Maternal Cumulative Exposure to Adverse Neighborhood Environments and Preterm Birth

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ABSTRACT

Preterm birth (PTB; <37 weeks gestation) is a high-priority population health issue, yet scholars have yet to explain why the majority of preterm births occur. Most studies examine prenatal risk factors, although pregnancy may be "too little, too late" in terms of delivering an intervention. This study explores, for the first time, risk factors within the preconception neighborhood environment. We devise a new approach to identify preconception neighborhoods within population-level data: we link consecutive births across mothers in California (2005-2010), geocode mother's home address at each birth, and append Census data. The neighborhood at the time of sibling 1's birth is defined as the preconception neighborhood for sibling 2. Thus, our approach transforms administrative data into prospective data. Grounded in life course epidemiology theory, we test a chains of risk model and find that sustained exposure to deleterious neighborhood environments (from the preconception period through birth) increases offspring's PTB risk.

ABBREVIATED BACKGROUND

In the U.S., preterm birth (PTB; < 37 weeks gestation) is one of the nation's "leading health indicators" — a subset of *Healthy People 2020* objectives designated as high-priority population health issues. Leading health indicators are "critical health issues that, if addressed appropriately, will dramatically reduce the leading causes of preventable deaths and illnesses" (Wright 2015). The classification of PTB as a leading health indicator is warranted. Preterm birth accounts for one-third of all infant deaths in the U.S.; surviving preterm infants can face numerous challenges later on, including neurodevelopmental problems (e.g., cerebral palsy, mental retardation), cognitive impairment, lower levels of educational attainment, and lower earned income in adulthood (Goldenberg et al. 2008; Moster, Lie and Markestad 2008).

Research suggests the etiology of preterm birth is multifactorial, but the majority of preterm births remain unexplained (Goldenberg et al. 2008; Purisch and Gyamfi-Bannerman 2017). Most past research has searched for risk factors within the prenatal period to elucidate the causes of preterm birth, but several scholars characterize pregnancy as "too little, too late" in terms of an opportunity to effectively intervene on factors that could prevent an adverse birth outcome (Lu and Halfon 2003). Calls for increased emphasis on the *preconception* period have been made (Johnson et al. 2006; Richardson, Hussey and Strutz 2012; van Dyck 2010). Such an emphasis coheres with a life course epidemiology framework in which adverse exposures—whether environmental, socioeconomic, or behavioral—accumulate over time, ultimately degrading health by wearing down the body's ability to continually repair damage (Ben-Shlomo and Kuh 2002; Kuh et al. 2003). This accumulation often involves multiple risk factors that are sequenced, wherein one adverse exposure increases the risk of a subsequent adverse exposure and each exposure maintains both an indirect and direct effect on the health outcome.

Researchers refer to this sequence as an additive chains of risk model (Kuh and Shlomo 2004). Indeed, increasing research finds that maternal early life exposures correlate with offspring adverse birth outcomes, including (but not limited to) preterm birth (Gavin et al. 2012; Harville et al. 2010; Kane 2015; Kane, Harris and Siega-Riz 2018; Strutz et al. 2014a; Strutz, Richardson and Hussey 2012, 2014b).

However, one potentially important preconception exposure – the preconception neighborhood environment – has received little attention to date. An extensive set of studies have associated the neighborhood environment at birth with adverse birth outcomes [see for example, (Ahern et al. 2003; Buka et al. 2003; Chae et al. 2017; Cubbin et al. 2008; Janevic et al. 2010; Kane et al. 2017; Masi et al. 2007; Mehra, Boyd and Ickovics 2017; Messer et al. 2006; Morenoff 2003; Ncube et al. 2016; Nkansah-Amankra 2010; O'Campo et al. 2008; Pearl, Braveman and Abrams 2001; Pickett et al. 2002; Roberts 1997; Vinikoor-Imler et al. 2011; Vos et al. 2014; Walton 2009), but very few have done so with the preconception neighborhood environment. This circumstance is somewhat surprising given the extensive research which documents the importance of the neighborhood environment for health. Neighborhoods shape social norms that govern behaviors, attitudes, and practices; constrain (or facilitate) opportunities for individuals to engage in health-promoting behaviors; regulate access to resources that individuals can use to procure health; and mediate stressors that, in turn, may lead to the adoption of unhealthy coping mechanisms (Kawachi and Berkman 2003; Link and Phelan 1995; Sampson 2003; Sampson, Morenoff and Gannon-Rowley 2002).

Data limitations are one important reason why the association between preconception neighborhoods and offspring health at birth has not yet received much attention in the literature. The identification of preconception neighborhood environments at the population level is not readily available in administrative (birth record) data. The handful of studies that do exist in this area have taken one of two approaches. The first approach is to link a mother's own birth record to that of her offspring; studies using this approach show that cumulative exposure to neighborhood poverty increases the risk of offspring low birth weight (Collins Jr et al. 2009), while upward economic mobility from birth to adulthood is associated with a decreased risk of small-for-gestational age (Collins, Mariani and Rankin 2018). The second approach is to link birth data with longitudinal poverty trajectories of the neighborhood at birth; this work shows that a woman residing in a neighborhood with a history of long-term high poverty (versus long-term low poverty) at the time of birth exhibits an increased risk of preterm birth (Margerison-Zilko et al. 2015). We, however, know of no research which examines the relation between preconception neighborhood environments and preterm birth. Furthermore, no work we are aware of has examined neighborhood environments during emerging and young adulthood—despite the fact that these stages in the life course are critically formative to adult health behaviors and health outcomes (Harris 2010; Hogan and Astone 1986; Shanahan 2000).

