




Spatiotemporal analysis of the association between residential eviction and fatal overdose in Rhode Island

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ABSTRACT

Objective Policy ramifications of the COVID-19 pandemic shape the concurrent housing and overdose crises in the USA. Housing insecurity is a known risk factor for overdose, yet how residential eviction may influence fatal overdose risk is understudied. We sought to evaluate the spatiotemporal relationship between neighbourhood-level residential eviction rates and overdose mortality in Rhode Island (RI) before and during a statewide eviction moratorium in response to COVID-19.

Methods We conducted an ecological study at the census tract level in RI (N=240) by modelling the association between quintiles of eviction rates and fatal overdose rates from 2016 to 2021. We applied a Bayesian spatiotemporal approach using an integrated nested Laplace approximation and adjusted for an a priori determined set of time-varying demographic and policy covariates.

Results Descriptively, we observed a direct, dose-response relationship between quintiles of eviction incidence rates over the full study period and fatal overdose. Prior to the implementation of a statewide eviction moratorium, census tracts in the highest eviction quintile had increased rates of overdose mortality, relative to those in the lowest quintile (posterior mean relative rate = 1.49, 95% credible interval: 1.05 to 2.13). Associations during the periods of eviction moratorium were non-significant.

Conclusion This work highlights the neighbourhood-level relationship between residential eviction and fatal overdose risk in the absence of an eviction moratorium. Enhanced investment in eviction prevention policies, such as rent relief and limitations to the circumstances under which landlords can file for eviction, may complement harm reduction efforts to reduce neighbourhood-level overdose inequalities.

INTRODUCTION

Drug overdose is the leading cause of injury-related death in the USA.¹ Overdose mortality accelerated during the COVID-19 pandemic, reaching record highs in 2021.^{2–5} Structural barriers to overdose prevention services—upheld by persistent criminalisation and

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Broadly, housing insecurity contributes to fatal overdose risk at both individual and neighbourhood levels, but little is known about the particular effects of residential eviction on overdose mortality. Eviction moratorium policies in response to the COVID-19 pandemic delayed tenants' risk of displacement due to eviction while still allowing landlords to threaten tenants with evictions via notice and filing. This context motivates further investigation of the impact of eviction filings and hearings on neighbourhood-level health outcomes such as overdose deaths.

WHAT THIS STUDY ADDS

⇒ In this spatiotemporal analysis of Rhode Island census tracts, census tracts in the highest quintile of eviction rates had a higher average rate of fatal overdose than census tracts in the lowest eviction quintile, in the absence of eviction moratorium policies.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Enhanced investment in eviction prevention in response to the COVID-19 pandemic may have had positive spillover effects on overdose mortality.

stigmatisation of people who use drugs (PWUD)—were reinforced by health and social policies in response to COVID-19 that disrupted healthcare and recovery services as well as patterns of substance use.⁶ For instance, policy ramifications of the pandemic shifted drug market dynamics and restricted access to harm reduction services.^{2 7 8} Simultaneously, the corresponding economic crisis left communities increasingly vulnerable to unstable housing situations.⁹

Eviction is a policy-sensitive driver of homelessness and a lasting effect of structural disinvestment in neighbourhoods and simultaneously of gentrification as well.^{10 11}



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To reduce evictions in the midst of unprecedented levels of economic vulnerability and housing instability during the COVID-19 pandemic, states and later the federal government implemented temporary eviction moratorium policies—blocking select stages of the eviction process such as notices, filings, hearings and/or enforcement.¹² These policies dramatically reduced evictions but did not eliminate them entirely, producing a sudden shift in which demographic groups were targeted for evictions and the immediacy of displacement threat posed by an eviction filing.^{13–15} In the context of pandemic-era eviction moratoria, the dynamics between housing and health may have shifted as well. Several previous studies have identified associations between eviction moratoria and improved physical and mental health outcomes, yet none to our knowledge has examined a relationship with overdose mortality.^{16–19}

