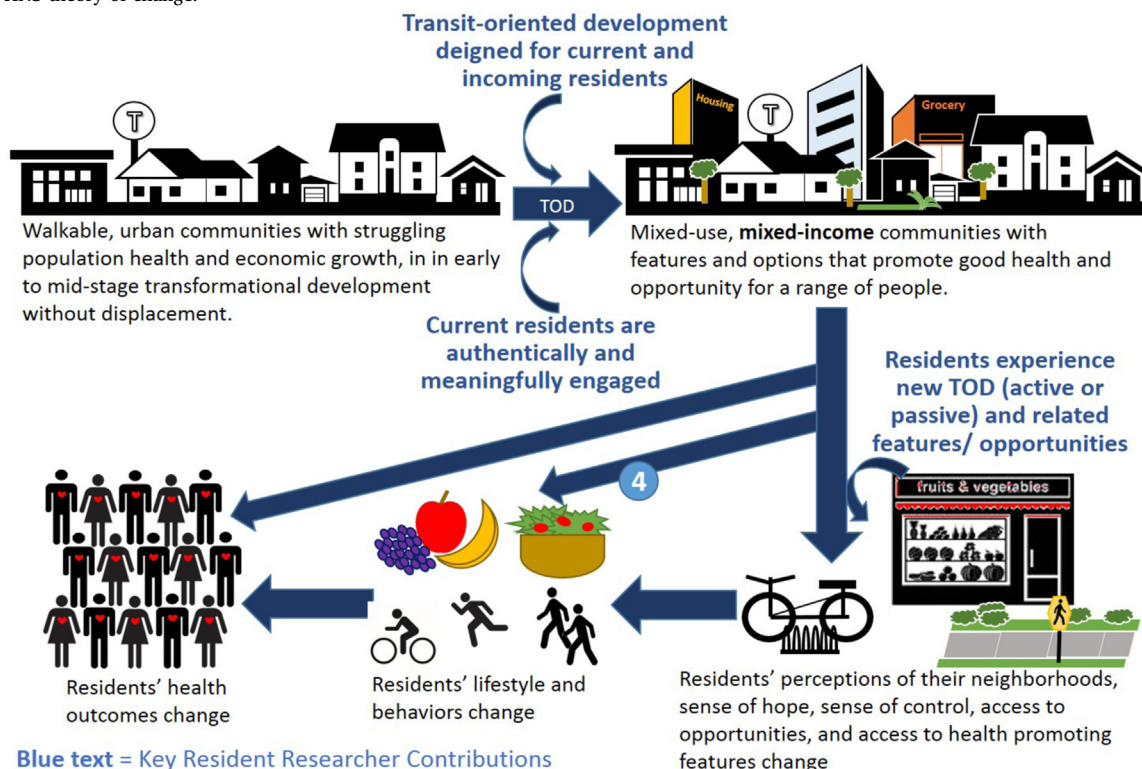
Primary health outcomes included on the survey are self-rated health and mental health. We used a single-item measure of self-rated health, reported on a 5-point likert scale, with higher scores representing better health. This measure is a widely used indicator of general health in community settings, and is strongly associated with morbidity and mortality in diverse populations (Idler and Benyamini, 1997; Finch et al., 2002). We calculated a mental health score based on responses to 5 items from the SF-36 mental health subscale (Ware and Sherbourne, 1992), with higher scores $(0 - 100)$ indicating better mental health.

