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The impact of county-level fees & fines as exploitative revenue generation on US birth outcomes 2011–2015

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ABSTRACT

Fees and fines collected through courts and law enforcement can comprise a considerable proportion of revenue for local governments. Law enforcement, as agents of revenue generation, change policing behavior to increase revenue, at times targeting Black and brown neighborhoods to bolster municipal budgets. This structural racism in revenue generation has not yet been assessed as an exposure for adverse health. Using the 2012 Census of Governments, and 2011–2015 vital statistics from the National Center of Health Statistics, we examine the relationship between countyaverage fees and fines as a percent of total own-source revenue and county-level characteristics, and risk of preterm birth and low birthweight across the United States. Mothers residing in counties with the greatest reliance on fees and fines had 1.08 (95% CI: 1.03–1.12) times the odds of preterm birth and 1.07 (95% CI: 1.02–1.11) times the odds of low birthweight than mothers residing in counties with the least reliance on fees and fines, controlling for individual- and county-level covariates. The addition of countylevel racial composition, and the Index of Concentration at the Extremes (ICE), reduced these associations yet remained statistically significant. Future studies should continue to examine how racist, exploitative revenue generation through police and court activities influences the health of residents.

1. Introduction

Following the extrajudicial killing of Michael Brown Jr. in Ferguson, Missouri on August 9, 2014, and the nationwide protests sparked in response, the United States Department of Justice (DOJ) released a report detailing how Ferguson City used fees and fines collected through police ticketing as a budgeted source of revenue for the municipality (United States Department of Justice Civil Rights Division, 2015). The report also found that this practice of revenue generation was racially-motivated; Black people were specifically targeted for traffic and other citations with monetary sanctions (United States Department of Justice Civil Rights Division, 2015). These revenue-generating, racialized enforcement practices underlay the initial interaction between Mike Brown, Jr. and the police officer who murdered him.

Studies have found that the use of fees and fines (F&F) to support governmental revenue is not unique to Ferguson or the St. Louis area, and is increasing as an own-source revenue for cities (Martin et al., 2018; Sances and You, 2017; Singla et al., 2020). In fact, revenue generated from parking and traffic citations, court fees, seized assets, and bail, can comprise a substantial proportion of local municipal budgets (Makowsky et al., 2019; Shaw, 2016; Surprenant, 2019), sometimes contributing to over half of general revenues (Graham and Makowsky, 2020). Fiscal distress in the municipality and restrictions in police budgets have been associated with increased revenue from fees, fines, and forfeitures (Baicker and Jacobson, 2007), though variation in this association has been found across states (Singla et al., 2020). Furthermore, law enforcement decision-making has been shown to be influenced by budgetary shortfalls, with police serving as street-level bureaucrats able to enforce revenue-generating laws at their discretion (Graham and Makowsky, 2020). Studies have found that financial distress predicts police behavior, including increased parking (Luh, 2020) and traffic-related stops and citations (Garrett and Wagner, 2009; A. P.

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Harris et al., 2020; Makowsky and Stratmann, 2009; Su, 2020), a shift towards criminalization of low-level, revenue-generating offenses (Makowsky et al., 2019), and a reduction in clearance rates related to violent and property crime (which typically do not generate revenue) (Goldstein et al., 2020). The collection of fees, fines, and forfeitures also predicts police militarization (Burkhardt and Baker, 2019) and police expenditures (Sances and You, 2017)—highlighting the political-economic symbiosis between law enforcement agencies and the government.

Racial discrimination in the collection of fees & fines (F&F) is also not unique to Ferguson, Missouri. Nationwide, Sances and You (2017) found the proportion of Black constituents within the municipality predicts F&F per capita, with municipalities serving the largest proportion of Black residents collecting between $12 and $19 more per capita than municipalities with the fewest Black residents (Sances and You, 2017). The association between Black residents and F&F revenue is persistent at the municipal-levels (Mughan, 2019; Sances and You, 2017; Singla et al., 2020) and in response to fiscal pressures at the neighborhood-level (Brazil, 2018; Henricks and Harvey, 2017; Luh, 2020). Though evidence on individuals has been limited, Harris et al. found that financial pressure in Missouri was associated with an increase in stops of Black motorists, even when there is likely no cause for citation or arrest (A. P. Harris et al., 2020). In Minnesota, Native Americans are disproportionally stopped and searched, particularly in neighborhoods with a higher proportion of indigenous peoples, and are more likely to be arrested for low-level crimes associated with a fine (Gorsuch and Rho, 2019).

Even in the absence of budgetary need, racial discrimination in policing and judicial systems is pervasive; and as contact with the legal system intensifies, so does legal financial obligations (A. Harris, 2016; Martin et al., 2018). Bails and bonds without regard for ability to pay, and daily incarceration "pay-to-stay" fees, exacerbate these racialized injustices (American Civil Liberties Union, 2010). Given historic and contemporary racism which constrain many Black, Latinx, Indigenous, and immigrant populations to poverty, penalty structures which accrue fees based on non-payments are even more punitive (American Civil Liberties Union, 2010). Even in municipalities with relatively low reliance on F&F, it is likely the brunt of fee collection is not evenly distributed among the population. Rather, the bulk of financial penalties are concentrated among low-income individuals, whose inability to pay leads to an accrual of fines, and among Black, Indigenous, Latinx, and other individuals most targeted by police.

The complex relationship between racialized policing, the collection of fees & fines in response to governmental budgets, and the racially disparate consequences, is an example of structural racism. Structural racism is defined by Gee & Ford as "the macrolevel systems, social forces, institutions, ideologies, and processes that interact with one another to generate and reinforce inequities among racial and ethnic groups" (Gee and Ford, 2011). These interconnected systems have long created the observed health inequities by race, and have recently gained more attention in social epidemiologic research (Bailey et al., 2017). In 2021, the National Institutes of Health issued a call to increase research on structural racism to end racial health injustices (National Institutes of Health, 2021). To date, no study has examined whether the exploitative collection of, and municipal reliance on, fees & fines—a manifestation of structural racism—is also a societal determinant of health.