Housing insecurity (a term used to describe limited or uncertain access to adequate housing²⁰) is a known risk factor for fatal overdose and is especially detrimental for people who are penalised for their drug use (ie, through losing housing, being excluded from supportive housing or incarceration).^{21–24} Eviction functions as a structural and policy-sensitive cause of housing insecurity.¹¹ Non-payment of rent, for instance, can initiate eviction proceedings, which often leads to removal from the home. The distribution or use of a controlled substance by tenants can also serve as legal justification for landlords filing for eviction, which puts PWUD at extremely high risk of losing housing—particularly those who experience an overdose that prompts law enforcement response.²⁵ Further, qualitative evidence from Canada suggests that gaps in tenancy protections and landlord dispute resolution processes for PWUD often lead to unlawful evictions.²⁶ However, little is known about the reverse association among communities of PWUD, that is, the impact of residential eviction on overdose risk. Eviction has the potential to disrupt patterns of drug procurement and consumption and at the same time could lead to increased neighbourhood blight, social fragmentation and socioeconomic marginalisation—stressors that amplify overdose risk.^{21 27–30} An earlier, county-level investigation found a positive association between eviction and drug and alcohol mortality in the USA.³¹ Eviction filings might increase overdose risk by (1) increasing psychosocial and financial stress^{17 32–34} and (2) displacing people from their homes.³⁵ As a means of coping with the former, people may change their patterns of drug use or engagement with harm reduction strategies.²² The latter might disrupt people's social networks,¹¹ access to healthcare³⁶ and harm reduction services,³⁷ and drug supply.²¹ More broadly, residential eviction is also associated with stressors such as interpersonal violence among PWUD,³⁸ mental distress^{34 39} and disengagement from healthcare services,^{36 40} which may further exacerbate overdose risk.

Rhode Island (RI) communities face risks that contribute to housing insecurity and overdose mortality, particularly because annual housing production in RI has

not kept pace with state need, ranking last in the nation in 2021.⁴¹ In a previous study in RI, we found that the proportion of residents living in unaffordable housing (ie, tenants who pay more than 30% of their income for housing) was associated with excess overdose fatalities at the beginning of a month, suggesting that even the threat of eviction may result in higher intensity of substance use leading up to rent deadlines.⁴² Using data from RI census tracts, we sought to examine how residential eviction plays a role in spatial patterns of fatal overdose in the context of pandemic-related policy and an increasingly potent drug supply. We hypothesise that eviction rates will be positively correlated with risk of fatal overdose. During the COVID-19 pandemic and periods of statewide eviction moratoria in RI, we hypothesise that the magnitude of association between eviction and overdose mortality is further increased as eviction filings that occurred during this time (ie, a time of great stress imposed by the pandemic) were potentially even more disruptive, exacerbating a range of additional pandemic-related social, economic and health stressors.

METHODS

Study setting

We obtained data from publicly available third-party sources or by requesting public records from the state of RI from 1 January 2016 to 31 December 2021. We used 2010 US Census tracts as our unit of analysis and included all RI census tracts that contained at least one renter-occupied housing unit in both the 2020 and 2021 5-year American Community Survey (ACS) estimates. Based on this criterion, we excluded one census tract (that which contains RI T.F. Green International Airport) and were left with a total of N=240 census tracts in our sample.

Exposure

We accessed address-level residential eviction records via a public records request from the RI Judiciary and aggregated these records by census tract. For generating descriptive statistics, we defined eviction incidence rates throughout the study period, fixed for each census tract, per the number of renter-occupied housing units per year reported by the ACS. Our analytical approach accounted for time-varying eviction rates in 6-month intervals, and so our modelling strategy used the cumulative incidence of residential eviction filing for each 6-month period. To capture households touched by the eviction process most broadly and given prior findings that threats of eviction may contribute to overdose risk in RI,⁴² our primary exposure of interest was eviction filing, an early step of the eviction process. Sensitivity analyses considered neighbourhood-level exposure to eviction hearings, a downstream step in the eviction process that may be more likely to lead to displacement. To facilitate our analyses given the skewness of these data, we categorised census tracts by quintile, first according to their fixed incidence rate of eviction over the full study period

and then by their time-varying cumulative incidence of eviction for each 6-month period, with constant thresholds over time.

