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Kay Jowers
Christopher Timmins
Nrupen Bhavsar
Qihui Hu
Julia Marshall

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Housing Precarity & the COVID-19 Pandemic: Impacts of Utility Disconnection and Eviction Moratoria on Infections and Deaths Across US Counties
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ABSTRACT

The COVID-19 pandemic has necessitated the adoption of a number of policies that aim to reduce the spread of the disease by promoting housing stability. Housing precarity, which includes both the risk of eviction and utility disconnections or shut-offs, reduces a person's ability to abide by social distancing orders and comply with hygiene recommendations. Our analysis quantifies the impact of these various economic policies on COVID-19 infection and death rates using panel regression techniques to control for a variety of potential confounders. We find that policies that limit evictions are found to reduce COVID-19 infections by 3.8% and reduce deaths by 11%. Moratoria on utility disconnections reduce COVID-19 infections by 4.4% and mortality rates by 7.4%. Had such policies been in place across all counties (i.e., adopted as federal policy) from early March 2020 through the end of November 2020, our estimated counterfactuals show that policies that limit evictions could have reduced COVID-19 infections by 14.2% and deaths by 40.7%. For moratoria on utility disconnections, COVID-19 infections rates could have been reduced by 8.7% and deaths by 14.8%. Housing precarity policies that prevent eviction and utility disconnections have been effective mechanisms for decreasing both COVID-19 infections and deaths.

Kay Jowers
Nicholas Institute
Duke University
2117 Campus Drive
Durham, NC 27708
kay.jowers@duke.edu

Christopher Timmins
Department of Economics
Duke University
209 Social Sciences Building
P.O. Box 90097
Durham, NC 27708-0097
and NBER
christopher.timmins@duke.edu

Nrupen Bhavsar
Division of General Internal Medicine
Duke University
School of Medicine
200 Morris St, 3rd floor
Durham, NC 27701
nrupen.bhavsar@duke.edu

Qihui Hu
Department of Economics, Duke University
213 Social Sciences Building
PO Box 90097
Durham, NC 27708
USA
qihui.hu@duke.edu

Julia Marshall
Department of Economics, Duke University
213 Social Sciences Building
PO Box 90097
Durham, NC 27708
USA
julia.e.marshall@duke.edu

1. Introduction

Reducing the spread of the COVID-19 virus has required policies that restrict many aspects of daily life. These policies, which have been introduced by all levels of government, include stay-at-home orders, restrictions on gatherings, and school closures. While these interventions can provide public health benefits, they have left many people struggling to meet their financial obligations and basic needs. Government responses to these challenges have ranged from direct payments to households to lending programs for affected businesses. Our analysis focuses on measures adopted to address housing precarity, which include policies to stabilize households' tenure and access to essential services. Housing precarity has long been a problem in the United States, but it has been exacerbated by public health interventions required to address the spread of COVID-19. Ensuring that people have access to housing *and* essential services for water and electricity within their housing is necessary in any adequate government response to the housing precarity created by the COVID-19 pandemic.

In response to the lockdowns and closures that accompanied the pandemic, many jurisdictions temporarily halted evictions, suspended foreclosures, and granted relief from utility disconnections. However, these policies have been gradually expiring or have been extended with just-in-time actions, such as the one-month extension of a moratorium on evictions issued by the Center for Disease Control signed into law five days prior to its original expiration date. All of this has taken place in the face of subsequent waves of COVID-19.

Given the rising number of cases and the phasing out of policy interventions for housing and essential services, we examine the associations between housing, water, and energy interventions and COVID-19 infection rates and mortality. Because it is difficult to control for the variety of factors that may affect the efficacy of federal- and state-level policy responses, we focus on housing precarity policies adopted at the county-level. This helps us to better identify the impact of eviction and utility disconnection moratoria, and we find statistically significant reductions in both the number of infections and deaths when both types of policies are implemented.

We motivate this research with background on housing precarity and the need to include not only eviction risks but also utility scarcity in this analysis. We follow with a discussion of the heterogeneity in policy responses to the pandemic and an explanation of the modeling approach used to address this heterogeneity. We then discuss the results, conclusions that can be drawn from those results, and potential implications of this work.

2. Background

The economic fall-out from the COVID-19 pandemic has both highlighted and exacerbated a pre-existing crisis around housing precarity in the United States. Much of the focus so far has been on examining the rising risk of being evicted from one's home due to job loss and financial strain associated with the pandemic (see e.g., Leifheit et al. 2020). Moreover, when facing eviction, complying with public health measures to limit social interactions is very challenging. Compounding these difficulties is the fact that healthcare costs can increase the risk of evictions (Allen et al. 2019; Schwartz et al. 2020) and evictions can negatively impact health

(Rinkoo et al, 2020; Vásquez-Vera et al, 2017). However, precarious housing conditions are not only related to losing one's housing entirely but also to the quality of the housing and access to essential services, such as water and electricity.

Utility scarcity, defined as the complete absence of or decreased access to water and energy resources (Eichelberger 2010), is also an important element to consider when reducing the spread of the COVID-19 virus (Broto and Kirshner 2020). Research shows that utility shut offs and the financial strains of associated penalties, deposits, and fees are precursors to eviction, indicating that housing insecurity and energy insecurity may be concurrent hardships (Humphries, Mader, Tannebaum, & van Dijk, 2019; Jessel et al., 2019). Safe and reliable access to water is vital to human health under any conditions and especially so in the midst of a pandemic. Inadequate access to reliable and clean water means that people lack access to safe water for drinking and cooking (Wutich and Brewis 2014), which can cause physical illness (e.g., dehydration) as well as for basic hygiene measures, such as hand washing, which are critical for protecting health and preventing the spread of communicable diseases (Rusca et al. 2017; Prüss-Ustün et al. 2019). Lacking access to safe and reliable water causes stress and can trigger mental health problems (Wutich 2009; Sultana 2011; Brewis, Choudhary, and Wutich 2019). People without adequate access to water are also is stigmatized within communities, which can further exacerbate mental health impacts (Brewis 2019; Flowers 2020). Water insecure households in the US are more likely to be renting their homes, earning lower incomes, and spending higher shares of gross income on housing costs. They are also more likely to be headed by people of color (Meehan et al. 2020). Though we think of water access as nearly universal in the United States, around 0.3% of the population lacks adequate access to water, which is the equivalent of the population of a US city somewhere between the size of Dallas, TX, and San Jose, CA (Meehan et al. 2020).

Energy insecurity or energy poverty is also a public health threat and is extremely prevalent in the United States (EIA 2018; Jessel et al., 2019; Doremus et al. 2020). Energy insecurity is associated with respiratory illnesses, such as asthma, pneumonia, as well as with mental health challenges, such as depression and anxiety (Hernández & Siegal, 2019). Service disconnections may strain chronic health conditions and force individuals to seek additional medical care (Jessel et al., 2019), which compounds their financial burdens placing them at even greater risk of eviction. The Energy Information Administration's most recent Residential Energy Consumption Survey (RECS) finds that 31% of US households experience energy insecurity (2018). It also finds that 20% of the households surveyed reduce or forego purchasing necessities such as food and medicine to pay for energy and 11% of households surveyed keep their homes at unhealthy or unsafe temperatures to avoid increases in their energy costs (2018). Since that time, energy costs have only increased for residential consumers (EIA 2018).

