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Short communication

Rising home values and Covid-19 case rates in Massachusetts

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ABSTRACT

We explore whether housing displacement pressure could help explain place-based disparities in Massachusetts COVID-19 prevalence. We use qualitative data from the Healthy Neighborhoods Study to illustrate how rising and unaffordable housing costs are experienced by residents in municipalities disproportionately affected by COVID-19. We then predict municipal-level COVID-19 case rates as a function of home value increases and housing cost burden prevalence among low-income households, controlling for previously identified community-level risk factors. We find that housing value increase predicts higher COVID-19 case rates, but that associations are ameliorated in areas with higher home values. Qualitative data highlight crowding, "doubling up," homelessness, and employment responses as mechanisms that might link housing displacement pressure to COVID-19 prevalence.

As the COVID-19 outbreak spreads across the United States, the disease has already devastated some communities while sparing others.

Researchers are identifying community characteristics that might explain which communities are hardest-hit. Candidate predictors of worse outcomes include total population size, population density (Chin et al., 2020; Kang et al., 2020; Wheaton and Thompson, 2020), air pollution (Setti et al., 2020; Wu et al., 2020), a higher proportion of racial/ethnic minority residents (Yancy, 2020), lower neighborhood-level socioeconomic status (Maroko et al., 2020), a higher prevalence of jobs that demand human contact (Almagro and Orane-Hutchinson, 2020), and household crowding (Chen and Krieger, 2020), among others added to the literature nearly daily (medRxiv, 2020). Crowded housing has also been noted as a possible explanation for why specific places have suffered early and badly (Chokshi and Katz, 2020), and homelessness is recognized as a serious risk factor for infection (Tsai and Wilson, 2020). The popular press and elected officials have called attention to intersecting vulnerabilities, noting that poverty, crowding, homelessness, pollution and other risks tend to travel together, often in low income communities of color, which are suffering most in the pandemic (Mansoor, 2020).

However, narratives focused on COVID-19 risks stemming from economic hardship in low income communities of color may overlook risks caused by housing and economic development pressure in these same places. In fact, low income, immigrant, and racially/ethnically diverse communities have also been sites of gentrification in recent decades (Freeman, 2011; Hwang, 2015), with concerns about housing displacement pressures mounting in recent years (The Everett Community Health Partnership et al., 2019). Unaffordable housing may create unique risks for SARS-CoV-2 transmission for low-income households, with the relationship possibly mediated by living arrangement adaptations, including "doubling up" (Skobba and Goetz, 2015), and/or by employment responses that include taking on additional work in jobs that cannot be done from home.

In this short communication, we share qualitative data from the Healthy Neighborhoods Study (HNS) (Arcaya et al., 2018), a mixed-methods, longitudinal participatory action research study, that illustrates how housing displacement pressure may put residents at risk for exposure to the novel coronavirus. HNS includes sites in the top four Massachusetts municipalities for confirmed COVID-19 rates, and in three highly affected Boston neighborhoods, making insights from this study particularly salient.

We then use publicly available data to model associations between municipal-level COVID-19 case rates and demographic, economic, and housing characteristics in Massachusetts. We aim to explore whether housing displacement pressure predicts higher infection rates net of other community characteristics linked to worse COVID-19 outcomes in other studies.

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1. Methods

1.1. Qualitative data

Resident researchers (Binet et al., 2019) recruited participants for 40–80 min in-depth, semi-structured interviews about neighborhood conditions and well-being conducted by HNS research staff between January 2018–March 2020. Participants were compensated $40 for their time (Arcaya et al., 2018). Interviews were audio recorded, transcribed, and index-coded in Atlas.ti (Deterding and Waters, 2018). Qualitative data reported here was selected from index codes for 'housing', and 'neighborhood belonging.'

1.2. Modeling COVID-19 case rates

To visually inspect the relationship between housing displacement pressure and COVID-19 case rates, we map municipal-level COVID-19 rates reported on July 15th, 2020, and overlay hatch marks on the 5% of cities and towns (n = 18) that have experienced the commonwealth's highest home value increases in the past five years.

We fit a series of four ordinary least squares regression models to test predictors of municipal-level confirmed COVID-19 case rates. First, we regress counts of confirmed COVID-19 cases per 100,000 people on previously identified risk factors: total population size; population density; percent of population living in poverty; two markers of work-from-home potential, including the share of the population in job categories previously associated with working from home, and the share of people with a college degree or higher; prevalence of overcrowded housing units; and the share of households without a car, which serves as a marker of public transportation reliance.