Outcome

We used fatal overdose data from the State Unintentional Drug Overdose Reporting System (SUDORS), a federally funded mortality surveillance system.⁴³ SUDORS captures all deaths occurring in RI where the manner of death is determined by the Office of the State Medical Examiners to be unintentional or undetermined, the manner type is a drug or medication, and death certificate underlying causes of death codes include X40–X44 or Y10–Y14.⁴⁴ SUDORS captures both medical examiner and death certificate data sources, but as the classification of death on the death certificate is made by the medical examiner, these two data sources are always in agreement. For the purposes of our study, fatal overdose data were aggregated by census tract according to the decedents' location of injury, or the address of residence for the 6.5% of overdose deaths during the study period in which information about the overdose location was invalid, missing or out-of-state but address of residence was not invalid, missing or out-of-state. We defined overdose mortality rates in 6-month intervals per the total population for each census tract, using ACS population data reported annually.

Covariates

We identified a set of sociodemographic, neighbourhood and policy characteristics that may confound the neighbourhood-level relationship between residential eviction and fatal overdose, determined a priori based on evidence from previously published literature. These measures included per cent distributions of age group (under 18 years, 18–34 years, 35–54 years, 55 years or older), race and ethnicity (black or African American, Hispanic or Latino, white, other and/or multiple races), educational attainment (less than high school, high school diploma or General Education Diploma (GED), some college or associate's degree, bachelor's degree or higher), household income (less than US\$25 000, US\$25 000–US\$49 999, US\$50 000–US\$99 999, US\$100 000 or more), employment status, health insurance status, household Supplemental Nutrition Assistance Programme (SNAP) receipt in past 12 months, marital status, households with children, households with individuals with a disability, rented housing units and unoccupied housing units obtained from ACS data. Finally, we included time-varying indicators of whether a statewide eviction moratorium was in place, and separately, whether the statewide distribution of emergency rental assistance funds was active via the RentReliefRI programme (see below).

In RI, there was a moratorium on eviction filings in effect from 8 April 2020 to 2 June 2020 and a moratorium on eviction hearings in effect from 17 March 2020 to 2 July 2020.¹² Additionally, the Centers for Disease

Control and Prevention (CDC) eviction moratorium was recognised in RI from 4 September 2020 to 31 July 2021. The CDC moratorium was reinstated on 3 August 2021 in 'areas of substantial COVID-19 transmission', only to be struck down by the Supreme Court on 26 August 2021. Additionally, RentReliefRI distributed federal emergency funds to support RI households in catching up on rent and utility payments in the wake of the COVID-19 pandemic. This rental assistance programme began accepting applications on 5 April 2021 and remained active through the end of the study period. Both the eviction moratorium and RentReliefRI covariates were operationalised as the proportion of each 6-month time interval in which these policies were in effect. Since these policies applied state-wide, these two variables varied only by time and not by geography.

Statistical analysis

We first generated descriptive statistics of the demographic characteristics of RI census tracts included in the analysis overall and by quintile of fixed residential eviction rates. To estimate the association between time-varying eviction quintile and fatal overdose rates, we used a hierarchical Bayesian spatiotemporal approach with conditional autoregressive (CAR) random effects to account for spatial autocorrelation in overdose mortality.^{45–47} We fit a Poisson-specified regression model to compare fatal overdose rates relative to the expected rates, under the assumption that census tracts adjacent to one another are likely to have similar overdose patterns.

We implemented estimation using integrated nested Laplace approximation (INLA), performed using R V.4.2.3 (R Foundation for Statistical Computing, Vienna, Austria) with the R-INLA (R-INLA Project) package.⁴⁸ We used the conjugate prior for Poisson, or the minimally informative gamma distribution that serves as the INLA default prior.^{45 47} We incorporated a CAR spatial random effect to account for the lack of independence of overdose counts in spatially contiguous census tracts and to avoid biases due to small area effects.^{46 49} We did not include year fixed effects in our models because descriptive findings indicated little variation in the relationship between eviction and fatal overdose by year, but instead, we used the eviction moratorium policy variable to account for secular trends in overdose mortality. We did not lag the outcome of interest because we only had data available in 6-month intervals; it is reasonable that households could experience both eviction and fatal overdose within a 6-month period and perhaps in either temporal sequence.