We present analysis of seven key measures of social risk/protective factors, and health. These seven variables were selected for analysis based on written and photographic documentation of the Collaborative Data Analysis workshops conducted with Resident Researchers. Specifically, Resident Researchers were asked to construct hypotheses to test the HNS Theory of Change by arranging note-cards representing survey variables. Academic personnel facilitating these workshops photographed Resident Researchers' hypotheses and took notes during group discussions regarding the Resident Researchers' selection of variables and generation of hypotheses. Prior to conducting any statistical tests, the authors analyzed photographs and notes from these workshops to identify the variables with the most support from Resident Researchers across all study communities. We identified variables with "broad" support across all Resident Researchers and workshops, as well as variables with "deep" support that received particular emphasis among a subset of Resident Researchers from particular geographic areas. The seven variables selected include: 1) difficulty paying bills, 2) food insecurity 3) experiencing discrimination in the neighborhood, 4) social support, 5) connectedness to the neighborhood, 6) expectations of leaving the neighborhood, and 7) a sense of ownership over changes in the neighborhood.

Trouble paying bills was measured based on the question, "In a typical month, how hard is it for you to cover your expenses and pay all your bills?" scored on a five point likert scale ranging from "very hard" to "very easy," taken from a survey on financial literacy administered by the Organisation for Economic Co-operation and Development (INFE, 2012). Although the HNS baseline survey also asked respondents to report their monthly income, Resident Researchers suggested that degree of difficulty with expenses was a more relevant measure of financial security in their communities than was absolute income.

We measured food insecurity using a locally validated (Kleinman et al., 2007), single item measure that asked respondents (yes/no) "In the past month, was there any day when you or anyone in your family went hungry because there was not enough money for food?"

We collected data on two discrimination variables. First, the study team adapted the Williams Everyday Discrimination scale (Williams et al., 1997) to ask if respondents had experienced discrimination in their neighborhoods (yes/no). We also measured everyday experiences of discriminatory mistreatment, which reflect chronic experiences of unfair treatment, using a modified version of the Williams Everyday Discrimination scale (Taylor et al., 2004), which asked about frequency of experiencing seven types of everyday mistreatment, ranging from being treated with less respect than others, to being harassed or threatened. While the Williams Everyday Discrimination Scale inquires about nine types of mistreatment, we removed questions on courtesy and dishonesty based on Resident Researcher input. Response options to indicate frequency of each type of mistreatment experience ranged from never (Williams and Marks, 2011), to almost every day (Kawachi and Berkman, 2003). Responses were averaged, with higher scores representing more frequent experiences of mistreatment.

We used a five-item scale, developed by Abramson et al. (2008) and drawing on Litwak's task specific model of social support (Litwak et al., 1989; Messeri et al., 1993), to measure functional social support. We asked respondents to answer a series of five questions (yes/no) indicating whether they had anyone to count on for: favors; taking care of them if they were sick and confined to bed for several weeks; lending them money for a medical emergency; talking to them about relationship trouble; or helping them locate housing if they had to move. Scores ranged from 0 for those who answered all questions negatively, to 5 for those who answered all five questions positively.

To measure connectedness to the neighborhood, we included a single item measure which asked participants to respond to the statement "I feel like I belong in my neighborhood" using a five-point likert scale ranging from strongly disagree to strongly agree (Witherspoon et al., 2009).

We also included a question about anticipated residential mobility, asking whether the respondent expects to move from the neighborhood in the next five years (yes/no). Past moves and reasons for past and expected moves were also collected, but are not analyzed here.

Finally, the study team wrote a new block of survey questions to measure types of neighborhood changes experienced by residents and feelings of ownership over each type of change. Respondents were asked (yes/no) if any of the following types of changes were happening in their neighborhood: construction of new housing; construction of new commercial space; redevelopment of public space, job creation; improvements to, or construction of, public amenities such as parks or libraries; development of new transportation options; and changes in police practices. Those who answered that a given change was happening in their neighborhood were then asked (yes/no) "Do you think these changes will make your life better?" We note that the first 22 HNS baseline surveys administered actually used the wording "are these changes for you?" However, early field reports conveyed respondent confusion over this item, and Resident Researchers suggested editing the survey to read "do you think these changes will make your life better?" In main models, we pool responses to both forms of the question but conducted supplementary analyses that excluded the first 22 responses to test whether results were sensitive to inconsistent wording.