We then add indicators of housing displacement pressure, including median gross rent, median home value, home value increase over the past five years, and prevalence of housing cost burden. We interact median home value and home value increase to capture differential associations of price increases with COVID-19 cases in high-versus low-cost areas. Because median home value, home value change, and their interaction exhibit structural multicollinearity, we also run a sensitivity analysis that operationalizes the intersection of housing value and 5-year housing value change as a single categorical variable, described in more detail below.

To account for potential prior common causes of housing displacement pressures and COVID-19 risk, we add the share of population that is foreign born and distance to Boston to our model. Immigrant neighborhoods have previously been shown to be at risk of gentrification (Hwang, 2015), and foreign-born residents may also face unique occupational and social risks of exposure to the novel coronavirus, particularly those who are undocumented (Page et al., 2020). Likewise, proximity to Boston influences trends in real estate values, and could also have had a unique spatial effect on COVID-19 risk because many early Massachusetts cases were tied to a meeting held in Boston (Rimmer, 2020).

To avoid presenting decontextualized associations between COVID-19 prevalence and specific racial/ethnic minority groups, which other researchers have warned against in order to avoid perpetuating misguided perceptions of COVID-19 disparities as arising from differences in biology or personal behavior (Chowkwanyun and Reed, 2020), we add racial/ethnic composition data to our most complete model describing municipal socioeconomic, housing, and built environments. Specifically, we add the proportion of the population that identifies as non-Hispanic Black, non-Hispanic White, Hispanic/Latino and non-Hispanic Asian. We view any associations with specific racial/ethnic minority groups as resulting from upstream inequities in socioeconomic status, the historic and cotemporary distribution of resources, and the interplay between the two that creates risk factors on the basis of place (Chowkwanyun and Reed, 2020).

In all models, we adjust for COVID-19 tests per 100,000 because testing prevalence affects measurement of case rates, and is a plausible proxy for unmeasured dimensions of community access to resources that affect community-level socioeconomic and housing characteristics we explore in this analysis.

1.3. Data sources and variables

COVID-19 data was obtained from the Massachusetts Department of Public Health and includes the number of confirmed cases and tests conducted as of July 15th, 2020 (Massachusetts Department of Public Health, 2020). We calculated COVID-19 confirmed case and testing rates per 100,000 population using municipal population estimates reported in the 2014–2018 American Community Survey (ACS).

We measure five-year change in municipal-level housing values by expressing Zillow Home Value Index averaged across January–March 2020 as a percent of the same index value averaged across January–March 2015 (Zillow Research, 2019). We express home value change in percentage points (range: -10.45%–52.83%). We combine home value change data with 5-year municipal-level median home value data from the 2014–2018 ACS to create a new categorical variable that takes on eight values based on whether or not home value change was "high," as defined by being in the top 20% of the value change distribution, across each of the median home value quantiles.

All other variables are 5-year municipal-level averages from the 2014–2018 American Community Survey. Population is expressed in thousands, and population density is population count per square mile. Home values are expressed in $100,000s. We estimate the share of people who can work from home based on those who report the following occupation categories: "management, business, science, and arts occupations," and "sales and office occupations" because workers in these jobs were most likely to report working from home prior to the pandemic (Bureau of Labor Statistics, 2019). We measure the prevalence of household crowding as the share of housing units home to more than one occupant per room. Housing cost burden prevalence is defined as the share of households earning under $50,000 and paying at least 30% of income towards housing costs. Finally, aerial distance from Boston is calculated from the center of the municipal geometry to the center of Boston's geometry using ArcGIS.

2. Results

2.1. The lived experience of housing displacement pressure

Rising rent is a top local concern, affecting both housing arrangements and employment strategies.

One participant noted, "*The biggest challenge I hear from everyone [is] rent. Like, 'the rent's going up, I'm going to have to move, or I'm going to have to have a roommate… '*"

While moving to avoid crowding is an alternative for some, the need to remain close to jobs and family forces others to cope with rising rents by living in smaller spaces.

A mother seeking a bigger apartment after having her second child wants to stay in her Boston neighborhood near her janitorial job and family-provided childcare help, but rising housing costs leave her family cramped. "*My neighborhood, I like it, I love it, [but] rent is going so high… Every time I heard a new development is coming, it starts raising values for the properties near. And when that happened, rent just started going higher and higher. Mine went high last year, and it was like, "whoa.*"

Rapidly increasing housing costs also force unrelated individuals into crowded living conditions. Respondents in Chelsea, the Massachusetts city with the highest COVID-19 case rate, discuss this common problem. "*There's a lot of people in Chelsea that are renting out rooms in houses because they can't afford the rent,*" explained one respondent. Another 50-year-old woman working two part-time jobs at a school and a supermarket, has been renting one of these rooms in Chelsea for three years. "*I live with five people that I am not related to,*" she said.