Using this approach to run unadjusted and adjusted models, we estimated posterior means and 95% credible intervals (CrIs) for each eviction quintile, relative to the lowest quintile, and the covariates. Exponentiated estimates, offset by the log of the counts of renters per census tract, were interpreted as relative rates. We made post hoc decisions to remove the educational attainment variable from the multivariable models due to model

Table 1 Characteristics of Rhode Island (RI) census tracts overall and by quintiles of average annual residential eviction filing rates, 2016–2021

Characteristics	All populated RI census tracts (N=240)	RI census tracts by fixed quintile of residential eviction filing rates				
		Lowest quintile (N=48)	2nd quintile (N=48)	3rd quintile (N=48)	4th quintile (N=48)	5th quintile (N=48)
Average annual residential eviction filing rate (per 100 renter-occupied housing units)	3.26 (2.13–4.64)	1.28 (0.85–1.54)	2.42 (2.13–2.63)	3.26 (3.02–3.55)	4.37 (4.05–4.64)	6.40 (5.73–7.98)
Average annual fatal overdose rate (per 100 000 person-years)	27.17 (13.65–44.11)	12.96 (6.92–21.64)	18.76 (11.49–29.87)	29.57 (15.80–41.52)	34.09 (18.57–48.00)	48.92 (34.33–62.94)
Age		Median (IQR) among census tracts				
Under 18 years	19.69 (16.86–22.84)	16.90 (12.66–20.36)	19.40 (17.01–21.40)	19.74 (17.67–21.98)	19.74 (17.41–23.66)	25.27 (19.11–29.02)
18–34 years	21.65 (17.62–27.54)	15.83 (13.52–27.54)	19.71 (17.14–21.74)	22.45 (18.80–25.36)	23.42 (19.23–30.00)	25.96 (23.41–29.15)
35–54 years	26.72 (23.76–29.17)	25.54 (21.59–28.31)	27.77 (24.95–31.15)	27.09 (23.58–29.23)	27.35 (25.33–29.91)	26.60 (24.06–28.81)
55 years or older	30.58 (22.21–36.14)	37.13 (32.48–41.87)	32.64 (28.14–36.00)	30.63 (25.61–35.34)	28.92 (19.21–32.49)	21.67 (17.99–28.50)
Race and ethnicity		Median (IQR) percentage among census tracts in 2016*				
Black or African American	2.47 (0.63–9.15)	1.03 (0.26–2.44)	0.82 (0.30–3.22)	2.85 (1.27–4.69)	3.84 (1.33–10.93)	11.22 (4.90–19.66)
White	85.47 (65.89–92.69)	91.64 (84.98–93.65)	92.19 (83.63–94.29)	82.59 (69.43–90.95)	80.97 (42.77–90.88)	50.95 (24.54–73.45)
Other and/or multiple races	5.09 (2.84–9.31)	4.68 (2.17–8.04)	3.99 (2.37–6.56)	6.01 (3.12–10.42)	5.57 (3.32–9.73)	6.43 (3.78–10.64)
Hispanic or Latino	5.61 (2.57–15.36)	2.94 (1.71–4.81)	3.09 (1.80–6.98)	6.16 (3.47–12.98)	6.77 (3.50–30.89)	25.80 (10.74–48.41)
Educational attainment		Median (IQR) among census tracts				
Less than high school	7.19 (4.55–12.19)	3.49 (2.32–5.68)	5.87 (4.59–8.11)	7.71 (5.81–12.84)	8.53 (5.39–13.58)	12.58 (9.53–17.22)
High school diploma or GED	19.84 (14.83–23.25)	13.15 (8.44–18.08)	20.53 (15.96–22.04)	21.23 (15.13–24.71)	19.83 (17.40–23.85)	22.99 (19.40–24.22)
Some college or associate's degree	19.55 (15.11–22.67)	16.47 (11.71–21.96)	19.99 (18.04–22.83)	20.81 (15.72–22.52)	21.11 (13.56–23.68)	17.71 (13.83–22.63)
Bachelor's degree or higher	21.16 (13.31–30.96)	36.88 (30.06–44.65)	24.31 (18.56–28.88)	20.28 (15.01–26.27)	17.23 (11.33–26.21)	8.42 (6.25–14.91)
Household income		Median (IQR) among census tracts				
Less than US\$25 000	19.86 (13.68–30.85)	15.05 (11.89–20.30)	16.67 (12.32–23.89)	20.63 (14.52–30.14)	20.38 (14.49–30.85)	36.82 (24.40–46.45)