We coded those who reported both noticing a change, and believing this change would improve their lives, as experiencing "ownership of neighborhood change." Observing no change *or* noticing changes that one did not believe would improve one's life was coded as not experiencing "ownership of neighborhood change" in a given domain. In order to focus on respondents' beliefs about the impact of neighborhood changes on their lives, rather than on neighborhood change in general, all models analyzing ownership of change variables also control for the number of domains in which respondents observed change, regardless of whether they felt these changes would improve their own lives.

Covariates include demographic, socioeconomic, and housing variables that our theory of change suggests are likely to be associated with both our health outcomes and resident-prioritized exposures, and which may therefore obscure important relationships of interest: employment status, gender, household size, education level, housing tenure, age, and race/ethnicity. We created a binary indicator of employment, where those who reported that they were employed or self-employed were categorized as employed, and all other employment arrangements, including being a student, homemaker, retired, unable to work or out of work were categorized as not employed. Other key descriptors and covariates were measured with commonly used response options and phrasings, including for gender (male, female, transgender, do not identify as male, female, or transgender), household size ("who do you currently live or stay with"), education level (six ordinal categories ranging from never attended school to college graduate), housing tenure (whether they or the head of household owned the home they lived in), age, and race/ethnicity.

2.6. Analytic strategy

We report descriptive statistics for study outcome variables, resident-prioritized exposures, analytic covariates, and selected additional descriptors from the baseline survey that provide important context about the study population. We used hierarchical linear models to show associations between each resident prioritized variable and mental health, and hierarchical ordered logistic models to show associations with self-rated health (Kondo et al., 2009). All models nest respondents within neighborhoods to account for autocorrelation of

responses within HNS study sites.

First, we show bivariate associations between each exposure and health outcome combination. We estimated a series of unadjusted hierarchical linear models rather than compute simpler measures of bivariate association because we expected a high degree of autocorrelation among responses to neighborhood-centered questions within the nine sites. Second, we show associations between each resident-prioritized exposure and health outcome after adjustment for the block of demographic, socioeconomic, and housing-related variables that could confound associations of interest. Finally, for each health outcome, we show results from the fully adjusted model that includes the full set of resident-prioritized social risk/protective factors and covariates.

For comparability across models, all regression analyses were run using data from the 232 HNS baseline respondents who provided complete data on the following set of demographic, socioeconomic, and housing-related control variables: age, race/ethnicity, gender, housing tenure, number of household members, highest level of education completed, and employment status. Older respondents were more likely to be missing race/ethnicity data, but no other systematic patterns of missingness emerged across the variables used in these analyses. While sample size varied slightly across models due to differences in missing data across the seven resident-prioritized exposure variables, differences in bivariate versus adjusted associations for each exposure can be attributed to the influence of statistical controls rather than to differences in sample composition. We used Stata for all analysis (StataCorp, 2015, 2017).

3. Results

3.1. Sample characteristics

Respondents predominantly identified as Hispanic/Latino or Black, and nearly sixty percent were women (Exhibit 4). Over half were employed and most had children. Respondents reported high degrees of financial distress. Over half earned less than $2100 per month, or $25,200 annually, over 70% of respondents said it was somewhat or very hard to cover their expenses each month, and one fifth said that they or a household member had gone hungry in the past month because there was not enough money for food. Forty-five percent of respondents expected to leave their neighborhoods within the next five years, and roughly 37% had moved in the previous five years. Over a third of the sample reported having experienced discrimination in their neighborhood. The proportion of people reporting ownership over changes in their neighborhoods were similar across categories of change and ranged from 44% (construction of new commercial spaces) to 55% (improvements to public amenities, or construction of public amenities such as parks or libraries).

The sample largely reported good health, with only 23% reporting poor or fair health, and 77% reporting good, very good, or excellent health. The mean mental health score was 69 corresponding to an average response of being in the positive mental states some to most of the time, and in the negative mental states less than some of the time.