Perhaps most dangerously, some residents never find any type of housing they can afford. A homeless respondent from Brockton, the Massachusetts city with the second highest COVID-19 case rate, says housing costs prevent him from getting off the streets.

"*And my biggest concern myself is I'm homeless here…. I want to move somewhere where housing is a little bit cheaper. Because I couldn't afford– not on my own, anyways… I've stayed at a few relatives' houses … and then a homeless shelter up the street. So that's about five, six places… I paid them rent. Or I tried to. I tried to give them what I could.*"

Residents also commonly cope with increasingly unaffordable housing costs by taking on additional work, frequently in jobs that require workers to be out in public. A respondent in the Dorchester neighborhood of Boston describes taking a second part-time job driving for Uber Eats in order to make his family's rising rent payments. "*I picked up a second job in October, and since October, I've been working, working, working…. It's better than my full-time job as far as finances, but as far as benefits and life [it's] not… there's no future in it.*"

2.2. Modeling rates of COVID-19 infection in Massachusetts municipalities

The Massachusetts Department of Public Health reported cased for 316 of the 351 Massachusetts municipalities as of July 15th, 2020, limiting our analytic sample to these cities and towns. Of the 316 municipalities with COVID-19 case data, 16 were missing home value or median gross rent data, resulting in an analytic sample of 300.

Visually, we observe substantial overlap between the highest rates of confirmed COVID-19 cases and the steepest five-year gains in home values (Fig. 1). The five municipalities with the Commonwealth's highest COVID-19 case rates, Chelsea, Brockton, Lynn, Everett, and Lawrence, also fell into the top 5% of communities experiencing home value increase from 2015 to 2020, for example.

In alignment with existing research, population density and overcrowded housing units predict higher municipal-level prevalence of COVID-19, while the share of the population with a college degree predicts lower case rates (Model 1). When we exclude college degree attainment, which is strongly correlated with other predictors, from Model 1, work-from-home job prevalence emerges as a protective factor (sensitivity analysis not shown).

Adding markers of housing displacement pressure, we see that each additional percentage point increase in housing values since 2015 is associated with 43 (95% CI: 29.01–57.3, $p < 0.001$) additional COVID-19 cases per 100,000 (Table 1, Model 2). Change in home value interacts with median home value in the expected direction, with associations between home value growth and COVID-19 cases exacerbated in more affordable communities.

These results are robust to controls for the share of the population that is foreign born and for proximity to Boston (Model 3). Crowding and density also remain positively associated with COVID-19 cases per 100,000 in this model. Distance from Boston is negatively associated with COVID-19 prevalence, while the share of foreign-born residents is associated with higher COVID-19 prevalence.

In Model 4, which includes additional controls for racial/ethnic composition, we see persistent associations between housing value change and COVID-19 prevalence. One additional percentage point in home value change is associated with approximately 14 additional COVID-19 cases per 100,000 (95% CI: (12.05–40.13, $P < 0.05$) in this model. The interaction between home value and home value change remains robust and negative, suggesting a protective effect of rising home values in higher cost areas. Density remains positively associated with COVID-19 case rates after adjustment for racial/ethnic composition, but the association with crowding is null in this model. Despite inefficiency caused by multicollinearity among our racial/ethnic composition measures, the share of the population that is Hispanic/Latino predicts higher COVID-19 prevalence. When we ran sensitivity analyses (not shown) that exclude percent non-Hispanic White, coefficients associated with the other racial/ethnic composition measures are estimated more precisely, and non-Hispanic Black population share is also positively associated with COVID-19 cases.