The costs to individuals and families impacted by F&F can be devastating, with the repercussions varying across the nation(Martin et al., 2018). Penalties for individuals unable to pay these fees, range from having one's driver's license revoked—influencing ability to work and care for families—to loss of voting rights, and incarceration for "willful refusal to pay" (American Civil Liberties Union, 2010; American Civil Liberties Union of North Carolina, 2019; A. Harris, 2016; Martin et al., 2018). This phenomenon has led the American Civil Liberties Union (ACLU) and other advocacy organizations to refer these undue consequences as type of debtor's prison, which incarcerates individuals because of their inability to pay (American Civil Liberties Union, 2010). Legal debt, which may not be canceled even in bankruptcy, influences people's ability to rent homes, apply for loans, and even bars access to some jobs (A. Harris, 2016; Martin et al., 2018). For instance, in Cook County, Illinois, having debt from citation fines makes individuals ineligible for jobs within the government (Sanchez and Kambhampati, 2018).

Together, the growing body of evidence reveals a willingness of governments and law enforcement to utilize law and policies for financial gain. This is further supported by the variation in reliance on F&F—including that approximately 14% of governments report no revenue from F&F, despite having the infrastructure to do so (Sances and You, 2017; United States Department of Justice Civil Rights Division, 2015). Some studies suggest that Black (Sances and You, 2017) and Latinx (Brazil, 2018; Singla et al., 2020) political representation decreases reliance on F&F, however other studies have found no such association for Black representation (Brazil, 2018). Racial concordance between police officers and constituents was protective against the collection of F&F for white, but not Black residents, in a sample of California municipalities, highlighting the prominence of organization structure, rather than individuals, for the racialized enforcement of crimes which generate revenue. (Singla et al., 2020).

Guided by Ford & Airhihenbuwa's Public Health Critical Race Praxis, and Krieger's Ecosocial Theory of disease distribution, we hypothesize that structural racism in the reliance on F&F in municipal budget becomes embodied, increasing the risk of adverse birth outcomes: preterm birth and low birthweight (Ford and Airhihenbuwa, 2010; Krieger, 2012). Public Health Critical Race Praxis supports health researchers examining racial disparities by offering principals of critical race theory into the design and production of health research. This study particularly draws on the PHCRP principle of structural determinism which proposes that macro-level decisions by dominant institutions—in this case municipal governments, law enforcement and judicial courts—maintain and reinforce the racial hierarchy to generate racial health disparities. Ecosocial theory links these macrolevel decisions to the physiologic changes which result in differences in population health through the tenet of embodiment. We expect the use of F&F to generate revenue will become embodied to influence health of individuals and communities through two key pathways, (1) through psychological distress associated with increased police surveillance, and (2) through the loss of income, social support, and loss of other resources.

Literature on Stop, Question, and Frisk (SQF) –another instance of increased and targeted police surveillance—helps identify potential pathways between the use of F&F for revenue generation, and its impact on targeted communities. Among young men who have been stopped during SQF, anxiety and PTSD symptomology increases as the number of stops increase (Geller et al., 2014). Additional studies have found that living in neighborhoods with high rates of SQF, even among those not personally stopped, is associated with worse self-rated health and higher blood pressure for Black and Latinx residents in general, as well as psychological distress among men(Sewell and Jefferson, 2016; Sewell et al., 2016). Stress, psychological distress, and trauma have also been associated with increased risk for preterm birth and lower birth weight and restricted fetal development, due to the physiologic changes caused by stress(Dunkel Schetter, 2011; Harville et al., 2010). Pregnant individuals with higher levels of cortisol—a stress hormone—have been found to deliver earlier, one proposed mechanism being that a precipitous increase in cortisol releasing hormone is an initial signal to begin labor (Dunkel Schetter, 2011). Chronic sympathetic nervous system activation causes vasoconstriction, which has been associated with intrauterine growth restriction, influencing birthweight (Widmaier et al., 2015).

The second pathway is through changes in resources and social support during pregnancy. Limited socioeconomic resources, particularly less education and lower income, is associated with increased risk for adverse birth outcomes (Blumenshine et al., 2010). Financial

hardship during pregnancy such as difficulty paying bills, or job loss of people in the household can be stressful, influence access to quality nutrition, or may increase behaviors that impact fetal development such as substance use(Blumenshine et al., 2010; Braveman et al., 2010). Conversely, increases in income have been shown to reduce rates of adverse birth outcomes (Brownell et al., 2016). In addition to using critical or limited funds to pay fines, pregnant individuals or members of their household may lose further income when it is necessary to leave work, or pay for child care to appear in court. Consequences of unpaid fines such as loss of driving privileges can further strain employment when public transit is unreliable and may be a barrier to attending prenatal visits. The incarceration of individuals due to unpaid F&F, such as partners or other supportive family members, may further reduce financial resources, and disrupt social networks to adversely impact birth outcomes (Braveman et al., 2010; Jahn et al., 2020).

The complex, insidious, and ecologic nature of structural racism makes its measurement in empirical research difficult. Indeed, the majority of epidemiologic research on structural racism uses varying measures of residential segregation as their key exposure (Groos et al., 2018). While segregation continues to be highly predictive of a range of health outcomes (Williams et al., 2019), including adverse birth outcomes (Mehra et al., 2017), the precise mechanisms which connect the prominence of Black and Brown residents in space must still be examined empirically. There has been a push to develop specificity in the measurement of structural racism to draw attention towards the institutional actors responsible for observed inequities, and to move away from using the presence or absence of racial groups in space as the primary indicator of structural racism (Riley, 2018; Sewell, 2016). As such, this study examines F&F as an independent predictor of preterm birth, as well as its relationship with measures of segregation based on U.S. Census data: (a) the Index of Concentration at the extremes (ICE), a formal measures which quantifies the concentration of two Census Bureau-defined groups within a specified area, in this case, the concentration of non-Hispanic Black residents versus non-Hispanic white residents (Krieger et al., 2016), and (b) a proxy measure, focused on the presence of racialized group(s), in this case the proportion of non-Hispanic Black residents, and also the proportion of residents of color, defined as Hispanic/Latino (Flanagin et al., 2021), and non-Hispanic Black, Asian, Native American, Native Hawaiian/Pacific Islander, and multiracial. Through examining the relationship between F&F and segregation, as well as their impact on birth outcomes, we aim to examine exploitative revenue generation as a type of structural racism, and its impact on birth outcomes. We use these formal (ICE) and proxy (racial composition) measures of segregation to situate this work within the growing body of research on structural racism.