3.2. Relationships between study characteristics and health

In unadjusted bivariate models (Exhibit 5), having trouble paying bills and being food insecure each cut the odds of being in excellent versus a lower self-rated health category in half. A higher everyday discrimination score was also associated with worse self-rated health, while higher levels of social support predicted better self-rated health. These associations remained robust after adjustment for age, race/ethnicity, gender, housing tenure, household size, education, and employment.

Null associations between two resident-prioritized risk/protective factors and self-rated health strengthened to the point of marginal

Exhibit 4
Sample characteristics.
Source: Author's analysis of HNS data.

Demographics and Socioeconomic Status[a]	N = 305	Percent
Gender	302	
Male	127	42.1%
Female	171	56.6%
Transgender	2	0.7%
Do not identify as male or female	2	0.7%
Race/Ethnicity	284	
Non-Hispanic White	78	27.5%
Non-Hispanic Black	75	26.4%
Asian	4	1.4%
Multiracial	25	8.8%
Other race	4	1.4%
Hispanic/Latino	98	34.5%
Children	285	
Children	167	58.6%
No Children	118	41.4%
Income level per month	236	
Less than $1250	77	32.6%
$1250–$2100	66	28.0%
$2100–$2900	35	14.8%
$2900–$4150	30	12.7%
$4150–$6250	10	4.2%
$6250–$8300	13	5.5%
$8300 or more	5	2.1%
Employment	284	
Employed	169	59.5%
Not Employed	115	40.5%
Education Levels	301	
Less than High school	50	16.6%
Grade 12 or GED	93	30.9%
Some College	87	28.9%
College Graduate or more	71	23.6%
Food Insecurity	290	
Went hungry in the last month	58	20.0%
Did not go hungry in the last month	232	80.0%
Discrimination in the neighborhood	285	
Have experienced discrimination in the neighborhood	113	39.7%
Have NOT experienced discrimination in the neighborhood	172	60.3%
Household Characteristics	**N**	**Percent**
Housing Tenure	287	
Own	72	25.1%
Rent	194	67.6%
Neither	21	7.3%
Past Moves	278	
Moved in last 5 years	107	36.8%
Did not move in the last 5 years	184	63.2%
Expected moves	278	
Expects to move in next 5 years	125	45.0%
Does not expect to move in the next 5 years	153	55.0%
Ownership of Neighborhood Change[b]	**N**	**Percent**
Public amenities for you	253	
Yes	140	55.3%
No	113	44.7%
Commercial spaces for you	256	
Yes	113	44.1%
No	143	55.9%
New homes, apartments or condos for you	263	
Yes	119	45.3%
No	144	54.8%
Transportation options for you	257	
Yes	133	51.8%
No	124	48.3%
Jobs for you	253	
Yes	135	53.4%
No	118	46.6%
Police practices or activities for you	248	
Yes	132	53.2%
No	116	46.8%
Demographics and Socioeconomic Status	**N**	**Mean/Median**
Age (18–95) *mean*	288	42.7
Difficulty covering bills and expenses (1–4) *mean*	270	2.9
Experience of everyday discrimination (1–6) *median*	275	1.9
Functional social support level (0–5) *median*	285	4

Exhibit 4 (*continued*)

Household/Neighborhood Characteristics	N	Mean/Median
Number of people in household (1–16) *median*	294	2
Years in neighborhood (0.08–77) *median*	284	15
Neighborhood Belonging (1–4) *mean*	276	2.9
Changes in Neighborhood	**N**	**Mean/Median**
Total Changes Observed (0–6) *mean*	279	3.9
Outcomes	**N**	**Mean/Median**
Mental health score (1–100) *mean*	277	68.6
Self-Rated Health	292	**Percent**
Poor	15	5.1%
Fair	53	18.2%
Good	96	32.9%
Very Good	76	26.0%
Excellent	52	17.8%

[a] For continuous variables, variable range reported in parenthesis and measure of central tendency in italics.