Energy insecurity is not only driven by increasing utility costs, but also by the relationship between neighborhood demographic factors and the quality of housing stock. In the 2018 RECS, the Energy Information Administration found that households with residents identifying as people of color and/or low-income experienced more energy insecurity (2018). In addition, energy insecure households were also likely to be living in homes built prior to 1990 (2018). The mechanisms driving these demographic differences in energy insecurity are tied to enduring patterns created by a host of institutional rules, regulations, and practices that included discriminatory planning and lending practices, known as "redlining" (Rothstein 2017), and other forms of disinvestment in historically Black neighborhoods. The result of this disinvestment has been the creation of disproportionate structural energy inefficiencies in the housing stock available to people of color and low-income people, whether they are renters or homeowners (Swain, Emmett, & Lawrence, 2020). For renters, landlords may not weatherize or invest in energy efficiency due to the high upfront costs, forcing renters to bear the financial burden of increased energy bills (Jessel et al., 2019). When low-income, energy insecure households choose to defer utilities payments in order prioritize other household expenses, such as rent or mortgage payments, they can enter a cycle of debt accumulation and payment deferral that puts them at an even greater risk of losing their home altogether (Rinkoo et al, 2020).

2.1 Heterogeneity in Government Responses to COVID-19

The policy response to the pandemic has been varied across the type of policy actor (federal, state, or local government), the policy target (e.g., schools, non-essential businesses), the mechanism selected (e.g., mask mandates, stay-at-home orders), the degree of implementation and enforcement (voluntary vs. mandated), and in the timing of policy enactment and expiration. Adding to the complexity is that the suite of policy interventions required to protect public health have also created substantial financial distress that necessitated a cascade of policies to mitigate the economic fallout. Hale et al. (2020) document a high amount of variation and nuance in state government responses to the COVID-19 pandemic. They find that even when state and local governments adopted similarly strong responses at the beginning of the outbreak in March, sharp divergences both across and within states began to emerge by April. We see such divergences in the responses of governments at all levels in their initiatives and relief to alleviate housing precarity.

At the federal level, the Department of Housing and Urban Development began by implementing early on a policy that placed a moratorium on evictions for those in federally subsidized rentals and on foreclosures for homes with federally-backed mortgages (HUD 2020). These provisions were incorporated into the Coronavirus Aid, Relief, and Economic Security Act, or the federal CARES Act (Pub. L. No. 116-136), which was signed into law on March 27, 2020, and placed a 120-day moratorium on evictions for properties that participate in government programs or that have a federally backed mortgage loan through July 31, 2020. The protections for homeowners with federal-based mortgages were put in place through December 31, 2020. After the CARES Act evictions moratorium expired, the Centers for Disease Control (CDC) issued the Temporary Halt in Residential Evictions to Prevent the Further Spread of COVID-19, an unprecedented moratorium on evictions invoking powers under the Public Health Service Act (85 Fed. Reg. 55292). The CDC's eviction order was put in place on September 4, 2020 and was set to expire on January 1, 2021. Congress extended the CDC's moratorium until January 31, 2021, in a second set of stimulus measures included in the Consolidated Appropriations Act, which passed on December 21, 2020 and was signed by President Trump on December 27, 2020 (Pub. L. No. 116-260). The second stimulus measures expand on the CARES Act by also allocating $25 billion in rental assistance that can be used by qualified families to pay rent or utilities as well as for past-due rent or utilities. These protections have been essential for ensuring housing security for those who have experienced job losses or income reductions related to the pandemic.

In addition to this federal response, many state and local governments issued their own stays on evictions (Desmond 2020; Poteat et al. 2020; Leifheit et al. 2020; Benfer et al. 2020). These stays and moratoria have varied in their application with some prohibiting the filing of petitions for evictions while others merely stayed the hearing process once an eviction petition was filed. Cowin and Stevens (2020) find that regardless of ban type, eviction filings were reduced in areas that adopted them. In the areas where these policies have expired, evictions proceedings have quickly returned to their pre-pandemic levels (Cowin and Stevens 2020). Evictions filings are also expected to increase as the pandemic continues and household financial situations continue to deteriorate. Some states have acted to match the current federal policy protections through January 31^{st}, 2021, including North Carolina (North Carolina Exec. Order 184). Others have gone further than the federal policy. In New York, the COVID-19 Emergency Eviction and Foreclosure Prevention Act of 2020 (2020 N.Y. Laws 381) was passed to prohibit evictions and foreclosures as well as any negative credit impacts for residents that related to the COVID-19 pandemic through May 1, 2021. Connecticut's governor extended their state's ban until February 9^{th}, 2021 (Conn. Exec. Order No. 9T). Washington's governor also extended their state eviction moratorium until March 31^{st}, 2021 (Wash. Exec. Order 20-19.5).

To address utility scarcity, state and local governments have also adopted a variety of voluntary and mandatory orders that electric and water service providers abstain from disconnecting service even when customers are unable to pay their bills (Poteat et al. 2020). A recent analysis of state moratoria on water disconnections found that places with mandatory policies in place tended to be wealthier but also had higher levels of income inequality and more racially/ethnically diverse populations (Warner, Zhang, and Rivas 2020). Partisan political control of the state government also affected the state's willingness to impose water disconnection moratoria, with Republican-controlled state governments less likely to issue a mandatory order (Warner, Zhang, and Rivas 2020).

2.2 Prior Research on the Efficacy of Housing Precarity Policy & COVID-19

Although there have been numerous studies conducted on COVID-19-related policy interventions, relatively few of those have focused on housing precarity and even fewer have focused on the efficacy of those housing precarity policies. Three recent analyses directly address the effectiveness of eviction moratoria adopted in response to the COVID-19 pandemic (Pan et al. 2020; Sheen et al. 2020; Leifheit et al. 2020). Leifheit and co-authors examine moratoria adopted by state governments and find that the incidence of infections and mortality both increased significantly in states where eviction moratoria are lifted. Their research design focuses on the state-level and cannot account for important unobserved and unmeasured omitted variables and/or confounding variables that could affect the outcome (infections and deaths) nor does it account for federal policies that were in place simultaneously. Focusing such analyses at a county or local level may provide more opportunity to control for the variety of potential confounders.

Pan et al. (2020) take an approach that focuses on the county-level across the United States and uses a classification of interventions that categorizes 12 county-level policy interventions according to the intensity of the intervention (low, moderate, high, aggressive). Their policy set includes the suspension of evictions in the high category for interventions. Pan and co-authors find that only the most aggressive category of interventions (shelter-in-place, mask requirements, and travel restrictions) were effective at reducing mortality rates across the US and that these interventions were combined with high intensity interventions like eviction suspensions that reduced infection rates and doubling times. Although their analysis is conducted at a level at which potential unobserved and unmeasured confounders may be reduced, they use a limited set of county co-variates to account for potential socio-environmental confounders and do not account for issues such as changes in testing capacity.