2. Methods

2.1. Population and outcome

Restricted-use individual-level birth vital statistics from the National Center of Health Statistics (NCHS) between 2011 and 2015 were used for this analysis (Centers for Disease Control and Prevention, 2015). We restricted the sample to non-induced, nulliparous, singleton live births among mothers born in the United States, for whom birthweight and gestational age data were not missing (99.83%) resulting in a total of 4, 270,207 live births. Mothers who migrated to the United States were excluded as a population of interest, as studies suggest that first generation migrants have different obstetric experiences and outcomes than women born in the United States (Acevedo-Garcia et al., 2005; Collins Jr et al., 2002; Dominguez et al., 2009; Elo et al., 2014). Key outcomes were preterm birth, defined as less than 37 weeks gestational age, and low birthweight, defined as a birthweight less than 2500 g.

Individual maternal covariates used in this analysis were age, education (four-year degree or higher, high school diploma with no four-year degree, and no high school diploma), and binary indicators for maternal comorbidities: diabetes, chronic hypertension, pregnancy-related hypertension. Mothers were assigned to the county of residence at the time of birth, which is the lowest geographic level available for all mothers in this dataset. Maternal race and ethnicity were self-reported separately in vital statistics (Arias et al., 2016)—we combined across categories to create the maternal racial/ethnicity groups: non-Hispanic Black, non-Hispanic white, Hispanic/Latino (any race), American Indian/Alaska Native, Native Hawaiian/Pacific Islander, Asian, and multiracial.

2.2. Exposure

We extracted exposure data from the publicly available Census of Governments (COG) Survey of State and Local Governments, a federally administered survey for local and state governments to report finances every five years (years ending in −2, and −7) (U.S. Census Bureau and Bureau, 2012). Using the 2012 COG, F&F are defined as the numeric response to the question "penalties imposed for violation of law; civil penalties (e.g., for violating court orders); court fees if levied upon conviction of a crime or violation … and forfeits of deposits held for performance guarantees or against loss or damage (such as forfeited bail and collateral)," or code U30. Following You and Sances (2017) methodology, only municipalities with expenditures associated with police or judicial operations were included, as these are necessary for the collection of F&F (Sances and You, 2017).

We then assigned city and county municipal governments to county (or county-equivalents). Only counties with at least one eligible municipal government, and with populations greater than 2500 were eligible for inclusion. In total, 3138 of 3142 US counties (99.8%) met this criteria.

Fees & fines were measured as percent of total own-source revenue, meaning revenue generated through the governments' own activities—thus excluding intergovernmental revenues (both state and federal). Though previous studies have used F&F per capita, for this analysis we have chosen to use F&F as a percent of total own source revenue because 1) this operationalization most closely represents the reliance on, or exploitative use of F&F, and 2) it is likely a better proxy for increased contact with law enforcement and the criminal justice system. F&F per capita approximates the cost-per-fine and financial burden, assuming the risk of being charged is evenly distributed across the populations, which research indicates is not accurate. For instance, according to a case study in the DOJ Ferguson report, one woman's single citation which began as $151 accumulated to over $1,000 as she struggled to pay and additional F&F were stacked (United States Department of Justice Civil Rights Division, 2015). In our dataset, Ferguson F&F per capita is $105.32, and F&F percent is 21.92%. Aligned with previous research, we consider F&F percent to be the most appropriate operationalization of F&F to capture exploitative reliance on F&F for revenue generation (Singla et al., 2020). Importantly, F&F as a percent and F&F per capita, are correlated in this study($r = 0.73$).

We used three area-based measures of racial/ethnic composition as an indicator for segregation (Massey and Denton, 1988), proportion of residents who are non-Hispanic Black, proportion of residents of color, and the Index of Concentrations at the Extreme (ICE) as a measure of spatial social segregation (Krieger et al., 2016). ICE was measured within the county as (#white residents-Black residents/total Population), creating a score between +1 and −1. More positive numbers indicate a greater concentration of white residents within the county, while more negative numbers indicate greater concentration of Black residents.

2.3. Analyses

Counties with at least one eligible municipal government were divided into quartiles such that those in the lowest quartile represented counties where F&F made up the smallest proportion of own-source

revenue, while counties in the highest quartile are those where F&F make up the largest proportion. All analyses compared F&F quartiles as categorical variables, with the primary comparison focused on the highest vs. the lowest quartile. We also assessed trend across quartiles of F&F reliance.

Primarily due to reporting differences by state and year, we observed missingness among key covariates including: educational attainment (9.5% missing), maternal race (1.8%) and maternal comorbidities (0.14%). Within the state, the missingness pattern suggests that data were missing completely at random, or at random. To address missingness we used a complete case analysis. The impact of missingness was further assessed through multiple sensitivity analyses, using a four-times multiply imputed dataset (Rja and Rubin, 1987), as well as missing indicators for maternal education and comorbidity. Study results were robust, producing similar results across approaches for addressing missingness.

The relationship between F&F percent, percent Black residents, percent residents of color, and ICE-Race were assessed using one-way ANOVA, and bivariable trend assessed using the non-parametric Spearman's rank correlation coefficient. We used three-level multilevel models with a logit link and binomial distribution to assess the impact of residing in one of the four F&F percent quartiles on individual odds of a preterm or low birthweight birth—modeled separately (Model 1). This model accounts for clustering at maternal county and state of residence, with random intercepts at levels 2 and 3. Next, we used multivariable models adding county-level covariates for population and total own-source revenue, as these influence the distribution of F&F (Model 2), then finally adjusting for maternal individual characteristics (Model 3). We then included, maternal race/ethnicity, proportion non-Hispanic Black, proportion residents of color, and ICE-Race to Model 3 as a sensitivity analyses, to determine if F&F remained an independent predictor. Finally, we stratified Model 3 to determine if the impact of F&F varied by maternal race/ethnicity. We assessed trends by repeating all analyses with F&F quartile coded as numeric. All data management and analyses were performed using SAS 9.4. Maps were produced using ArcGIS 10.7. The Harvard University Institutional Review Board reviewed and determined this study protocol exempt. The NCHS approved the use of restricted vital statistics birth data.

3. Results

A total of 3138 of 3142 counties had at least county or sub-county municipal government with the infrastructure to collect fees & fines and population over 2,500, aligned with previous analyses. A total of 4,269,176 births (99.9%) met the criteria for inclusion in this analysis, encompassing 3135 of the 3138 included counties.

Fees & fines ranged from 0% to 38.28% of total own-source county revenue, with the county average F&F approximately 1.91% (SD 2.78%) of total revenue, and a median of 1.04% (Table 1). This reflects the heavily left skewed nature of sub-county fees & fines, with many municipalities containing the structure to collect fees & fines (i.e. courts, law enforcement), though only some actually collecting F&F revenue according to the 2012 Census of Governments (Fig. 1). A total of 233 of the 3138 counties (7.43%) reported $0 F&F across all eligible governments in the county. Furthermore, F&F tends to have a long tail, with the variance in average county fines over 10x that in the highest quartile compared to the other three quartiles (Table 1).