Continued

Table 1 Continued

Characteristics	All populated RI census tracts (N=240)	RI census tracts by fixed quintile of residential eviction filing rates				
		Lowest quintile (N=48)	2nd quintile (N=48)	3rd quintile (N=48)	4th quintile (N=48)	5th quintile (N=48)
US\$25 000–\$49 999	20.99 (17.05–26.54)	17.66 (14.90–21.60)	18.04 (14.58–22.39)	20.92 (17.77–25.87)	24.96 (18.40–29.10)	24.23 (19.50–29.76)
US\$50 000–US\$99 999	29.46 (24.38–34.61)	27.52 (23.68–33.02)	31.60 (26.10–36.09)	30.86 (28.00–34.65)	30.47 (25.90–35.54)	24.92 (21.10–33.70)
US\$100 000 or more	24.86 (13.72–34.34)	35.56 (31.04–42.75)	30.00 (24.22–39.56)	23.22 (16.76–30.98)	18.58 (11.08–30.82)	10.59 (6.74–17.25)
Employed	92.63 (89.57–94.75)	94.20 (92.23–95.69)	93.87 (91.86–95.29)	92.64 (90.02–95.07)	91.51 (88.19–93.64)	89.30 (86.67–92.54)
Had health insurance	92.52 (87.60–95.00)	94.17 (91.90–96.23)	93.47 (91.63–95.49)	92.96 (89.06–94.79)	91.63 (82.76–94.46)	86.95 (83.07–91.73)
Received SNAP in past 12 months	12.07 (6.15–23.10)	5.74 (2.85–9.18)	8.22 (5.17–14.08)	13.83 (9.40–22.28)	14.62 (7.28–25.91)	29.85 (18.83–44.42)
Married household	16.83 (12.99–21.40)	15.34 (11.06–21.41)	18.93 (14.30–23.57)	17.57 (12.55–19.80)	17.31 (13.76–22.32)	15.03 (12.60–17.76)
Children in household	28.78 (22.85–34.70)	22.67 (17.13–28.02)	29.20 (25.18–32.52)	27.36 (22.30–33.69)	29.57 (23.46–40.40)	33.31 (28.69–40.60)
Person with disability in household	25.28 (21.49–30.30)	20.93 (17.19–25.46)	24.89 (21.83–28.23)	24.86 (22.26–32.70)	28.12 (22.33–31.24)	28.12 (23.25–33.16)
Rented housing†	38.22 (23.08–61.24)	25.92 (17.43–41.86)	25.29 (17.78–42.98)	39.91 (25.54–54.96)	35.76 (27.62–68.91)	66.43 (44.59–77.34)
Unoccupied housing‡	9.42 (5.70–12.25)	10.34 (5.08–21.42)	7.27 (4.70–10.38)	8.67 (4.53–10.59)	9.17 (6.28–11.37)	11.93 (9.20–17.21)

*These columns present the median percentage of each relevant population characteristic in 2016, along with its IQR, across all census tracts included in the analysis.

†Rented housing is defined as the percentage of occupied housing units that were rented in a given census tract.

‡Unoccupied housing is defined as the percentage of housing units that were vacant in a given census tract.

GED, General Education Diploma; SNAP, Supplemental Nutrition Assistance Programme.

instability and to remove the RentReliefRI indicator because of collinearity with the periods of eviction moratoria. Finally, we conducted stratified analyses by 6-month periods for which none versus some of that period was covered by a state or federal eviction moratorium (effectively stratifying by the COVID-19 pandemic era). This study followed the Strengthening the Reporting of Observational Studies in Epidemiology reporting guidelines. Participants or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