[b] Ownership of Neighborhood Change variables were coded "No" when participants did not report noticing a change in a given domain, or did not believe the chang they noticed would benefit, or was "for," them. Ownership of Neighborhood Change variables were coded "Yes" when participants reported noticing change in a given domain, and reported that the change they noticed would benefit, or was "for," them.

statistical significance only after covariate adjustment. Specifically, a stronger sense of belonging in one's neighborhood was marginally associated with better health (p = .061) after covariate adjustment. Similarly, "ownership of neighborhood change" in the housing domain, defined as noticing new housing construction in the neighborhood that respondents thought would improve their lives, emerged as a marginally significant predictor of better self-rated health (p = .098).

In the fully-adjusted model predicting self-rated health, which included all seven resident-prioritized risk/protective factors and full covariate adjustment, higher levels of everyday discrimination remained robustly associated with worse self-rated health. Full adjustment also revealed a relationship between "ownership of change" in the housing domain, defined as noticing new housing construction in the neighborhood and believing it would improve one's life, and better self-rated health (p = .035). Full adjustment widened confidence intervals around estimates for social support and food insecurity to the point of statistical non-significance, and around trouble paying bills to marginal significance (p = .090).

Six of the seven resident-prioritized variables were associated with mental health in bivariate models. Trouble paying bills, everyday discrimination, food insecurity, and expecting to move from the neighborhood were each associated with worse mental health, while functional social support and feeling connected to the neighborhood predicted better mental health. Covariate-adjustment for age, race/ethnicity, gender, housing tenure, household size, education, and employment did not substantively change the size or strength of any of these unadjusted associations (Exhibit 5). After full adjustment, only trouble paying bills, everyday discrimination, and expecting to leave the neighborhood within the next five years remained associated with worse mental health.

We note that across the two health outcomes, all seven of the social factors prioritized by Resident Researchers yielded strong empirical associations in at least some covariate-adjusted specifications. Results were consistent when self-rated health was modeled asa continuous versus ordinal variable.

In sensitivity analyses excluding surveys that used the original wording "are these changes for you?" to measure ownership of neighborhood change (n = 22), covariate-adjusted results were substantively unchanged. Excluding these responses from the fully-adjusted model that predicted self-rated health, however, widened confidence intervals around ownership of neighborhood change in the housing domain to the point of marginal statistical significance (p = .062).

We did not include coefficient estimates for covariates in Exhibit 5,

Exhibit 5

Associations between social risk/protective factors and self-rated health, mental health score.
Source: Authors' analysis of HNS data.