Fees & fines as a percent varied significantly across the four quartiles for all measures assessed: total revenue, population, percent Black residents, percent residents of color, and the ICE-Race measure of spatial social segregation (Table 1). On average, the counties least reliant on F&F (Quartile 1) and the counties most reliant on F&F (Quartile 4) both were less populated and collected less in total revenue than counties in the middle (Table 1). This nonlinearity was addressed by using natural

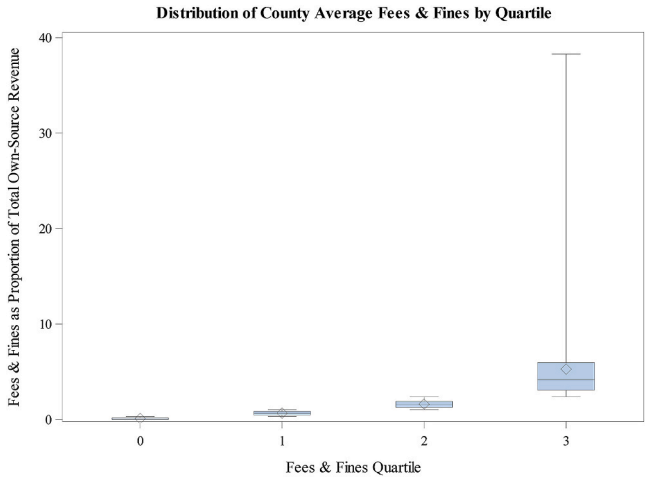

Fig. 1. Distribution of 2012 County-Average Fees & Fines as a percent of total own-source revenue across quartiles (2012 Census of Governments).

Table 1
United States County-average Descriptive Statistics by 2012 United Fees & Fines as a Percent of Total Revenue Quartiles (2012 Census of Governments, 2015 American Community Survey 5-year estimates).

	Total n = 3138	Percent Fees & Fines Quartile 1 (Lowest) N = 784	Percent Fees & Fines Quartile 2 n = 784	Percent Fees & Fines Quartile 3 n = 785	Percent Fees & Fines Quartile 4 (Highest) n = 785
2012 COG Financial Descriptive					
Fees &Fines as Percent Range	0.0%–38.28%	0.000%–0.316%	0.318%–1.037%	1.037%–2.379%	2.382%–38.280%
Median F&F Percent	1.037%	0.068%	0.654%	1.556%	4.145%
Mean (SD) F&F Percent	1.908% (2.779%)	0.097% (0.100%)	0.660% (0.211%)	1.606% (0.375%)	5.273% (3.806%)
Median F&F Per Capita*	$15.14	$1.47	$7.32	$14.32	$37.48
Median County Own-Source Revenue	$29,658.00	$18,636.00	$46,292.00	$50,089.00	$20,958.50
Median County Revenue*	$38,367.00	$24,483.00	$57,945.00	$68,329.00	$28,234.50
Mean County Population Size (SD)*	100,861.52 (323221.42)	40,905.76 (111813)	101,356.68 (215831.67)	192,259.08 (528899.89)	68,807.36 (257516.99)
2015 ACS County Sociodemographic Characteristics					
Mean % Black*	8.89% (14.40%)	3.28% (7.88%)	7.99% (13.53%)	9.25% (14.01%)	15.05% (17.83%)
Mean % People of Color*	22.70% (19.92%)	14.99% (17.46%)	19.70% (17.90%)	25.20% (19.68%)	30.92% (20.81%)
Mean ICE-Race (SD)*	0.684 (0.308)	0.82 (0.22)	0.72 (0.29)	0.66 (0.30)	0.54 (0.34)
Mean Household Income (SD)*	$46,645 ($12,105)	$48,200.80 ($11,845.59)	$48,188.20 ($12,616.23)	$47,447.72 ($12,607.02)	$42,753.35 ($10,368.50)

*p-value for trend <0.01.

log of population and own-source revenue in models adjusting for county characteristics, following the methodology of previous studies (Sances and You, 2017).

On average, both percent Black residents ($r = 0.283$, $p < 0.0001$) and percent residents of color ($r = 0.299$, $p < 0.0001$) increased as F&F percent increased, suggesting a moderate monotonic trend. On average, counties for which F&F comprised the largest proportion of the budget had a larger proportion of Black residents and residents of color, compared to counties where F&F comprised the smallest proportion of the budget (15.05% vs. % 3.28% $p < 0.001$; 30.92% vs. 14.99%; $p < 0.001$) respectively (Table 1).

Using the ICE measure of racial segregation, where 1+ indicates an entirely white residential population, and −1 indicating an entirely Black residential population, across all counties the average ICE score was 0.684. On average ICE decreased as F&F percent increased ($r = -0.326$, $p < 0.001$), indicating a lower concentration of white residents in counties in the highest quartile for F&F percent compared to counties in the lowest quartile for F&F percent at (0.82[0.22] vs 0.54 [0.34] vs; $p < 0.001$). Mean household income was lowest in the counties collecting the greatest proportion of F&F relative to their total revenue [$43,211 (SD: $10,763 vs $47,865 (SD: $11,230) $p < 0.001$], though the relationship between income and F&F quartile was weaker than the relationship between F&F and segregation, and monotonically decreasing ($r = -0.165$ $p < 0.001$).

We assessed the correlation between percent of births in our sample by maternal race and the four F&F quartiles (Table 2). The strongest trends were among non-Hispanic Black ($r = 0.36$, p-for trend<0.001) and white mothers ($r = -0.33$, $p < 0.01$). Non-Hispanic Black mothers represented a greater proportion of births in counties collecting the largest proportion of F&F compared to counties collecting the smallest proportion of F&F as revenue (19.0% vs. 9.7%), compared to an inverted trend for non-Hispanic white mothers, who comprised a greater proportion of births in the lowest F&F quartile compared to the highest (75.9% vs. 62.13% [Table 2]). There was evidence of trend among Hispanic/Latino ($r = 0.15$, $p < 0.01$), and weaker trends among Native Hawaiian/Pacific Islander ($r = 0.05$, $p < 0.001$), Asian ($r = 0.04$, $p = 0.07$). There is no evidence of a trend in proportion of births to Native American ($r = -0.03$,$p = 0.12$) and multiracial mothers ($r = -0.002$, $p = 0.88$) across F&F quartiles. Mothers residing in counties relying most heavily on F&F were less likely to have a 4-year college degree and private insurance, and were more likely to receive WIC benefits (all $p < 0.001$). Mothers residing in the highest quartile were also more likely to have pregnancy-related hypertension, and were less likely to have diabetes (Table 2).