RESULTS

Estimated as average annual rates over the full study period for all census tracts included in the analysis, the median residential eviction rate was 3.26 (IQR 2.13–4.64) per 100 renter-occupied housing units and the median fatal overdose rate was 27.17 (IQR 13.65–44.11) per 100 000 person-years (table 1). The average annual eviction rates were higher prior to the COVID-19 pandemic and periods of eviction moratoria; over the prepandemic study period, the median was 3.73 (IQR 2.34–5.36) per 100 renter-occupied housing units, but during the pandemic, the median was 2.18 (IQR 1.29–3.31) per 100 renter-occupied housing units. Conversely, the average annual fatal overdose rates increased during the COVID-19 pandemic, as the medians were 24.99 (IQR 11.61–40.77) per 100 000 person-years over the prepandemic study

period and 28.74 (IQR 12.30–51.34) per 100 000 person-years during the pandemic.

Residents of census tracts in higher eviction quintiles were generally younger with lower incomes and were more likely to be black or Hispanic, unemployed, uninsured or live in an unmarried household compared with those living in census tracts belonging to lower eviction quintiles (table 1). Census tracts in higher eviction quintiles also had proportionally more households who received SNAP, had children or had individuals with a disability and had greater proportions of housing units that were vacant and housing units that were rented compared with those in lower eviction quintiles (table 1). Notably, census tracts in higher quintiles of eviction rates, based on average annual estimates over the full study period, had increased rates of fatal overdose relative to those in lower quintiles of eviction rates (figure 1).

In the time-updated models in which rates of eviction and fatal overdose were each discretised in 6-month periods, the association between eviction and fatal overdose was only significant during periods in which a state-wide eviction moratorium was not in effect (tables 2 and 3, online supplemental table 1). Prior to the implementation of an eviction moratorium in response to the COVID-19 pandemic in RI, the average annual rate of fatal overdose in census tracts in the highest eviction quintile was 1.49 times (95% CrI 1.05 to 2.13) that of census tracts in the lowest eviction quintile (table 3, online supplemental table 1). However, there were also substantially

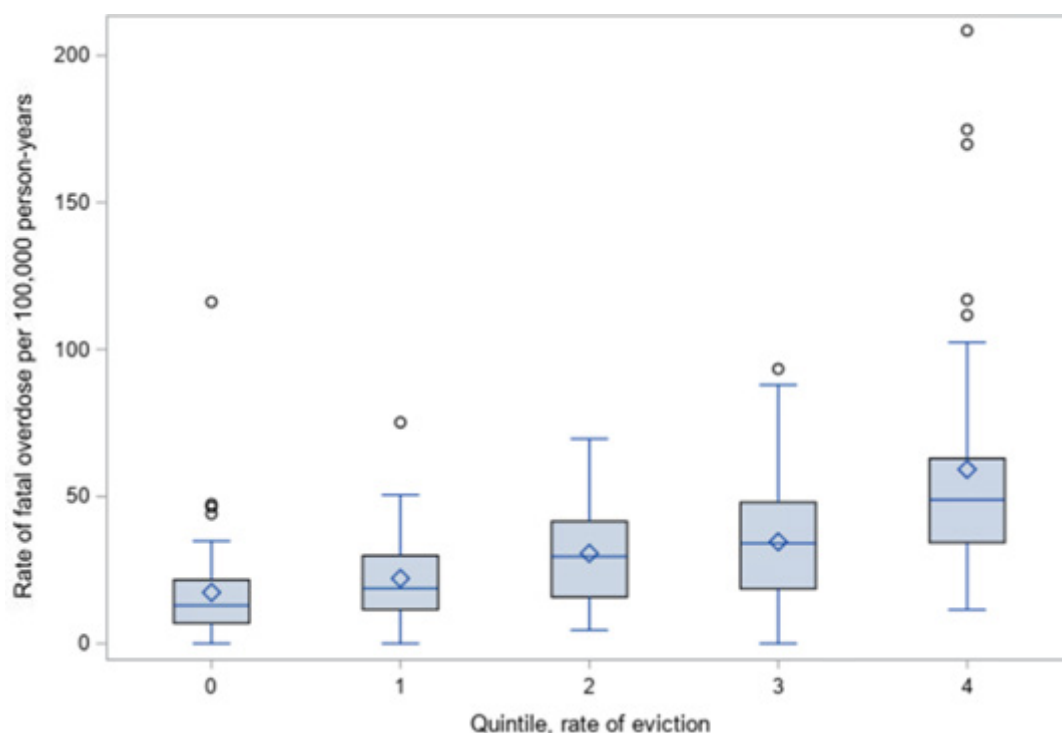


Figure 1 Rate of fatal overdose by fixed quintile of residential eviction filing rates, Rhode Island, 2016–2021. Rhode Island census tracts were binned into fixed quintiles of average annual residential eviction filing rates over the duration of the study period, with the lowest quintile (quintile 1) representing tracts with the lowest rates of eviction and the highest (quintile 5) representing tracts with the highest rates of eviction.