	Self-rated health			Mental Health Score		
	Bivariate OR(CI)	Covariate-adjusted OR(CI)	Fully adjusted OR (CI)	Bivariate coef(CI)	Covariate-adjusted coef (CI)	Fully-adjusted coef(CI)
Difficulty covering bills and expenses	0.54*** (0.39,0.75)	0.49*** (0.34,0.70)	0.64 (0.37,1.10)	− 7.42*** (−9.84, −5.00)	− 7.83*** (−10.26, −5.39)	− 5.17** (− 8.31, − 2.03)
Experience of everyday discrimination	0.73** (0.58,0.92)	0.61*** (0.47,0.78)	0.61* (0.42,0.90)	− 6.42*** (−8.05, −4.79)	− 6.62*** (−8.32, −4.93)	− 4.63*** (−6.80, −2.46)
Functional Social support level	1.51*** (1.27,1.80)	1.42*** (1.16,1.73)	1.17 (0.85,1.61)	2.06** (0.71,3.41)	2.36** (0.93,3.79)	1 (− 0.82,2.82)
Went hungry in the last month	0.47* (0.28,0.91)	0.51* (0.27,1.00)	0.77 (0.27,2.13)	− 10.06*** (−15.04, −5.09)	− 10.30*** (−15.21, −5.39)	1.24 (−4.93,7.42)
Belonging in the neighborhood	1.29 (0.92,1.79)	1.42 (0.98, 2.04)	1.05 (0.65,1.69)	3.25** (0.81,5.69)	3.01* (0.50,5.52)	0.41 (− 2.34,3.16)
Expects to move in next 5 years	1.1 (0.68,1.80)	0.95 (0.56,1.62)	0.91 (0.43,1.90)	− 5.78** (−9.74, −1.82)	− 5.25** (−9.39, −1.12)	− 6.68** (− 11.11, − 2.25)
Total changes observed	1.1 (0.86,1.40)	1.03 (0.79,1.35)	1.16 (0.82,1.65)	0.8 (− 1.25,2.85)	0.29 (− 1.80,2.37)	0.86 (−1.29,3.01)
Ownership of public amenities changes	0.81 (0.39,1.69)	0.8 (0.37,1.76)	1.1 (0.43,2.85)	− 3.97 (−9.82,1.89)	− 4 (−7.50,3.19)	− 2.08 (−7.8,3.63)
Ownership of commercial spaces changes	0.9 (0.38,2.14)	0.63 (0.25,1.58)	0.4 (0.14,1.15)	3.51 (−3.17,10.19)	3.8 (−2.95,10.56)	1.15 (−5.26,7.55)
Ownership of housing changes	1.23 (0.61,2.46)	1.96 (0.91,4.22)	3.00* (1.19,7.61)	0.07 (−5.56,5.70)	− 0.89 (− 6.73,4.96)	0.44 (−5.21,6.09)
Ownership of job changes	1.02 (0.45,2.33)	1.19 (0.50,2.78)	0.68 (0.24,1.91)	0.58 (−6.16,7.32)	1.05 (−5.52,7.64)	0.23 (−5.97,6.43)
Ownership of police practices or activities changes	0.58 (0.27,1.26)	0.64 (0.28,1.46)	0.6 (0.23,1.60)	− 3 (−9.28,3.28)	− 1.33 (−7.62,4.96)	− 1.42 (−7.22,4.38)
Ownership of transportation changes	1.21 (0.57,2.57)	1.1 (0.50,2.42)	1.53 (0.59,3.96)	− 1.2 (−7.22,4.81)	− 2.48 (−8.35,3.38)	− 3.09 (−8.66,2.4)

NOTES:

[a] *p < 0.05, ** p < 0.01, *** p < 0.001; [b] Covariate-adjusted models control for race, gender, age, housing tenure, household size, education, employment status. Fully adjusted models additionally control for all Resident-prioritized variables simultaneously. [c] Ownership of Neighborhood Change variables were coded "No" when participants did not report noticing a change in a given domain, or did not believe the change they noticed would benefit, or was "for," them. Ownership of Neighborhood Change variables were coded "Yes" when participants reported noticing change in a given domain, and reported that the change they noticed would benefit, or was "for," them.

but we note robust associations between several of demographic and socioeconomic factors and health. Older age and Hispanic ethnicity versus White non-Hispanic race/ethnicity predicted worse self-rated health, while being employed was associated with better self-rated health in nearly all covariate-adjusted models. Black compared to White race was associated with better mental health in all covariate-adjusted models, while male versus female gender and being employed were associated with better mental health in most specifications.

4. Discussion

Our results provide important data on conditions in the HNS neighborhoods, offer new methods for understanding neighborhood conditions identified as important by residents, and elucidate mechanisms by which urban development may affect health. Respondents surveyed in the nine study neighborhoods exhibited high levels of financial and social vulnerability. Roughly 70% had a somewhat or very hard time covering their expenses each month, and a fifth reported that they or another household member had gone hungry in the past month. Nearly 40% reported experiencing discriminatory mistreatment within the boundaries of their neighborhoods, and about 45% anticipated moving from their neighborhoods within the next five years.