3.1. Preterm birth

The proportion of preterm births ranged from 10.1% in the lowest quartile to 12.3% in the highest quartile (Table 2.; p-value for trend <0.0001). Unadjusted multilevel analyses show a small, significant increase in odds of preterm birth (OR = 1.074; 95% CI: 1.03–1.12) among all births to mothers residing in counties with the greatest reliance on fees & fines compared to the lowest quartile. There is a graded increase in odds of preterm birth as F&F percent increases (p-value for trend = 0.01).

We next controlled for the log of own-source revenue and population, which slightly increased the association between F&F percent and preterm birth, and was significant among mothers residing in the second, (OR: 1.049; 95% CI: 1.02–1.08), third (OR: 1.087; 95% CI: 1.05–1.13), and fourth quartile (OR: 1.083; 95% CI: 1.04–1.13) of reliance on fees & fines (p-value for trend<0.001; Table 3). Model 3, which adjusts for individual maternal characteristics, showed a graded, significant increase in the odds of preterm birth for mothers residing in the second (OR:1.044; 95% CI: 1.01–1.08), third (OR:1.076; 95% CI: 1.04–1.11), and fourth quartiles (OR:1.075; 95% CI: 1.03–1.12) of reliance on fees & fines (p-value for trend = 0.01; Table 3).

We then added proxy measures of segregation, to determine if F&F remained an independent predictor of preterm birth. The odds of preterm birth among mothers living in the second, (OR: 1.03, $p < 0.05$), third (OR: 1.05, $p = 0.003$) and fourth quartiles (1.04, $p = 0.03$) of

Table 2
2011–2015 United States maternal sociodemographic and clinical characteristics by 2012 united fees & fines as a percent of total revenue quartiles (2012 census of Governments, 2011–2015 NCHS restricted use natality files).

	Total (n=4,269,176)	Percent Fees & Fines Quartile 1 (Lowest) (n=431,283)	Percent Fees & Fines Quartile 2 (n=1,057,652)	Percent Fees & Fines Quartile 3 (n=2,044,547)	Percent Fees & Fines Quartile 4 (Highest) (n=735,694)
Total Births	100%	10.1%	24.77%	47.89%	17.23%
% Preterm Birth*	10.99%	10.32%	11.05%	10.63%	12.3%
% Low Birthweight*	7.99%	7.39%	7.87%	7.82%	8.98%
Race/Ethnicity					
Non-Hispanic Black*	14.83%	8.03%	14.06%	14.55%	20.55%
Non-Hispanic White*	63.61%	77.32%	71.47%	57.72%	60.67%
Hispanic/Latinx*	16.57%	8.27%	10.4%	22.01%	15.23%
American Indian	0.89%	1.71%	0.59%	0.82%	1.05%
Asian*	1.69%	1.35%	1.27%	2.27%	0.9%
Native Hawaii/Pacific Islander*	0.14%	0.19%	0.07%	0.19%	0.06%
Multiracial	2.27%	3.12%	2.13%	2.43%	1.54%
Maternal Age (SD)*	25.56 (5.87)	25.80 (5.70)	25.87 (5.80)	25.59 (5.93)	24.88 (5.82)
Maternal Education					
Less than HS*	12.24%	10.66%	10.84%	12.65%	14.05%
HS Diploma, no BA*	54.47%	54.38%	53.35%	54.75%	55.42%
Bachelor's Degree *	33.29%	34.97%	35.81%	32.60%	30.53%
Private Insurance*	54.39%	58.45%	57.82%	54.00%	48.17%
Receives WIC*	42.24%	38.41%	39.78%	42.99%	45.82%
Maternal Morbidity					
Chronic Hypertension	1.03%	1.09%	1.05%	0.96%	1.15%
Diabetes*	3.82%	4.23%	3.91%	3.72%	3.73%
Eclampsia	0.24%	4.02%	4.09%	3.96%	4.59%
Pregnancy Hypertension*	4.11%	0.28%	0.26%	0.21%	0.27%
Maternal BMI (SD)	25.65 (6.2)	25.75 (6.22)	25.66 (6.19)	25.55 (6.12)	25.86 (6.41)

*p-value for trend <0.01.

Table 3
Crude and adjusted odds of preterm birth among mothers in the United States (2011–2015) by 2012 county-average fees & fines as a percent of total revenue (Quartiles)[a].

Preterm Birth												
	Model 1: Crude Association				**Model 2: Adjusted for County Population & Revenue**				**Model 3: Adjusted for Maternal Characteristics and County Population and Revenue**			
County Fees & Fines	**Beta**	**OR**	**OR 95%**	**CI**	**Beta**	**OR**	**OR 95%**	**CI**	**Beta**	**OR**	**OR 95%**	**CI**
Intercept	−2.124				−1.798				−2.1056			
Lowest Quartile (1)	Ref	1.00	-	-	Ref	1.00	-	-	Ref	1.00	-	-
2	0.0286	1.029	0.996	1.063	0.0478	1.049 ǂ	1.016	1.082	0.0431	1.044 ǂ	1.012	1.077
3	0.0511	1.052**	1.016	1.09	0.0831	1.087 ǂ	1.049	1.125	0.0731	1.076 ǂ	1.04	1.113
Highest Quartile (4)	0.0711	1.074 ǂ	1.032	1.117	0.0797	1.083 ǂ	1.041	1.128	0.0723	1.075 ǂ	1.034	1.118
Test for Trend	β = 0.023		p=<0.001		β = 0.026		p < 0.001		β = 0.023		P < 0.001	
County-level Characteristics												
(log)County Population					−0.0161	0.984	0.967	1.002	−0.0154	0.985	0.965	1.005
(log)County Revenue					−0.0141	0.986	0.965	1.007	0.0019	1.002	0.985	1.019
Maternal Characteristics												
Maternal Age									0.0166	1.017 ǂ	1.016	1.017
Chronic Hypertension									1.1202	3.065 ǂ	2.996	3.136
Diabetes									0.4416	1.555 ǂ	1.533	1.577
Pregnancy Hypertension									1.1445	3.141 ǂ	3.104	3.178
<HS Diploma									Ref	1.00	–	–
HS Diploma, No Bachelor's degree									−0.354	0.702 ǂ	0.695	0.709
Bachelor's degree +									−0.7195	0.487 ǂ	0.481	0.493