Finally, we re-fit Model 4 using a single categorical variable to represent the intersection of housing value and housing value change (Model 5). This alternative specification allows us to examine non-linearities in the housing value and value change relationship, and also avoids the structural multicollinearity induced by interacting

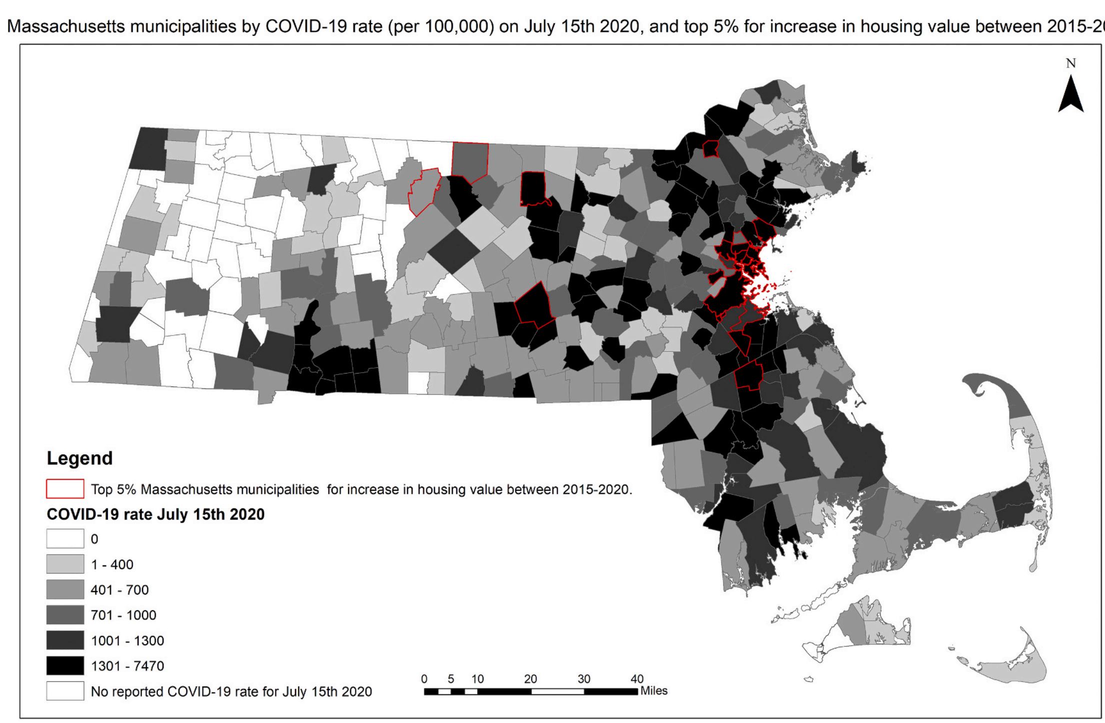

Fig. 1. Confirmed COVID-19 cases per 100,000 people on July 15th, 2020 overlaid by 5% largest increases in home values between 2015 and 2020.].

Table 1
COVID-19 Rate (per 100,000) predicted by municipal-level social, demographic, and housing characteristics.

Variable	M1	M2	M3	M4	M5
R^2	0.634	0.682	0.726	0.776	0.785
(Intercept)	728.46* (276.58)	−136.91 (384.56)	915.61* (423.45)	−26.6 (1633.96)	−72.91 (1638.34)
COVID-19 test rate (per 100,000)	0.05*** (0.01)	0.05*** (0.01)	0.05*** (0.01)	0.04*** (0.01)	0.04*** (0.01)
Total population (1,000)	0.75 (0.83)	0.42 (0.79)	−0.22 (0.74)	−0.37 (0.71)	0.19 (0.7)
Population density	0.09*** (0.02)	0.12*** (0.02)	0.07*** (0.02)	0.04* (0.02)	0.05* (0.02)
Percent of households without car	−9.07 (13.18)	−12.28 (12.55)	−2.4 (11.96)	−6.07 (10.93)	−5.78 (10.81)
Percent who can work from home	12.55† (6.27)	4.83 (6.32)	−5.3 (6.4)	0.61 (6.12)	3.97 (6.01)
Percent with college degree or higher	−23.66*** (5.55)	−11.55 (5.98)	−7.08 (5.74)	−7.16 (5.25)	−9.85† (5.34)
Percent living in poverty (Poor)	−10.27 (10.95)	−3.09 (12.73)	−1.57 (11.92)	−19.98† (12.01)	−16.19 (11.93)
Percent overcrowded housing units	202.17*** (31.82)	147.12*** (31.53)	68.75* (31.82)	32.18 (31)	33.15 (30.54)
Median Gross Rent		0.05 (0.12)	−0.05 (0.11)	−0.02 (0.11)	−0.07 (0.1)
Cost burdened households earning less than $50,000		−5.55 (7.41)	−7.2 (6.92)	−2.16 (6.45)	−3.91 (6.36)
Median home value ($100,000)		120.73*** (38.15)	52.61 (37.43)	−0.26 (35.05)	
Percentage point change in housing value between January 2015–2020		43.17*** (7.19)	30.48*** (7.39)	14.43* (7.06)	
Interaction between median home value and housing value change		−10.34*** (1.78)	−8.82*** (1.69)	−5.66*** (1.61)	
Aerial distance from Boston			−5.25*** (1.53)	−5.95*** (1.4)	−4.38*** (1.33)
Percent foreign born			31.03*** (5.59)	33.31*** (8.44)	27.27*** (8.51)
Percent non-Hispanic White				9.48 (16.16)	6.91 (16.22)
Percent non-Hispanic Black				30.99† (18.69)	29.16 (18.5)
Percent Hispanic/Latino				38.58* (15.93)	35.8* (15.93)
Percent non-Hispanic Asian				−10.11 (17.77)	−8.79 (17.58)
Home value categories: Median home value 75-100th percentile, high value change					−568.66*** (149.17)
Home value categories: Median home value 50-75th percentile, low-moderate value change					217.06* (80)
Home value categories: Median home value 50-75th percentile, high value change					171.36 (134.78)
Home value categories: Median home value 25-50th percentile, low-moderate value change					202.51* (99.69)
Home value categories: Median home value 25-50th percentile, high value change					443.58*** (122.24)
Home value categories: Median home value 0-25th percentile, low-moderate value change					223.35† (125.14)
Home value categories: Median home value 0-25th percentile, high value change					329.74* (143.57)