Social risk/protective factors prioritized by Resident Researchers exhibited robust associations with health. We detected several associations in-line with previous literature, which provide confidence in the quality of the survey data, and suggest that our sample may share important commonalities with larger, more geographically diverse cohorts that have also shown similar relationships between better health and higher subjective socioeconomic status (Singh-Manoux et al., 2005), lower age (Idler and Benyamini, 1997), and less discriminatory

mistreatment (Krieger et al., 2005; Pascoe and Smart Richman, 2009). We also underscore the potential health relevance of a new construct, ownership of neighborhood change, that was conceived by the HNS team. Although we hypothesized that a higher degree of observed neighborhood change itself would be associated with worse health, associations between a measure of overall observed change and health were null. Rather, observing housing-related changes *and* feeling ownership over those changes was associated with better self-rated health in our fully adjusted model. Possible explanations include the fact that housing development, unlike the other change categories, directly addresses a basic human need. Further, new housing construction may gain its salience by most strongly highlighting for residents changing neighborhood composition, as well as the growing gap between affordable housing needs and supply.

We note that simultaneous adjustment for all risk/protective factors not only revealed an association between ownership of housing changes and health, but also weakened the association between social support and self-rated health such that confidence intervals around social support contained one. Social support may be a prior common cause of both better health and feeling more ownership over neighborhood changes. After full adjustment, confidence intervals around measures of food insecurity and trouble paying bills both widened to the point of statistical insignificance, although trouble paying bills retained a stronger association with self-rated health. Trouble paying bills may act as a confounder of the relationship between food insecurity and self-rated health, and a larger sample is likely needed to test if trouble paying bills is a robust independent predictor of self-rated health net of all other predictors and covariates.

In models predicting mental health outcomes, results also differed between covariate- and fully adjusted specifications. After full

adjustment, social support and feelings of belonging in one's neighborhood were no longer associated with better mental health, food insecurity no longer predicted worse mental health, and expecting to move emerged as a predictor of worse mental health. It may be that low social support and a lack of belonging in the neighborhood are upstream causes of both worse mental health and expecting to move, while trouble paying bills may be a prior common cause of both food insecurity and worse mental health.

We also note several limitations to our analysis. First, a PAR approach to sampling allowed us to reach populations within each neighborhood that Resident Researchers deemed important for representativeness; however, results may not generalize to the residents of rapidly changing, low-income areas of metropolitan Boston more broadly, and small sample sizes prevent us from making inferences about subpopulations. Secondly, the baseline HNS survey only allows us to assess cross-sectional relationships, which cannot be interpreted as causal estimates. However, the HNS research partnership plans to repeat and expand data collection in the coming years, allowing us to assess relationships longitudinally and within subpopulations of interest. This expansion includes conducting in-depth interviews with a subset of respondents, which will help us move from a broadly descriptive theory of change, to causal models describing how specific constructs measured in HNS interact to affect health. At the present time, our interpretation of fully adjusted models is hampered by a lack of narrative explanation about how risk/protective factors influence each other and combine to affect health. Future statistical analyses will test associations among variables that in-depth interviewees describe as causally related. Third, there are high levels of missing data for some variables in the data set (Exhibit 4), and these data do not appear to be missing at random. Conducting analyses on the subsample of respondents who provided complete data on demographic, socioeconomic, and housing-related control variables limits generalizability and reduces statistical power, but represents an attempt to improve comparability across bivariate versus covariate-adjusted models. In other words, differences between bivariate versus adjusted associations for each exposure can be attributed to the influence of statistical controls rather than to differences in sample composition, which reduces the influence of non-random missing data patterns on results. Fourth, all responses are self-reported and are therefore subject to response biases despite efforts to limit threats from response bias by employing previously validated measures. Fifth, we encountered difficulty with maximum likelihood estimation of some adjusted multilevel ordered logistic regression models, but were able to specify different stepping algorithms to handle nonconcave regions of the likelihood function in these cases to obtain reliable estimates. As a robustness check, we also modeled self-rated health linearly, and found that results were consistent with the ordered logistic model specification.