Sheen and co-authors (2020) model the potential for COVID-19 transmission based on data regarding evictions filings in Philadelphia. They find that increased evictions increase the risk of COVID-19 infection not only for those households experiencing the eviction but for all households. Their simulations suggest that if evictions in Philadelphia were allowed to merely return to their pre-pandemic levels, another 0.5% of the population (7,200 people) could be infected. If eviction rates rise as expected, then the authors predict that excess infections due to evictions could increase from 0.5% to 1% if the eviction rate doubled and to 2.6% (or ~41,000 extra infections) if the eviction rate increased 5-fold, which is the level some have predicted may be reached (Sheen et al. 2020).

Although these three analyses shed light on the efficacy of policies to address evictions, they do not account for utility scarcity, an important precursor to eviction, and the policy interventions adopted to address shut offs for essential services like water and electricity. In addition, they do not control well for federal policy (the CARES Act) that may vary in its implementation at a local level depending on how many federally subsidized renters and/or homeowners live in an area. Our paper uses the variation in policies adopted at the county-level to address housing precarity and implements panel regression models with fixed effects to account for potential state- and federal-level confounders to examine whether these interventions are associated with COVID-19 incidence and deaths.

3. Research Design and Method

It is difficult to identify the impact of policies undertaken in response to the COVID-19 pandemic because of the potential role of unobserved omitted and/or confounding factors. This is particularly true for policies implemented at the state or federal level. For example, COVID-19 struck early in Washington state, New York city, and other large cities around the country for reasons such as exposure to international travelers. Rates of international travel within a state are not measured but are nevertheless an omitted variable that could affect the number of infections and deaths from COVID-19. Once the virus had become more widespread, variation in confirmed case counts was determined, in part, by differences in testing policy across states. Therefore, variations in testing policies across states could have causal effects on both the enactment of housing precarity policies and on the number of confirmed infections and deaths reported in a state. Factors like these rates of international travelers and testing policies, which vary over time and place, make it difficult to accurately identify the effects of state eviction moratoria or national level policy, such as the CARES Act or the CDC moratorium on evictions.

We address this problem by focusing on the role of local policies adopted to address housing precarity (evictions and utility scarcity) while controlling for the effects of state and national policies along with other potentially omitted or confounding variables with a rich set of fixed effects described more fully below. The inclusion of fixed effects is a common approach to control for any differences across place (e.g., states) that remain constant over time, or temporal effects that are common across locations. By including fixed effects in the modeling, differences in means of the outcome across place, time, or other types of effects are controlled for in the estimation and thus cannot bias the identification of the causal effect of interest. By using fixed effects to control for anything that varies over time at the state level, our research design capitalizes on the variation in policy adoption and phased implementation at the county-level.

We use a panel of daily observations of the confirmed infections and deaths in each of 3,141 U.S. counties from March 1st to November 28th (COVID Tracking Project 2020). With these data, we can estimate two sets of fixed effects – one varies by both state and week and the other varies by both the county level of housing insecurity and week since March 1st. We use the former to control for any unobserved factor that affects infection or death rates at the state (or national) level from week to week. This might include the differential effect of international travelers in different states, as described above. It will also control for any policy (e.g., eviction moratorium, stay-at-home order, or mask mandate) implemented at the state level as well as for heterogeneity across states and over time in testing activity. The latter fixed effects are included to control for anything that varies from week to week at the county level depending upon the county's level of housing insecurity; here, we are thinking particularly about the role of the federal CARES Act. We create a binary variable to indicate the level of housing insecurity in a county that combines the percentage of housing in the county that is subsidized by Housing Choice Vouchers and the percentage of single-family homes with Federal Housing Administration (FHA) mortgage insurance in effect (US Dept of Housing and Urban Dev 2019, 2020). Originally available at the census tract level, both the HCV and FHA variables are aggregated to the county-level for the purpose of this estimation. We code a county as housing insecure if it is above the national median for both FHA and HCV. We then interact the housing insecurity indicator with a vector of week indicators. We include these fixed effects primarily to control for the impacts of the national CARES Act, which provided protections against foreclosures and evictions.

We estimate separate models for infections per capita and deaths per capita as research shows that there may be distinct factors affecting the risk of infection and the risk of death once one is infected. For infections, we estimate four specifications that vary by the type of lag terms and the fixed effects included.

Our linear regression model for infections per 100,000 residents (*I*) takes the following form:

$$I_{jt} = \beta_0 + \beta_1 x_{jt} + \beta_2 z_j^I + \beta_3 I_{jt-1} + \alpha^I_{s(j)w(t)} + \rho^I_{p(j)w(t)} + \epsilon_{jt} \qquad (1)$$

I_{jt} is measured daily (*t*) at the county (*j*) level by the COVID Tracking Project (2020). x_{jt} represents the matrix of time-variant policies adopted to address evictions and utility scarcity as described below. z_j^I is a set of time-invariant control variables for county characteristics, which are also summarized below. $\alpha_{s(j)w(t)}^I$ represents the vector of fixed effects for the state *s* containing county *j* in the week *w* containing day *t*. $\rho_{p(j),w(t)}^I$ similarly represents the vector of fixed effects that vary by week and the housing precarity of county *j*.

In an alternative specification, we replace $I_{jt-1}$with a spatial-temporal lag term that translates the vector of infections in counties nearby to county *j* on day *t-1* (into their impact on infections in county *j* on day *t*.

$$I_{jt} = \delta_0 + \delta_1 x_{jt} + \delta_2 z_j^I + \delta_3 \omega \bar{I}_{jt-1} + \lambda_{s(j)w(t)}^I + \phi_{p(j)w(t)}^I + u_{jt} \quad (2)$$

In particular, $\bar{I}_{jt-1}$ is a matrix of infection rates in nearby counties on day *t*-1,[1] and ω is a matrix that translates them into single value that affects county *j* on period *t* through the parameter δ_3. Other terms in this specification are defined similarly to the specification above.

Our model for deaths per capita takes a slightly modified form that incorporates the average number of infections registered in the county from *t*-28 to *t*-14:

$$D_{jt} = \gamma_0 + \gamma_1 x_{jt} + \gamma_2 z_j^D + \gamma_3 \left(\tfrac{1}{15} \textstyle\sum_{k=14}^{28} I_{jt-k}\right) + \alpha_{s(j),w(t)}^D + \rho_{P(j),w(t)}^D + u_{jt} \quad (3)$$

The lag time between COVID-19 infection and death varies from 2 to 8 weeks (Testa et al. 2020, WHO 2020). We use 2 to 4 weeks, anticipating that the median range from infection to death is on average 28 days (about 4 weeks).