ǂ<0.001; **<0.01; *<0.05.

reliance on F&F were attenuated, yet remained significantly associated with PTB after the inclusion of percent Black residents (p-value for trend 0.02; Table 5(a)). Including the proportion of all residents of color also reduced the effect of F&F reliance on PTB, and remained significant, with the odds of preterm birth significantly higher for residents in the second (OR: 1.04, p = 0.02), third (OR:1.06; p = 0.001) and fourth quartiles (OR: 1.05; p = 0.012) compared to the lowest (p-value for trend = 0.01). Similarly, controlling for the ICE-Race measure attenuated the relationship between F&F and PTB and was significant for those residing in the second (OR: 1.03, p = 0.04), third (OR:1.05, p < 0.01) and fourth (OR:1.04, p = 0.04) quartiles of F&F reliance. Adding maternal race into Model 3 attenuated the association between F&F and PTB in all three quartiles, and remained significant at p = 0.05 level for those living in the third quartile, and was marginally significant (p < 0.10) for the second and fourth quartiles (Supp. Table 1) Finally, we stratified the Model 3 by maternal race/ethnicity. We found that among all mothers except those identifying as Native Hawaiian/Pacific Islander, living in counties more reliant on F&F was associated with increased odds of preterm birth (Table 6(a)). However, for all race-stratified models, there was no trend as reliance increased, while Native Hawaiian/Pacific Islander mothers saw a marginal decreasing trend. Only among Native American mothers did the odds of preterm birth increase monotonically as reliance on F&F increased, where mothers residing in counties with the greatest reliance on F&F having 1.13 (95% CI: 0.962–1.325) times the odds of preterm delivery compared to Native American mothers residing in the lowest quartile. Unexpectedly, among Black mothers, the association between preterm birth and the second, third, and fourth quartiles decreased as F&F increased, though all were associated with increased odds of preterm birth compared to the lowest quartile.

3.2. Low birthweight

The proportion of low birthweight births ranged from 7.39% in the lowest quartile to 8.98% in the highest quartile (Table 2.; p-value for trend <0.0001). In unadjusted multilevel analyses, residing in counties in the highest quartile reliant on F&F was associated with higher odds for low birthweight deliveries (OR: 1.052; 95% CI: 1.01–1.10). When controlling for county-level population and total revenue, the strength of the association was increased and reached significance among mothers in the second (OR:1.037; 95% CI: 0.999–1.07), third (OR:1.081; 95% CI: 1.04–1.12) and fourth (OR:1.075; 95% CI: 1.03–1.12) quartiles for reliance on F&F (p-value for trend <0.01; Table 4). When individual maternal characteristics were added to the model, the point estimate decreased slightly, and remained significant for the third (OR = 1.073; 95% CI: 1.03–1.12) and fourth quartiles of F&F reliance (OR = 1.066; 95% CI: 1.02–1.11), with evidence of a positive trend as reliance on F&F increased (p-value for trend <0.01; Table 4).

The addition of maternal race to the Model 3 attenuated the association between highest F&F quartile and low birthweight, such that there were no differences in odds of LBW across the four strata (Supp. Table 1). When area-level measures of segregation were added, we observed similar pattern of attenuated effect size, with the inclusion of percent Black-residents (OR: 1.01, p = 0.72, the inclusion of percent people of color (OR:1.03, p = 0.20), and ICE-Race (OR:1.01, p = 0.64) reducing the relationship to non-significance (Table 5(b)). When stratified by maternal race, there was no association between reliance on F&F and LBW, nor was there evidence of a trend (Table 6(b)).

4. Discussion

The collection of fees & fines through law enforcement and court activities is a geographically variable, often racially targeted experience for individuals in the United States, however it is yet unknown how this may influence population health. Importantly, given the complex relationship between the government, law enforcement, and courts, which utilize race to bolster revenue while disenfranchising non-white residents—the exploitative collection of F&F serves as an example of structural racism. This analysis aimed to examine F&F as one type of structural racism, that has yet to be studied in epidemiologic research, as a predictor of preterm birth and low birthweight.

We found that residing in counties where F&F make up the largest proportion of own-source revenue was associated with higher odds of preterm birth and low birthweight, even when controlling for individual maternal, and county-level characteristics. We also found that F&F was associated with a greater proportion of Black residents and residents of color, and with a greater percentage of births to Black and Latino mothers, and a smaller percentage of white mothers. We found the

Table 4
Crude and adjusted odds of low birthweight among mothers in the United States (2011–2015) by 2012 county-average fees & fines as a percent of total revenue (Quartiles)[a].

Low Birthweight												
	Model 1: Crude Association				Model 2: Adjusted for County Population & Revenue				Model 3: Adjusted for Maternal Characteristics and County Population and Revenue			
County Fees & Fines	**Beta**	**OR**	**OR 95%**	**CI**	**Beta**	**OR**	**OR 95%**	**CI**	**Beta**	**OR**	**OR 95%**	**CI**
Intercept	−2.5021				−2.182				−2.685			
Lowest Quartile (1)	Ref	1.00	-	-	Ref	1.00	-	-	Ref	1.00	-	-
2	0.0143	1.016	0.978	1.052	0.0367	1.037*	0.999	1.074	0.0393	1.040*	1.005	1.077
3	0.0409	1.042*	1.002	1.083	0.0775	1.081 ǂ	1.038	1.124	0.0706	1.073 ǂ	1.033	1.115
Highest Quartile (4)	0.0506	1.052*	1.006	1.099	0.0727	1.075**	1.026	1.123	0.0636	1.066 **	1.020	1.113
Test for Trend	β = 0.019		p = 0.007		β = 0.025		p < 0.001		β = 0.021		P = 0.003	
County-level Characteristics												
(log)County Population					0.0052	1.005	0.985	1.026	−0.0366	0.964**	0.943	0.986
(log)County Revenue					−0.0358	0.965	0.942	0.988	0.0274	1.028**	1.008	1.048
Maternal Characteristics												
Maternal Age									0.0233	1.024 ǂ	1.023	1.024
Chronic Hypertension									1.3481	3.850 ǂ	3.759	3.944
Diabetes									0.1201	1.128 ǂ	1.108	1.147
Pregnancy Hypertension									1.3727	3.946 ǂ	3.897	3.996
<HS Diploma									Ref	1.00	–	–
HS Diploma & No Bachelor's degree									−0.3556	0.701 ǂ	0.693	0.709
Bachelor's degree +									−0.8781	0.416 ǂ	0.409	0.422

ǂ<0.001** < 0.01; *<0.05.