Table 2 Census tract-level associations of time-varying quintiles of residential eviction filing rates with overdose deaths, 2016–2021

Quintile	Unadjusted	Adjusted*
	Posterior mean relative rate (95% credible interval)	
Lowest quintile (0–0.612 filings per 100 housing units)	Ref	Ref
2nd quintile (0.613–1.197 filings per 100 housing units)	1.04 (0.86 to 1.26)	1.02 (0.84 to 1.23)
3rd quintile (1.198–1.857 filings per 100 housing units)	1.07 (0.88 to 1.30)	1.06 (0.87 to 1.29)
4th quintile (1.858–2.836 filings per 100 housing units)	1.12 (0.92 to 1.37)	1.13 (0.92 to 1.39)
Highest quintile (2.837–10.526 filings per 100 housing units)	1.08 (0.87 to 1.33)	1.12 (0.90 to 1.40)

*Covariates in the adjusted model included per cent distributions of age group, race and ethnicity, household income, employment status, health insurance status, household Supplemental Nutrition Assistance Programme receipt in past 12 months, marital status, households with children, households with individuals with a disability, rented housing units and unoccupied housing units, as well as the proportion of each 6-month time interval in which a state or federal eviction moratorium was in effect.

more census tracts in the higher-evicting quintiles during this time period (online supplemental table 2). During periods in which an eviction moratorium was in effect, the average annual rate of fatal overdose in census tracts in the highest eviction quintile was 1.32 times (95% CrI 0.88 to 1.98) that of census tracts in the lowest eviction quintile (table 3, online supplemental table 1). Sensitivity analyses using quintiles of eviction hearings rather than eviction filings produced similar results (online supplemental tables 3–5).

DISCUSSION

In this 6-year population-based study, we found a direct, dose–response, census tract-level association between residential eviction and fatal overdose rates in the absence of a statewide eviction moratorium (ie, during the 4 years prior to the COVID-19 pandemic). These results highlight a neighbourhood-level relationship between residential eviction and fatal overdose prior to the COVID-19 pandemic and suggest that pandemic-era policy interventions to prevent evictions may have had additional benefits vis-à-vis overdose risk. Enhanced investment in eviction prevention policies, such as rent

relief and Just Cause rules that limit the circumstances under which landlords can file for eviction, may complement ongoing harm reduction efforts in the state to mitigate neighbourhood-level overdose inequalities. It may also be true that efforts to destigmatise drug use and address overdose mortality (eg, through harm reduction approaches) could serve to reduce housing insecurity.

Our findings contradicted our hypothesis that we would observe a stronger association between eviction and fatal overdose on implementation of an eviction moratorium. Instead, we did not find a significant association between eviction filings and fatal overdose in the periods covered by eviction moratoria. This is not to say that evictions during the pandemic did not cause harm. There are several potential mechanisms to explain the null association. First, moratoria during this period changed the meaning of eviction filings, reducing the immediate risk of displacement associated with a filing. If the association between filings and overdose operates largely via displacement, rather than the stress of a filing alone, moratoria could attenuate associations by intervening on a key mediator.²¹ Second, it is possible that the contrast between high-evicting and low-evicting census

Table 3 Adjusted* census tract-level associations of time-varying quintiles of residential eviction filing rates with overdose deaths by whether a statewide eviction moratorium was in effect,† 2016–2021