When modeling infections and mortality, we account for the impact of county-level policies through x_{jt}. The main policy variables of interest in our analysis are the impact of: (1) policies targeting evictions, and (2) policies designed to prevent shut-off of essential services for water and electricity. The data for the state and local moratoria on evictions were derived from Princeton University's Eviction Lab (2020) and the Health Justice Advocacy Clinic at Columbia Law School (2020). The moratoria on utility service shut off moratoria come from Food & Water Watch (2020) and from the National Association of Regulatory Utility Commissioners (2020). State and national policy impacts are again captured through our two vectors of fixed effects.

z_j^I and z_j^D are vectors of control variables representing county attributes, including demographic, health, and environmental variables. For our model of infections as the outcome, z_j^I includes the percentage of the population over age 65, race and ethnicity, and median income (U.S. Census Bureau 2019). We also include the percentage of people with health insurance to capture disparities

[1] In particular, we use a 1/distance weight, with distance defined by miles between the centroid of the county in question and that of all other counties in the continental US.

in access to testing, the percentage of the population living in institutional facilities as the rates of infection are high in these environments, the means of transportation to work (as public transportation may increase one's exposure),), and the percentage of essential workers, who will be less able to work from home (U.S. Census Bureau 2019). For our model with mortality as the outcome, the county attributes we control for shift to capture those attributes that may increase the likelihood of death from COVID. The socioeconomic characteristics for race, age, and income included in z_j^D remain the same. We add variables to capture co-morbidities that may increase the likelihood of death. Specifically, we include the percentage of population who are obese, and diabetic (Univ of Wisconsin 2020).[2] We also control for air pollution in the form of fine particulate matter (PM2.5), which is associated with exacerbating respiratory illness and disease. We remove the variables for means of transportation and the percentage of essential workers as those measures are more associated with the risk of infection from COVID-19 rather than that with the risk of death conditional upon infection.

Descriptive statistics for all policy and control variables are included in Table 1.

4. Findings & Analysis

4.1 Estimation Results

Parameter estimates for both our model of infections and deaths per 100,000 people are reported in Table 2.[3] Models 1-4 measure infections as the outcome. Model 1 uses the one-day lag in infections and includes state-by-week and housing insecurity-by-week fixed effects. Model 2 adds county fixed effects to the specification from Model 1. Model 3 uses a one-day lag of the average number of cases in the county in question as well as in nearby counties with state-by-week and housing insecurity-by-week fixed effects. Model 4 adds county fixed effects to the specification from Model 3. Models 5 measures deaths as the outcome and use the 2–4-week lag of infections within the county in question from Model 1 with state-by-week and housing insecurity-by-week fixed effects. Model 6 adds county fixed effects to the specification in Model 5.

While our focus is on the impact of housing precarity policies, we first consider our county-level covariates from Models 1, 3, and 5. These results are consistent with other results in the new and growing literature on COVID-19. In particular, we find that, regardless of the type of lag used (temporal or spatial), infections and deaths are both higher for African American, Latinx, and Native American populations, reflecting what has been a well-documented aspect of the pandemic (Mahajan and Pettigrew 2020). Death rates are also higher in counties with a higher percentage of residents over the age of 65. Higher median income is associated with higher infection rates but lower death rates conditional upon infection. Infection rates are significantly higher in counties with a higher percentage of renters and residents who commute by carpool or public transit. Higher percentages of residents in institutional living facilities and workers in essential services also

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[2] We excluded the percentage of smokers in the county as the research on smoking and COVID-19 outcomes is mixed (*see e.g*., Raines et al. 2020; Adrish 2020; Para-Bracamonte 2020) and some have even found an inverse association between smoking and COVID 19 (Iyanda et al. 2020), which is thought to be related to colliders bias (Griffith et al. 2020).

[3] State-by-week and housing insecurity-by-week fixed effects are not reported.

increase the rate of infections. Higher percentages of residents without health insurance raise both rates of infection and death. Consistent with recent research (Wu et al. 2020), we find that increased exposure to small airborne particulates (PM2.5) also increases the rate of death. We find that the one-day lag of the average number of cases as well as a one-day lag of the average number of cases in nearby counties have significant effects on cases in the county in question, and the 2–4-week lag of infections within the county in question has a significant and positive impact on deaths.

Our primary interest is in the local policy variables – days since an eviction or utility shutoff moratorium had gone into effect in the county. Briefly, these policies significantly decreased infection and death rates across all model specifications. The following subsection provides details about the impact of these policies with a series of counterfactual simulations using results from Model 1, which uses the one-day lag in infections and includes state-by-week and housing insecurity-by-week fixed effects.

4.2 Counterfactual Analyses

Next, we use statistical simulations to identify the impact of policies designed to address housing insecurity at the local level on our outcomes of interest, COVID-19 infections and deaths. The predictions of the simulations use the estimates from Model 1, which yielded our most conservative estimates of the impact of our local policy variables. 95% confidence intervals for our simulated outcomes are generated using 2,000 bootstrap estimations. In Figure 1, we simulate cumulative infections on each day with all county-level policies in place as they were implemented (i.e., the status quo) as well as with those policies removed. We can also compare the impact of these policies had they been implemented on the first day of the study period and in all counties, as compared to when and where they were actually implemented. That is, we can test the impact of implementing these policies earlier in the pandemic and analyze how they contribute to COVID-19 infections in an average county.

Next, in Figure 2 we simulate similar counterfactual analyses for cumulative deaths in an average county. It is important to note that these models require the results of the counterfactual infections simulations as an input, as we use the 2–4-week average lagged infections per capita as an input into this simulation. Failure to implement an eviction moratorium may have both a direct effect (i.e., increasing the death rate) and an indirect effect (i.e., increasing the infection rate, which in turn can increase the death rate). 95% confidence intervals on predicted deaths are also generated with 2,000 bootstrap estimations.

Our results suggest that policies designed to address housing insecurity can have a significant impact on both infections and deaths. With all policies as implemented, Figure 1 shows that our model predicts a cumulative number of infections of 4410.5 per 100,000 on the final day of our sample. Turning off all county-level housing precarity policies, this value rises to 4805.6 – an increase of 8.2%. Simply having a local eviction moratoria decreases cumulative infections to 4622.5, or by 3.8%, while having only local utility disconnection moratoria decreases the value to 4593.6, or by 4.4%. These are sizeable impacts that show the capacity of these policies to reduce infections.

Next, we use our model to show the full potential of these policies were they to have been applied nationwide from the start of our study period. Note, however, that mass adoption of these policies will involve additional benefits from the county-to-county spillovers that arise through the spatial lag term used in the infections equation for Models 3 and 4. Figure 1 also shows cumulative cases per 100,000 without any of the county-level housing precarity policies adopted along with cumulative cases assuming that all those policies had been adopted everywhere beginning at the start of our sample period. Cumulative infections fall to 3702.3 per 100,000 residents – a reduction of 22.9% relative to the case with no local housing precarity policies. We also break this effect out into the separate effects of county-level eviction and utility disconnection moratoria. Per 100,000 residents, the former reduces cumulative infections to 4124.6, or by 14.2%, while the latter reduces them to 4383.2, or by 8.7%.