Notes: (†) $p < 0.1$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

housing value and housing value change (VIF > 10). Results show that for the highest value housing, large housing value increases appear protective against COVID-19 case rates compared to the reference category of equally valuable housing that has seen relatively slower value growth, predicting nearly 570 fewer confirmed cases per 100,000. In the bottom two quantiles of housing value, the role of large value increases reverses from a protective, to risk, factor. That is, coefficients associated with the high housing value change categories are larger than the coefficients associated with lower housing value change categories for this more affordable housing stock.

3. Discussion

Housing value increase robustly and positively predicts confirmed COVID-19 case rates at the municipal-level in Massachusetts after accounting for known and theoretically important confounding variables, including density, proximity to Boston, crowding, work from home potential, and other suspected community-level COVID-19 risk factors, with associations ameliorated in higher cost communities. These statistical associations, while not causal estimates, align with qualitative reports of how housing displacement pressures push financially precarious residents into crowded housing, sometimes with other unrelated adults, create risks of homelessness, and drive people to take on additional work in jobs that cannot be done from home. The relationship between housing value change and COVID-19 prevalence, while robust, is attenuated after controlling for racial/ethnic composition by specific minority group categories. We suspect that structural confounding, induced by strong patterning across municipalities in the distribution of deleterious combinations of housing displacement pressure, occupational mix, crowding, and other social risks for COVID-19 (Chowkwanyun and Reed, 2020), explains this attenuation and why crowding appears unrelated to COVID-19 case rates after adjustment for racial/ethnic composition.

We note important limitations to this preliminary analysis, including that municipal-level data mask important variation within communities. Analyses should be repeated when granular geographic data on hospitalizations and deaths, which are less susceptible to selection biases, become available. Because rates will necessarily change as the pandemic spreads, our results are specific to understanding factors associated with early spread of COVID-19. Finally, we highlight that differences in built form, metropolitan fragmentation, and metropolitan-level supply of affordable housing mean results are unlikely to generalize to many other states and regions. However, our findings suggest that rapidly increasing and unaffordable housing costs warrant further investigation as risk factors for exposure to the novel coronavirus, especially in lower cost communities where housing may have recently been affordable to financially precarious households who are now tied to the neighborhood.

4. Conclusion

Housing market conditions may put residents at “risk of risks” as SARS-CoV-2 spreads. Crowding, doubling up, homelessness, and taking on part-time work in jobs that carry COVID-19 exposure risk may help explain how rapidly increasing home values and unaffordable housing create geographic and social disparities in COVID-19 outcomes.

Credit statement

Mariana Arcaya: conceptualization, methodology, writing-original draft preparation, investigation, and supervision. Yael Nidam: conceptualization, data curation, visualization, formal analysis (quantitative), writing-original draft preparation, project administration. Andrew Binet: data curation, methodology (qualitative), formal analysis (qualitative), writing – reviewing and editing. Reann Gibson: writing - reviewing and editing, investigation, and supervision. Vedette Gavin: conceptualization, methodology, writing – reviewing and editing, investigation, and supervision.

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