Quintile	No eviction moratorium	Active eviction moratorium
	Posterior mean relative rate (95% credible interval)	
Lowest quintile (0–0.612 filings per 100 housing units)	Ref	Ref
2nd quintile (0.613–1.197 filings per 100 housing units)	1.01 (0.73 to 1.39)	0.92 (0.70 to 1.19)
3rd quintile (1.198–1.857 filings per 100 housing units)	1.26 (0.91 to 1.76)	0.89 (0.66 to 1.20)
4th quintile (1.858–2.836 filings per 100 housing units)	1.43 (1.03 to 1.99)	1.07 (0.77 to 1.49)
Highest quintile (2.837–10.526 filings per 100 housing units)	1.49 (1.05 to 2.13)	1.32 (0.88 to 1.98)

*Covariates in the adjusted models included per cent distributions of age group, race and ethnicity, household income, employment status, health insurance status, household Supplemental Nutrition Assistance Programme receipt in past 12 months, marital status, households with children, households with individuals with a disability, rented housing units and unoccupied housing units, as well as the proportion of each 6-month time interval in which a state or federal eviction moratorium was in effect.

†Analyses were stratified by 6-month periods for which none versus some of that period was covered by a state or federal eviction moratorium.

tracts became less meaningful during the moratorium. This could be true if, for example, landlords replaced formal eviction filings with informal or illegal evictions during the moratoria,¹³ such that rates of tenant stress and displacement were similar between the two. Third, the moratoria reduced levels of filings overall. With fewer census tracts in the top quartiles of eviction filings postmoratorium, we are potentially less powered to see associations. Lastly, elevated pandemic-era overdose mortality was driven by a complex combination of factors, including a range of psychosocial, health, and economic stressors and an increasingly potent drug supply⁵—all of which may have obscured the relationship between eviction and fatal overdose and any effects that the eviction moratorium may have had on overdose outcomes.

Future research should consider racial and ethnic inequities in the relationship between eviction and fatal overdose, and the extent to which law enforcement over-surveillance in black and Hispanic communities contributes to this. There is potentially a stronger correlation between eviction rates and risk of fatal overdose in minoritised communities that are disproportionately affected by policing and other mechanisms of structural racism, particularly as racialised policing and over-surveillance of PWUD may reinforce exclusionary housing practices.⁵⁰ This work motivates further assessment of an individual-level association between eviction and fatal overdose, which may allow for the evaluation of how this relationship varies by race and ethnicity and other socio-structural factors.

Although our analysis offers preliminary findings, more robust and expansive data may add richness to our results by investigating additional factors that contribute to eviction and overdose risk in more generalisable contexts. There are opportunities for future work to examine other mechanisms at a more granular level, including how changes in employment status occurring throughout the pandemic may have precipitated eviction and/or served as a common cause of eviction and fatal overdose. As more recent fatal overdose data become available, it will also be critical to explore postpandemic patterns in eviction and fatal overdose following the expiration of the eviction moratorium.

This study is primarily limited by its ecological design and thus we cannot infer causality, temporality or individual-level relationships between eviction and fatal overdose. It is feasible that a fatal outcome on an individual level may actually precede the exposure of interest within the household, if, for instance, a household is evicted as a result of an overdose death in that household, and future research should better assess this temporal relationship. However, our effect modification findings by whether an eviction moratorium was in place support our hypothesis that intervening on neighbourhood-level eviction risk may have implications for overdose mortality. Additionally, we were limited in our ability to control for educational attainment due to model instability and to assess effect measure modification of the association between

eviction and fatal overdose by race and ethnicity due to insufficient variation in the tract-level distributions of race and ethnicity. The RI population is segregated to the extent that the vast majority of the black and Hispanic populations live in the state's relatively few urban census tracts. We attempted to assess the effect modification by race and ethnicity of overdose decedents to overcome this data constraint, but we encountered challenges with small sample sizes. We encourage future research to consider how racial segregation shapes the geospatial relationship between eviction and fatal overdose. Lastly, we do not account for unmeasured confounding and our measured covariates do not allow us to fully disentangle how structural racism, poverty and segregation shape neighbourhoods and affect both eviction and overdose mortality.

In conclusion and despite these limitations, our study offers a broad examination of the relationship between eviction filing and fatal overdose in RI and suggests that, in the absence of an eviction moratorium, neighbourhood-level exposure to early stages of the eviction process is associated with elevated overdose mortality.

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