Turning to the impacts of housing precarity policies on deaths, Figure 2 shows cumulative deaths per 100,000 residents with local housing precarity policies in place as adopted along with a counterfactual in which those policies had never been implemented. This raises the average cumulative death rate at the end of our sample period from 76.9 to 94.3 per 100,000 – an increase of 18.4%. Local eviction moratoria reduced cumulative deaths per 100,000 to 83.9, or by 11%, while utility disconnection moratoria only reduced it to 87.2, or by 7.4%. Note that these impacts incorporate both direct policy impacts on deaths, and indirect effects that come through their impacts on average lagged infection rates. Figure 2 also shows how deaths would have been affected had all local policies instead been adopted everywhere at the start of our sample period. These results highlight the public health potential of these policies. Cumulative deaths per 100,000 at the end of our sample period would have fallen to 41.9 – a reduction of 55.5% relative to a world in which all of these policies had been turned off. Breaking these impacts down by type of policy, we find that adopting local eviction moratoria in all counties starting on the first day of the study period would have reduced deaths to 55.9 – a reduction of 40.7%. Similarly, mass adoption of utility disconnection moratoria starting on the first day would have reduced deaths per 100,000 to 80.3 – a reduction of 14.8%.

Next, we estimate the counterfactuals using the results from Model 3, which captures the additional benefits from county-to-county spillovers that arise through the spatial lag term in the infections equation. These spillovers will be particularly important if the policies are adopted on a national scale. Turning off all county-level housing precarity policies raises infections to 5165. If the policies were to have been implemented in all counties at the start of our study period, cumulative infections would have fallen to 3861.137 per 100,000 residents – a reduction of 25.24% relative to the case with no local housing precarity policies. Breaking this effect out into the separate effects of county-level eviction and utility disconnection moratoria, we find that the eviction moratoria would have reduced cumulative infections per 100,000 residents to 4360.275, or by 15.58%, while the utility disconnection moratoria alone would have reduced them to 4674.601, or by 9.49%.

Using the estimates from Model 3 to generate the 2-4-week lag term for deaths, we estimate that if none of the policies had been enacted, the average cumulative death rate at the end of our sample period would have gone from 76.69 to 94 per 100,000 – an increase of 22.6%. Eliminating only local eviction moratoria would have raised cumulative deaths per 100,000 to 83.7 while eliminating only utility disconnection moratoria would have raised it to 87. If all local policies had instead been adopted everywhere at the start of our sample period, cumulative deaths per 100,000 at the end of our sample period would have fallen to 41.7 – a reduction of 55.6% relative to a world in which all of these policies had been turned off. Breaking these impacts down by type of policy, adopting local eviction moratoria in all counties starting on the first day of the study period would have reduced deaths to 55.6– a reduction of 40.9%. Similarly, mass adoption of utility disconnection moratoria starting on the first day would have reduced deaths per 100,000 to 80 – a reduction of 14.9%.

5. Discussion and Conclusion

From the beginning of the pandemic through the end of November, housing precarity policies that include eviction and utility disconnection moratoria have been effective at decreasing both COVID-19 infections and deaths. Our analysis is consistent with findings from others (Pan et al. 2020; Leifheit et al. 2020; Sheen et al. 2020) that report significant impacts of evictions moratoria on infections and/or deaths from COVID-19. Our analysis builds upon these studies by evaluating additional policy mechanisms that address housing precarity. Specifically, we show that policies that stop utility disconnections during the pandemic have also been effective and have decreased the number of COVID-19 cases and deaths. This study focuses on estimating the effects of policy actions related to housing precarity adopted at the county level while controlling for policies adopted at the state and federal level. We do this in order to address the role of concurrent factors at the state and federal level that make it difficult to identify the effects of the federal and state housing precarity policy impacts. Our findings, however, can be applied to inform policies adopted by federal and state governments. We expect that these housing precarity policy mechanisms produce comparable results when implemented at broader geographic scales. We provide an indication of the impacts of a national policy with a series of counterfactual simulations where we model the policies adopted by all counties starting at the beginning of our study period.

Specifically, we see effects that are both statistically and pragmatically significant in terms of the change in the total number of COVID-19 infections and deaths if such policies had been implemented and fully phased in across the nation (i.e., at the federal level) from the beginning of the pandemic. Our simulations show that implementing these policies across all counties from the beginning of the pandemic could have prevented 395 additional infections and 52 additional deaths in the average county. These findings suggest that housing precarity policies are important and effective policy mechanisms for reducing the spread of COVID-19.

Our analysis is limited to assessing the efficacy of policies that, at best, will delay the financial impacts of the pandemic rather than stopping them completely. Most eviction and utility disconnection moratoria merely delay, but do not stop, the eviction and/or disconnection process for financially stressed households. Other policy mechanisms, such as rent and utility relief or forgiveness, are not captured here but may also play an important role in reducing COVID-19 infections and mortality. If policy makers want to holistically address the housing precarity impacts of the pandemic, then adopting policies that provide both immediate and long-term relief is necessary. The recent stimulus package has allocated significant funds to aid qualified households with paying rent and utilities. Such aid will be important as housing precarity policies expire.

References

Adrish, M., Chilimuri, S., Mantri, N., Sun, H., Zahid, M., Gongati, S., . . . Singhal, R. 2020. Association of smoking status with outcomes in hospitalised patients with COVID-19. *BMJ Open Respiratory Research, 7*(1) doi:http://dx.doi.org.proxy.lib.duke.edu/10.1136/bmjresp-2020-000716

Allen, H. L., Eliason, E., Zewde, N., & Gross, T. (2019). Can Medicaid expansion prevent housing evictions?. *Health Affairs*, *38*(9), 1451-1457. https://doi.org/10.1377/hlthaff.2018.05071.

Banzhaf, H. S., Ma, L., & Timmins, C. (2019). Environmental Justice: Establishing Causal Relationships. *Annual Review of Resource Economics, 11*(1), 377-398. doi:10.1146/annurev-resource-100518-094131

Benfer, E., D. Vlahov, M. Long, E. Walker-Wells, J.L. Pottenger, G. Gonsalves, D. Keene. 2020. Eviction, Health Inequity, and the Spread of COVID-19: Housing Policy as a Primary Pandemic Mitigation Strategy. Forthcoming in *Journal of Urban Health*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3736457

Brewis, A., N. Choudhary, A. Wutich.. 2019. Household water insecurity may influence common mental disorders directly and indirectly through multiple pathways: Evidence from Haiti. *Soc. Sci. Med*. 1982 238, 112520.

Brewis A. 2019. Community hygiene norm violators are consistently stigmatized: Evidence from four global sites and implications for sanitation interventions. Soc. Sci. Med. 220, 12–21.

Castán Broto, V., Kirshner, J. Energy access is needed to maintain health during pandemics. *Nat Energy* **5,** 419–421 (2020). https://doi.org/10.1038/s41560-020-0625-6.

Centers for Disease Control and Prevention, Department of Health and Human Services. Temporary Halt in Residential Evictions to Prevent the Further Spread of COVID-19. 85 Fed. Reg. 55292 (Sept. 4, 2020). Retrieved from https://www.federalregister.gov/documents/2020/09/04/2020-19654/temporary-halt-in-residential-evictions-to-prevent-the-further-spread-of-covid-19.