Although associations detected in HNS baseline data should be analyzed in a longitudinal setting, tested in different geographies, and scrutinized in larger samples, results suggest that initiatives aiming to improve community health through urban development should consider how projects may change residents' risk of experiencing discrimination in the neighborhood, connectedness to neighborhoods, access to social support, financial and food security, and feelings of ownership over neighborhood changes, particularly around new housing.

HNS also demonstrates that using a PAR framework to explore links between neighborhood change and health is not only feasible but also yields fruitful new research findings that may help uncover how urban development could exacerbate or mitigate health disparities. For example, during survey design and data analysis workshops, some Resident Researchers indicated that they experienced discrimination as a phenomenon tied to gentrification, both in their own neighborhoods and elsewhere in the city, and hypothesized that gentrification could pose a health risk to neighbors via increased incidence of discrimination (Williams et al., 1997). As a result, the HNS baseline survey contained an extensive list of questions about discrimination because resident researchers were "at the table." PAR-generated hypotheses about these processes align with scholarship indicating that little social mixing actually occurs in gentrifying communities, that wealthier newcomers tend to self-segregate within lower-income communities, and that the result is increasing polarization and concentrated inequality (Lees, 2008; Walks and Maaranen, 2008). Research also shows that segregation and discrimination have historically traveled together in gentrifying neighborhoods (Wyly and Hammel, 2004). A PAR design was also crucial to investigating emerging themes and patterns that residents of rapidly-changing communities are experiencing on a day-to-day basis. Gentrification was viewed as a major health determinant by the study communities, and as neighborhoods gentrify nationally (Hwang and Lin, 2017), the inclusion of resident voices will be key to understanding the implications of this neighborhood change process. In short, participatory approaches to epidemiological and public health research can complement traditional forms of scholarly research, and may generate meaningful evidence for academics, practitioners, and community members by broadening the aim and scope of research to include topics of political and social importance to residents of study communities (Cornwall and Jewkes, 1995).

We also note that PAR facilitated several practical aspects of the study, such as data collection, and increases the usefulness of the findings. For example, Resident Researchers were better positioned than outside research assistants to connect to potential respondents, discuss the relevance of the research in the context of community change, and establish a level of comfort that made it easier to ask about personal information such as financial security. Secondly, PAR, as an approach that is inherently focused on designing actionable research, has also provided conduits for translation and capacity building. Resident Researchers have begun sharing initial findings with their local communities and are working with partner organizations and the HNS team to develop and implement action plans to put the data to use. These efforts include producing local maps and data-rich profiles to complement ongoing advocacy efforts, offering public testimony based on baseline findings, Just Cause Eviction ordinance advocacy, tenants-rights advocacy, and the development of arts-based tools for community-wide data dissemination. Community Partner Organizations that had previously not worked with one another are also beginning to exchange learnings across communities and areas of work and pursuing joint projects. For example, organizations with decades of experience in anti-displacement advocacy are beginning to collaborate with those outside the housing sector, but who are seeking to incorporate an anti-displacement lens into community health and environmental justice efforts.

Putting residents' lived experience at the heart of research design is crucial for working with communities that have historically been exposed to extractive research traditions, particularly in a context where low-income residents of gentrifying communities report that they must battle to have their concerns heard by public sector actors and real estate developers. As one Resident Researcher stated, "experience *is* expertise when analyzing one's own space, home or community. Nothing about us should happen without us." The HNS demonstrates the power of PAR approaches to center the experiences of neighborhood residents in all aspects of research design and analysis. New PAR-generated insights into neighborhoods and health relationships may provide important mechanisms by which residents drive change in their neighborhoods.

Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.healthplace.2018.05.014.

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