Table 5
Odds of preterm birth and low birthweight among mothers in the United States (2011–2015) by 2012 county-average fees & fines as a percent of total revenue (quartiles)[a] adjusting for county-level racial demographic characteristics (ACS, 2015 5-year).

(a) Preterm Birth

	% Black			**% Non-white**			**ICE-Race**		
	Beta	OR (95% CI)	p-value	Beta	OR (95% CI)	p-value	Beta	OR (95% CI)	p-value
Intercept	−2.068			−2.062			−1.855		
County F&F									
Lowest Quartile	Ref	–	–	Ref	–	–	Ref	–	–
2	0.030	1.031 (1.001–1.062)	0.047	0.036	1.037 (1.006–1.069)	0.019	0.032	1.033 (1.002–1.064)	0.036
3	0.052	1.053 (1.019–1.088)	0.003	0.057	1.059 (1.024–1.095)	0.001	0.051	1.053 (1.019–1.088)	0.003
Highest Quartile	0.042	1.043 (1.005–1.083)	0.030	0.050	1.051 (1.011–1.092)	0.012	0.041	1.042 (1.003–1.082)	0.035
Test for trend	β = 0.014	p = 0.024	β = 0.015	P = 0.013	β = 0.013	p = 0.037			
County-level Racial Demographic Characteristics									
% Black	0.4667	1.593 (1.477–1.719)	<.0001						
% Non-White				0.2496	1.284 (1.215–1.356)	<.0001			
ICE Race							−0.200	0.819 (0.791–0.848)	<.0001

(b) Low Birthweight

	% Black			**% Non-white**			**ICE-Race**		
	Beta	OR (95% CI)	p-value	Beta	OR (95% CI)	p-value	Beta	OR (95% CI)	p-value
Intercept	−2.626			−2.619			−2.261		
County F&F									
Lowest Quartile	Ref	–	–	Ref	–	–	Ref	–	–
2	0.013	1.013 (0.982–1.045)	0.406	0.0288	1.029 (0.996–1.063)	0.088	0.020	1.020 (0.988–1.053)	0.223
3	0.030	1.031 (0.996–1.066)	0.088	0.0455	1.047 (1.009–1.085)	0.016	0.033	1.033 (0.998–1.070)	0.070
Highest Quartile	0.007	1.007 (0.969–1.047)	0.721	0.0272	1.028 (0.986–1.071)	0.202	0.009	1.010 (0.970–1.051)	0.638
Test for Trend	β = 0.003	p = 0.577	β = 0.008	p = 0.226	β = 0.003	p = 0.670			
County-level Racial Demographic Characteristics									
% Black	0.8337	2.302 (2.132–2.485)	<.0001						
% Non-White				0.402	1.494 (1.408–1.586)	<.0001			[a]
ICE Race							−0.341	0.711 (0.686–0.738)	<.0001

[a] Analyses adjusts for maternal age, chronic hypertension, diabetes, and maternal education, as well as the log county-level population and total revenue.

positive relationship between F&F and odds of preterm birth remained statistically significant when we included the proportion of Black residents, the proportion of residents of color, and the Index of Concentration at the Extremes (ICE). However, when adding maternal race/ethnicity only among those residing in the third quartile of F&F reliance did the association with PTB hold. The relationship between LBW and F&F was null with the inclusion of the individual and area-level racial demographics. Of note, in all non-stratified analyses the estimate for the third quartile was more precise than the fourth quartile, likely due to the larger proportion of births (47.9 vs. 17.3% Table 2), however a consistent trend across quartiles would further support reliance on F&F as driving the association. When stratifying by race, we found that among

Table 6
Odds of preterm birth and low birthweight (2011–2015) among mothers in the United States by county-level average fees & fines as a percent of total revenue (quartiles), stratified by maternal race/ethnicity, adjusted for maternal and county-level characteristics.

(a) Odds of Preterm Birth

County Fees & Fines	Non-Hispanic Black Mothers	Non-Hispanic White Mothers	Latinx Mothers	Native American Mothers
Lowest (1)	Ref	Ref	Ref	Ref
2	1.097 (1.029–1.169)	1.022 (0.990–1.055)	1.011 (0.944–1.082)	1.035 (0.903–1.185)
3	1.076 (1.006–1.151)	1.042 (1.005–1.079)	1.034 (0.966–1.108)	1.063 (0.933–1.211)
Highest (4)	1.071 (0.995–1.154)	1.032 (0.990–1.075)	1.034 (0.958–1.115)	1.129 (0.962–1.325)
p-value for trend	0.579	0.1082	0.270	0.1429

(b) Odds of Low Birthweight

County Fees & Fines	**Non-Hispanic Black Mothers**	**Non-Hispanic White Mothers**	**Latinx Mothers**	**Native American Mothers**
Lowest (1)	Ref	Ref	Ref	Ref
2	1.038 (0.976–1.104)	1.013 (0.979–1.049)	0.984 (0.914–1.059)	1.039 (0.870–1.240)
3	1.032 (0.967–1.101)	1.028 (0.990–1.068)	0.973 (0.903–1.047)	1.111 (0.937–1.316)
Highest (4)	1.026 (0.956–1.102)	1.005 (0.963–1.050)	0.974 (0.897–1.057)	1.105 (0.897–1.361)
p-value for trend	0.873	0.7348	0.502	0.2338

(a) Odds of Preterm Birth (Continued)

County Fees & Fines	Asian Mothers	Native Hawaiian/Pacific Islander Mothers	Multiracial Mothers
Lowest (1)	Ref	Ref	Ref
2	1.085 (0.935–1.260)	0.967 (0.670–1.394)	1.077 (0.975–1.189)
3	1.175 (1.011–1.365)	0.829 (0.608–1.131)	1.094 (0.987–1.212)
Highest (4)	1.053 (0.884–1.255)	0.686 (0.442–1.065)	1.066 (0.945–1.203)
p-value for trend	0.3129	0.0614	0.3376

(b) Odds of Low Birthweight (Continued)

County Fees & Fines	**Asian Mothers**	**Native Hawaiian/ Pacific Islander Mothers**	**Multiracial Mothers**
Lowest (1)	Ref	Ref	Ref
2	0.941 (0.798–1.111)	0.984 (0.613–1.578)	1.028 (0.922–1.145)
3	1.004 (0.853–1.182)	0.912 (0.600–1.385)	1.097 (0.983–1.223)
Highest (4)	0.918 (0.759–1.111)	0.759 (0.435–1.322)	1.135 (0.999–1.289)
p-value for trend	0.8212	0.3292	0.0152

a Analyses adjusts for maternal age, chronic hypertension, diabetes, pregnancy hypertension, and maternal education, as well as the log county-level population and total revenue. * p-value 0.10; ** p-value <0.05 (for quartile).