Connecticut Exec. Order No. 9T. 2020. Retrieved from https://portal.ct.gov/-/media/Office-of-the-Governor/Executive-Orders/Lamont-Executive-Orders/Executive-Order-No-9T.pdf

Consolidated Appropriations Act, 2021. Pub. L. No. 116-260, 116th Cong. (2020). Retrieved from https://www.congress.gov/bill/116th-congress/house-bill/133/text; https://beta.documentcloud.org/documents/20433223-covid-19-relief-bill

Coronavirus Aid, Relief, and Economic Security Act of 2020. Pub. L. No. 116-136, 116th Cong. (2020). Retrieved from https://www.congress.gov/bill/116th-congress/house-bill/748

COVID Tracking Project. 2020. US Current and Historical Data. Prepared by Social Explorer.

Desmond, M., & Shollenberger, T. 2015. Forced Displacement from Rental Housing: Prevalence and Neighborhood Consequences. *Demography, 52*(5), 1751-1772. doi:10.1007/s13524-015-0419-9

Desmond, M., & Travis, A. 2018. Political Consequences of Survival Strategies among the Urban Poor. *American Sociological Review, 83*(5), 869-896. doi:10.1177/0003122418792836

Dobin, D., & Dobin, A. 2020. Racial/ethnic and socioeconomic disparities of Covid-19 attacks rates in Suffolk County communities. Retrieved from https://arxiv.org/pdf/2004.12175.pdf

Doremus, J., Jacqz, I., & Johnston, S. 2020. Sweating the energy bill. Extreme weather, poor households, and the energy spending gap. Presented at the 2021 ASSA Annual Meetings.

Eichelberger, L. P. Living in Utility Scarcity: Energy and Water Insecurity in Northwest Alaska. *Am J Public Health* 100, 1010–1018 (2010).

Eviction Lab, Princeton University. 2020. COVID-19 and Changing Eviction Policies Around the Nation. https://evictionlab.org/covid-eviction-policies/.

Flowers, Catherine Coleman. 2020. Waste: One Woman's Fight Against America's Dirty Secret. New York, NY: The New Press.

Food & Water Watch. 2020. Local-State Water Shutoff Moratoria Amidst Coronavirus. https://docs.google.com/spreadsheets/d/153Ze6RRZ-ZZ9oVkaSErhVHGMv3Z4laQDs0GRO7UmYnQ/edit#gid=1796772260.

Griffith, G.J., Morris, T.T., Tudball, M.J. *et al.* 2020. Collider bias undermines our understanding of COVID-19 disease risk and severity. *Nat Commun* 11, 5749. https://doi.org/10.1038/s41467-020-19478-2

Hale, T., T. Atav, L. Hallas, B. Kira, T. Phillips, A. Petherick, A. Pott. 2020. Variation in US states' responses to COVID-19. *Blavatnik School of Government Working Paper*. Available: www.bsg.ox.ac.uk/covidtracker

Health Justice Advocacy Clinic, Columbia Law School. 2020. COVID-19 Eviction Moratoria by State, Commonwealth, and Territory. https://docs.google.com/spreadsheets/u/1/d/e/2PACX-1vTH8dUIbfnt3X52TrY3dEHQCAm60e5nqo0Rn1rNCf15dPGeXxM9QN9UdxUfEjxwvfTKzbCbZxJMdR7X/pubhtml#.

Hernández, D., & Siegel, E. 2019. Energy insecurity and its ill health effects: A community perspective on the energy-health nexus in New York City. *Energy Research & Social Science, 47*, 78-83. doi:https://doi.org/10.1016/j.erss.2018.08.011

Humphries, J. E., Mader, N. S., Tannenbaum, D. I., & Dijk, W. v. (2019). Does Eviction Cause Poverty? Quasi-Experimental Evidence from Cook County, Il. *Political Methods: Experiments & Experimental Design eJournal*.

Iyanda, A. E. *et al.* 2020. A retrospective cross-national examination of COVID-19 outbreak in 175 countries: a multiscale geographically weighted regression analysis (January 11-June 28, 2020). *J Infect Public Heal* 13, 1438–1445.

Jessel, S., Sawyer, S., & Hernández, D. (2019). Energy, Poverty, and Health in Climate Change: A Comprehensive Review of an Emerging Literature. *Front Public Health, 7*, 357. doi:10.3389/fpubh.2019.00357

Leifheit, K.M., S. L. Linton, J. Raifman, G.L. Schwartz, E.A. Benfer, F.J. Zimmerman, C.E.Pollack. 2020. Expiring eviction moratoriums and COVID-19 incidence and mortality. https://ssrn.com/abstract=3739576

Mahajan, U. V. & Larkins-Pettigrew, M. 2020. Racial demographics and COVID-19 confirmed cases and deaths: a correlational analysis of 2886 US counties. *J Public Health* doi:10.1093/pubmed/fdaa070.

Meehan, K., Jurjevich, J. R., Chun, N. M. J. W. & Sherrill, J. 2020. Geographies of insecure water access and the housing–water nexus in US cities. *Proc National Acad Sci* 117, 28700–28707.

Millett, G. A., Jones, A. T., Benkeser, D., Baral, S., Mercer, L., Beyrer, C., . . . Sullivan, P. S. 2020. Assessing differential impacts of COVID-19 on black communities. *Annals of Epidemiology, 47*, 37-44. doi:https://doi.org/10.1016/j.annepidem.2020.05.003

National Association of Regulatory Utility Commissioners. COVID19 State Response Tracker. https://www.naruc.org/compilation-of-covid-19-news-resources/state-response-tracker/.

New York. 2020 N.Y. Laws 381. COVID-19 Emergency Eviction and Foreclosure Prevention Act of 2020. Retrieved from https://assembly.state.ny.us/leg/?default_fld=&leg_video=&bn=S09114&term=2019&Summary=Y&Actions=Y&Text=Y

North Carolina Exec. Order 184. Extending Assistance for North Carolinians at Risk of Eviction and Reinstating Processes to Expedite Payment of Unemployment Insurance Claims. Retrieved from https://files.nc.gov/governor/documents/files/EO184-Evictions-Extension-and-Unemployment-Ins-Claims.pdf

Pan, W. K., S. Tyrovolas, G. V. lago, R.R. Dasgupta, F. Daniel, B. Zaitchik, P.M. Lantos, C. W. Woods. 2020. COVID-19: Effectiveness of Non-Pharmaceutical Interventions in the United States before Phased Removal of Social Distancing Protections Varies by Region. https://doi.org/10.1101/2020.08.18.20177600.

Parra-Bracamonte, G. M., Lopez-Villalobos, N. & Parra-Bracamonte, F. E. 2020. Clinical characteristics and risk factors for mortality of patients with COVID-19 in a large data set from Mexico. *Ann Epidemiol* 52, 93-98 e2.

Poteat, T., Millett, G. A., Nelson, L. E., & Beyrer, C. (2020). Understanding COVID-19 risks and vulnerabilities among black communities in America: the lethal force of syndemics. *Annals of Epidemiology, 47*, 1-3. doi:https://doi.org/10.1016/j.annepidem.2020.05.004

Prüss-Ustün, A. et al. 2019. Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low and middle-income countries. Int. J. Hyg. Environ. Health 222, 765–777.

Raines, A.M., J.L. Tock, S.J. McGrew, C.R. Ennis, J. Derania, C. L. Jardak, J. H. Lim, J. W. Boffa, C. Houtsma, K. R. Jones, C.Martin-Klinger, K. Widmer, R. Schapira, M. J. Zvolensky, M. Hoerger, J. I. Constans, C. L. Franklin. 2020. Correlates of death among SARS-CoV-2 positive veterans: The contribution of lifetime tobacco use. Addictive Behaviors 113: 106692. ISSN 0306-4603. https://doi.org/10.1016/j.addbeh.2020.106692

Raudenbush, D. (2016). "I Stay by Myself": Social Support, Distrust, and Selective Solidarity Among the Urban Poor. *Sociological Forum, 31*(4), 1018-1039. doi:https://doi.org/10.1111/socf.12294

Rinkoo, A. V., Songara, D., Sharma, A., Patnaik, B. R., Singh, R. R., & Srivastava, R. K. (2020). Reliable energy and responsive built environment: the missing links in COVID-19 response in resource-limited settings. *Tropical medicine and health, 48*, 67. doi:10.1186/s41182-020-00255-2

Rothstein, 2017. The Color of Law: A Forgotten History of How Our Government Segregated America. New York, NY: Liveright.

M. Rusca, C. Alda-Vidal, M. Hordijk, N. Kral, 2017. Bathing without water, and other stories of everyday hygiene practices and risk perception in urban low-income areas: The case of Lilongwe, Malawi. Environ. Urban. 29, 533–550.

Sharkey, P., & Faber, J. W. 2014. Where, When, Why, and For Whom Do Residential Contexts Matter? Moving Away from the Dichotomous Understanding of Neighborhood Effects. *Annual Review of Sociology, 40*(1), 559-579. doi:10.1146/annurev-soc-071913-043350

Sheen, J. *et al.* 2020. The effect of eviction moratoriums on the transmission of SARS-CoV-2. *Medrxiv Prepr Serv Heal Sci* (2020) doi:10.1101/2020.10.27.20220897.

Sultana, F. 2011. Suffering for water, suffering from water: Emotional geographies of resource access, control and conflict. *Geoforum* 42, 163–172.

Swain, M., McKinney, E., & Susskind, L. 2020. Water Shutoffs in Older American Cities: Causes, Extent, and Remedies. *Journal of Planning Education and Research*, 0739456X20904431. doi:10.1177/0739456X20904431

Testa, C., N.Krieger, J.T. Chen, and W.P. Hanage. 2020. Visualizing the lagged connection between COVID-19 cases and deaths in the United States: An animation using per capita state-level data (January 22, 2020 – July 8, 2020). Harvard Center for Population and Development Studies Working Paper Series 19(4). Available at https://cdn1.sph.harvard.edu/wp-content/uploads/sites/1266/2020/07/HCPDS-WP_19_4_testa-et-al_Visualizing-Lagged-Connection-Between-COVID-19-Cases-and-Deaths-in-US_final_07_10_with-cover.pdf/

Vásquez-Vera, H., Palència, L., Magna, I., Mena, C., Neira, J., & Borrell, C. 2017. The threat of home eviction and its effects on health through the equity lens: A systematic review. *Soc Sci Med, 175*, 199-208. doi:10.1016/j.socscimed.2017.01.010

Warner, M. E., Zhang, X., & Rivas, M. G. 2020. Which states and cities protect residents from water shutoffs in the COVID-19 pandemic? *Utilities Policy, 67*, 101118. doi:https://doi.org/10.1016/j.jup.2020.101118

Washington Exec. Order 20-19.5. 2020. Retrieved from https://www.governor.wa.gov/sites/default/files/proclamations/proc_20-19.5.pdf?utm_medium=email&utm_source=govdelivery

Webb Hooper, M., Nápoles, A. M., & Pérez-Stable, E. J. 2020. COVID-19 and Racial/Ethnic Disparities. *JAMA, 323*(24), 2466-2467. doi:10.1001/jama.2020.8598

World Health Organization. 2020. Report of the WHO-China joint mission on coronavirus disease 2019 (COVID-19).

Wu, X., R. C. Nethery, M.B. Sabath, D. Braun, F. Dominici. 2020. Exposure to air pollution and COVID-19 mortality in the United States: A nationwide cross-sectional study. doi: 10.1101/2020.04.05.20054502

Wutich, A. 2009. Intrahousehold disparities in women and men's experiences of water insecurity and emotional distress in urban Bolivia. Med. Anthropol. Q. 23, 436–454 (2009).

Wutich, A, A. Brewis. 2014. Food, water, and scarcity: Toward a broader anthropology of resource insecurity. Curr. Anthropol. 55, 444–468.

U.S. Census Bureau. 2019. American Community Survey 2014-2018 5-Year Data Release. Prepared by Social Explorer.

U.S. Dept. of Housing and Urban Development. 2020. Mortgagee Letter 2020-04: Foreclosure and Eviction Moratorium in connection with the Presidentially Declared COVID-19

National Emergency. https://www.hud.gov/sites/dfiles/OCHCO/documents/20-04hsgml.pdf

U.S. Energy Information Administration. 2018. One in three U.S. households faces a challenge in meeting energy needs. Available at https://www.eia.gov/todayinenergy/detail.php?id=37072.

---------------------. 2018. 2015 Residential Energy Consumption Survey (RECS). Available at https://www.eia.gov/consumption/residential.

---------------------. 2020. In 2018, U.S. energy expenditures increased for second consecutive year. Available at https://www.eia.gov/todayinenergy/detail.php?id=45076.

University of Wisconsin Population Health Institute. 2020. County Health Rankings and Roadmaps. https://www.countyhealthrankings.org/.

Table 1. Descriptive Statistics

	mean	*sd*	*min*	*max*
Outcomes *(N=605241)*				
Cases	1761.652	7918.248	0	391004
Cases per 100,000	0.018	0.079	0	3.91
Added Cases per 100,000	16.161	39.679	-1845.739	9370.104
Deaths	49.819	227.263	0	7623
Deaths per 100,000	0	0.002	0	0.076
Added Deaths per 100,000	0.282	1.51	-53.548	151.976
Housing Precarity Policy *(N=605241)*				
Days Eviction Moratorium in Effect	36.8	61.731	0	270
Days Utility Disconnection Moratorium in Effect	68.752	73.324	0	264
County Characteristics *(N=3141)*				
% Over 65 Years of Age	17.7%	4.2%	7.4%	55.6%
% African American	10.6%	15.2%	0.0%	85.9%
% Latinx	6.3%	10.8%	0.0%	94.4%
% Native American	1.1%	4.1%	0.0%	76.7%
% Asian	1.6%	2.5%	0.0%	35.9%
Median Household Income, $2018	52,166	13,993	20,188	136,268
% Renter	29.7%	8.1%	10.2%	80.4%
% Commuting by Carpool	9.7%	2.5%	2.0%	26.0%
% Commuting by Public Transit	1.1%	3.3%	0.0%	61.9%
% Commuting by Other Means	8.3%	3.7%	0.9%	44.8%
% Living in Group Quarters	3.5%	4.1%	0.0%	55.7%
% Employed in Essential Services	68.0%	6.5%	30.9%	85.5%
Population Density (1000s/sq mile)	0.33	1.45	0.001	37.49
% w/o Health Insurance	9.5%	4.5%	2.0%	39.5%
% Diabetic	11.7%	2.6%	4.2%	20.9%
% Obese	32.3%	4.5%	14.3%	49.5%
Average Air Pollution (PM2.5)	6.895	1.667	1.583	16.517
% Rentals Subsidized by Housing Choice Vouchers	6.5%	3.4%	0.5%	32.1%
% FHA-Insured Mortgages	2.1%	1.2%	0.0%	8.6%