Black, white, and Asian mothers, residing in the third quartile of F&F reliance was associated with significantly higher odds of preterm birth. Residing in the highest quartile of F&F reliance was associated with a marginally significantly higher odds of preterm birth among all mothers except those identifying as Native Hawaiian/Pacific Islander, for whom there was a negative association between F&F and preterm birth. Among Native American mothers there was a non-significant monotonic trend of greater odds of PTB as F&F reliance increased, though all were nonsignificant.

The results of stratified analyses were unexpected, as we hypothesized that F&F is a type of structural racism, we expected the effect of reliance of F&F to be strongest among mothers of color, particularly Black mothers. However, among Black mothers, residing in the second quartile of F&F reliance was associated with higher odds of PTB than residing in the highest quartile. This is perhaps due to our measure, as currently operationalized, being unable to distinguish between county-level reliance on F&F that is racially driven, and greater reliance on F&F in general. The most salient racially-driven reliance on F&F likely occurs at the sub-county geographies, driven by local governments and law enforcement agencies—such as the case of Ferguson, Missouri—which are able to utilize neighborhood or even street-level segregation to target the collection of F&F (Brazil, 2018; A. P. Harris et al., 2020; United States Department of Justice Civil Rights Division, 2015). This initial examination into F&F using the COG is likely not granular enough to distinguish between the micro-targeting of Black and Brown bodies—distinguishing between areas where F&F collection is more equitable and those where its collection is an example of structural racism. As such, these results may be best interpreted globally rather than stratified by race. Furthermore, it's likely that even when F&F revenue is low, and Black residents are fewer in population, that Black residents are still the most targeted. Studies suggest there is protection gained from living in ethnic enclaves, such as protection gained from political representation and empowerment (LaVeist, 1993), and may explain why segregation is not always associated with worse health outcomes, and an imperfect proxy for structural racism. Though unexamined here, this may explain why in stratified analyses among Black mothers, residing in the second quartile of reliance has higher odds of PTB than the fourth. Importantly, the overrepresentation of Black births in the highest category of F&F, as well as literature which suggests Black, Indigenous, and other people of color are most targeted by policing, suggests that the conditional impact across levels of F&F may not be as important as the population impact for mothers of color. This study was limited by the unavailability of birth data at sub-county geographic levels.

Additionally, there were many counties where the number of births to mothers of color was low or zero for the years we observed. This lack of nationwide coverage presents positivity concerns which make subgroup interpretation practical only for non-Hispanic white mothers, who are represented in all counties in the time-period we examined. In contrast, mothers of color were only represented in some strata for some states, and absent in others. This may also be particularly salient among Native American mothers and Native Hawaiian/Pacific Islander mothers, who due to settler-colonialism, imperialism, racism, genocide, and land theft, make up a small proportion of mothers in this study, and are clustered in a small portion of counties in this sample. Small sample size may explain the slight signal of a trend across F&F categories for PTB, though null in categorical analyses for Native American. Given that Native American women are at the greatest risk for fatal police violence (Edwards et al., 2019), future research should examine how increased police contact and surveillance pose a specific intergenerational risk for this population. Contextual differences among the small sample of counties with Native Hawaiian/Pacific Islanders may account for the seemingly protective effect of living in counties most reliant of F&F. PHCRP and Ecosocial theory together remind researchers that contemporary racism requires both spatial and contextual theorizing, as the underlying processes and dynamics through which racism operates may vary by geography and racial group.(Ford and Airhihenbuwa, 2010; Krieger, 2011, 2012).

This study suggests that there is a deleterious, though small and heterogenous relationship between governments financed through law and criminal justice activities and the health of their constituents, though analyses would benefit from more granular data. The overall

results suggest that the collection of fees & fines deserves public health attention, particularly in places where the reliance on F&F encode a substantial burden on the residents of that community. Surveillance by, and interactions with, law enforcement can result in harm for women of color, particularly Native American and Black women (Edwards et al., 2019). Research should continue to examine non-lethal, even non-violent interactions with the police, as a significant source of stress among populations where the threat of violence is salient and real. Future research should also aim to understand the impact of paying fees & fines, particularly for those with the least financial resources. Advocacy organizations have likened F&F consequences to debtors' prison which extract large amounts of money from a handful of individuals. Understanding the public health impact of this governmental extraction through F&F is an important next step.

A major strength to this analysis is that it is the first to assess the health impact of fees & fines. The interaction between governments, law enforcement, and their constituents is an important yet understudied exposure in social epidemiologic research. Research examining structural influences of health, particularly structural racism, should leverage the availability of complete, administrative financial data such as the COG. A major limitation of this analysis is that the ecologic county-level F&Fs cannot determine who is most at risk being hit with a fee or fine at the sub-county level. Future research should aim to determine how the collection of fees & fines is motivated by segregation in the area, and the individual's race/ethnicity to further operationalize F&F as structural racism in that area. Nevertheless, that a consistent effect was found should prompt further, more granular multilevel studies of this phenomena. Understanding that exploitative, racialized revenue generation, and its relationship to population health may vary across space and may be moderated by risk for police-related surveillance and additional stressors, this study can serve as a foundation for local, applied public health research where the community level relationships are well-known by the researcher.

The exploitative use of fees & fines to bolster governmental revenue is not only an abuse of state power, but our research suggests it may harm population-level birth outcomes among mothers who reside there, and thus is antithetical to public health efforts from the same organizational structure. The graded increase in risk for preterm birth and low birthweight, even at an ecologic level, highlights the embodied risk of governmental and police decision making on constituents (Krieger, 2011). Understanding how political and economic structures degrade health, such as the observed case in reliance on F&F, should continue to be of importance to public health researchers and policy makers to address structural injustices perpetuated by the state.

Declaration of competing interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.healthplace.2023.102990.

County average fees and fines as a proportion of total own-source revenue was divided into quartiles.

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