Table 2. Regression Results for the Effects of Housing Precarity Policies on Added COVID-19 Cases and Deaths Per 100,000

	(1)	(2)	(3)	(4)	(5)	(6)
	Added Cases	Added Cases	Added Cases	Added Cases	Added Deaths	Added Deaths
Days Eviction Moratorium in Effect	-0.0146***	-0.0244***	-0.0195***	-0.0286***	-0.0010***	-0.0006***
	(0.0033)	(0.0041)	(0.0034)	(0.0042)	(0.0001)	(0.0002)
Days Utility Disconnection Moratorium in Effect	-0.0091***	-0.0122***	-0.0121***	-0.0178***	-0.0004***	-0.0007***
	(0.0018)	(0.0033)	(0.0018)	(0.0034)	(0.0001)	(0.0001)
% Over 65 Years of Age	17.9376***	0.0000	-19.5130***	0.0000	0.2006***	0.0000
	(1.6557)	(.)	(1.6884)	(.)	(0.0767)	(.)
% African American	2.6188***	0.0000	3.9164***	0.0000	0.4664***	0.0000
	(0.4791)	(.)	(0.4884)	(.)	(0.0229)	(.)
% Latinx	13.8185***	0.0000	19.4669***	0.0000	0.5911***	0.0000
	(0.6627)	(.)	(0.6777)	(.)	(0.0299)	(.)
% Native American	13.2369***	0.0000	17.9358***	0.0000	0.9113***	0.0000
	(1.3217)	(.)	(1.3470)	(.)	(0.0612)	(.)
% Asian	-0.5801	0.0000	-1.2349	0.0000	0.0156	0.0000
	(2.6992)	(.)	(2.7500)	(.)	(0.1189)	(.)
Median Household Income ($2018)	0.1165*	0.0000	0.2217***	0.0000	-0.0165***	0.0000
	(0.0687)	(.)	(0.0700)	(.)	(0.0031)	(.)
% Renter	4.7980***	0.0000	6.2476***	0.0000	-0.1875***	0.0000
	(0.9321)	(.)	(0.9496)	(.)	(0.0429)	(.)
% Commuting by Carpool	6.6738***	0.0000	9.3147***	0.0000		
	(1.9731)	(.)	(2.0104)	(.)		
% Commuting by Public Transit	7.5593**	0.0000	9.4458***	0.0000		
	(3.5494)	(.)	(3.6162)	(.)		
% Commuting by Other Means	-23.9352***	0.0000	-27.5921***	0.0000		
	(1.7005)	(.)	(1.7331)	(.)		
% Living in Group Quarters	27.5446***	0.0000	34.0567***	0.0000		

	(1.2262)	(.)	(1.2485)	(.)		
% Employed in Essential Services	6.7617***	0.0000	8.8897***	0.0000	0.0501	0.0000
	(1.2439)	(.)	(1.2673)	(.)	(0.0541)	(.)
Population Density (1000s/sq mile)	-0.2785***	0.0000	-0.3722***	0.0000	-0.0056***	0.0000
	(0.0719)	(.)	(0.0733)	(.)	(0.0016)	(.)
% w/o Health Insurance	7.4968***	0.0000	9.2876***	0.0000	0.1486*	0.0000
	(1.9715)	(.)	(2.0086)	(.)	(0.0842)	(.)
Temporal Lag	0.1974***	0.1810***				
	(0.0013)	(0.0013)				
Spatial-Temporal Lag			35943.8807***	35262.3338***		
			(988.4306)	(1019.0239)		
% Obese					-0.3761***	0.0000
					(0.0819)	(.)
% Diabetic					1.2784***	0.0000
					(0.1803)	(.)
Average Air Pollution (PM2.5)					0.0084***	0.0000
					(0.0017)	(.)
Rolling Avg Cases 2-4 Weeks Prior					0.0003***	0.0006***
					(0.0000)	(0.0000)
Constant	-5.4758**	0.0046	-8.4748***	0.0046	-0.2310**	0.0001
	(2.1443)	(0.2636)	(2.1851)	(0.2677)	(0.0983)	(0.0118)
State x Week FE	Yes	Yes	Yes	Yes	Yes	Yes
County FE	No	Yes	No	Yes	No	Yes
Housing Insecurity x Week FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	605241	605241	605241	605241	605241	605241
R-squared	0.3104	0.3069	0.2843	0.2791	0.0486	0.0458

Standard errors in parentheses
* p<0.1 ** p<0.05 *** p<0.01

Figure 1. Cumulative COVID-19 Cases by Housing Precarity Policy Adoption with 95% Confidence Intervals

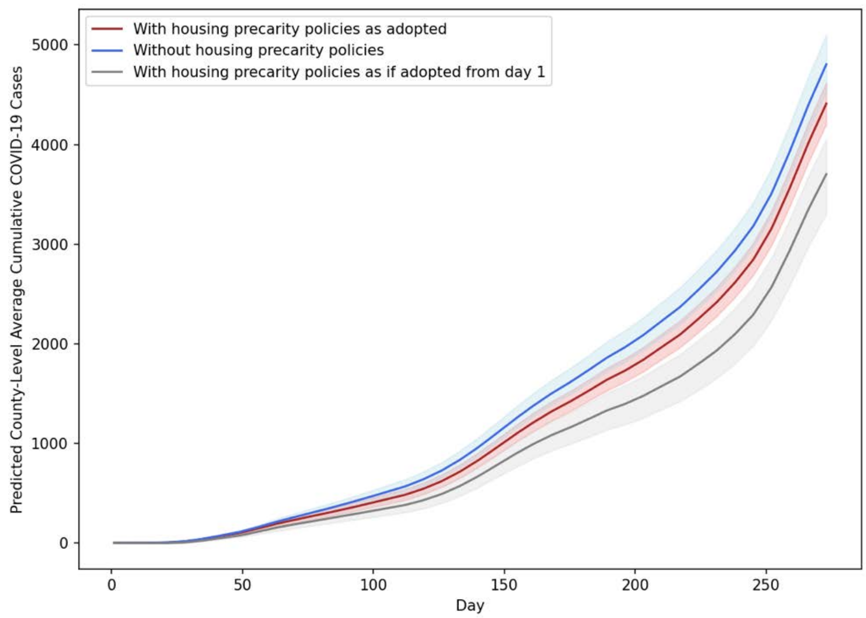

Figure 2. Cumulative COVID-19 Deaths by Housing Precarity Policy Adoption with 95% Confidence Intervals