The objective of this study is to estimate the association between the maternal preconception neighborhood environment (during emerging and young adulthood) and offspring PTB. We ground this inquiry in life course epidemiology theory, testing a chains of risk model, and devise an approach, that, to the best of our knowledge, has never-before been used to identify preconception neighborhoods using population-level data. We first link consecutive births across mothers within a dataset containing all births to women living in the state of California between 2005 and 2010. After geocoding mother's home address (listed on the birth record) and appending Census data, we define the neighborhood social environment at the time of each sibling's birth. The neighborhood social environment at the time of sibling 1's birth is defined as the preconception neighborhood social environment for sibling 2. *Thus, our approach effectively transforms administrative data into prospective data.*

This innovative approach allows us to identify, for the first time, the effect of the preconception neighborhood social environment on preterm birth, and to test if these associations are robust to the inclusion of indicators of concurrent neighborhood social environment (at the time of birth) and a number of individual-level factors selecting women into neighborhoods (e.g., socioeconomic status, race/ethnicity). Thus, our approach affords greater leverage to address a question plaguing all research on neighborhood effects on health: do these effects hold, net of factors selecting women into living in a given neighborhood?

DATA/METHODS

Data and Sample

This study retrieved birth certificate data from the California Department of Public Health birth files for the years 2005-2010 (N = 3,572,193). The birth file contains over 99.99% of all live births in California. We obtained exposure measures from the 2010 U.S. Decennial Census. From the full birth file, we identified 450,408 pairs of siblings (900,816 infants in all) that met our inclusion criteria: consecutive (singleton) births; mother's home address was in the state of California, successfully geocoded[1] (those that could not be geocoded either did not contain a full address or were cases in which mother's home address was located outside of the state of California), and located in an urban area; had plausible values of key covariates (birthweight, gestational age); and had complete information on all study covariates. The siblings

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[1] We geocoded maternal address of residence using ArcGIS software version 10.4 (Redlands, California). We located maternal addresses using a 2013 street directory and assigned a corresponding census tract (a proxy of neighborhood) based on 2010 U.S. Census geography. We excluded birth records with maternal addresses that failed to reach a minimum location match score of 80 percent, or with unknown, missing, or non-California census tracts.

in our analytic dataset were nested within 6,442 census tracts. We focus on urban areas because the neighborhood-level indices employed in this study were specifically developed for, and validated within, urban areas only. We selected census tract as the level-2 unit to maximize opportunities for comparison with the existing literature.

Variables

The primary outcome assessed in this study is preterm birth (birth at <37 weeks of gestational age). Supplementary analyses explored other adverse birth outcomes including low birth weight, birth weight percentile for gestational age, and small-for-gestational age. The etiology of each of these adverse birth outcomes are distinct, although past research suggests that each is affected by the neighborhood environment. We explore these other outcomes as a means by which to assess the generalizability of the impact of the preconception neighborhood environment on adverse birth outcomes, defined more broadly.

The independent variables in this study are neighborhood affluence and disadvantage, each measured at two points in time: the preconception period and the time of birth. We developed indices for neighborhood affluence and disadvantage based on past research (Kane et al. 2017; King, Morenoff and House 2011). Using an exploratory factor analysis (EFA), we extracted two orthogonal factors representing affluence and disadvantage. The affluence factor consisted of three indicators: the proportion of 16+ year old civilian workers in professional/managerial occupations, the proportion of 25+ year olds with 16 or more years of education, and median home values. The Cronbach's alpha value was .93, indicting high reliability. The disadvantage factor consisted of six indicators: the proportion of households with income less than $15,000, the proportion of households with income greater than or equal to $50,000 (reverse coded), the proportion of families in poverty, the proportion of households receiving public assistance, the total unemployment rate, and the proportion of vacant housing units (Cronbach's alpha = .92). We standardized each variable before performing the EFA; thus, values of each factor can be interpreted as the number of standard deviations away from California state urban mean levels.

Covariates included maternal years of education completed [less than high school, high school (*reference*), some college, Bachelor's degree or higher, other], public insurance expected to pay for the delivery (*reference* = private insurance expected to pay), maternal age [<20, 20-24, 25-29 (reference), 30-34, 35-39, 40+], parity (0, 1, 2, 3+), male infant (*reference* = female), and maternal race/ethnicity (non-Hispanic Black, Hispanic, non-Hispanic Asian, non-Hispanic White (*reference*), other].

Statistical Method

We used probabilistic linkage strategies to identify singleton infants born to the same mother in California between 2005 and 2010. We performed record linkages using Link Plus (version 2.0), an open-source probabilistic record linkage program developed at CDC's Division of Cancer Prevention. Link Plus offers two modes: (1) deduplication mode recognizes potential "duplicates", or records that represent the same person or event, and (2) link mode, which links records across multiple files. We used deduplication mode to identify matched pairs of birth records representing the same mother in birth files for years 2005-2010.

Link Plus computes linkage scores based on a theoretical framework developed by Fallegi and Sunter (1969). The program first identifies potential matches by "blocking" pairs of records with identical values of a specified variable. The program then compares and assigns a match score to comparison-pairs based on similarity of specified "match" variables. Pairs with higher scores are more likely to be "true" matches. The user sets an upper-bound score above which all pairs are deemed a match, and a lower bound score below which all pairs are deemed not a match.

In this project, we “blocked” records based on maternal date of birth – that is, comparison pairs comprised records representing mothers with identical birth dates. Pairs were then assigned a match score according to similarity of maternal first and last name, in addition to maternal date of birth. We set the upper-bound score at 15.0, at or above which comparison-pairs share a common maternal date of birth, last name and first name. We rejected pairs of women with different last names, corresponding to match scores below 12.0. We conducted a manual review of pairs with match scores between 12.0 and 14.9 and additionally compared infant date of birth (in record 1) with date of last delivery (in record 2). Uncertain matches with comparable dates for last delivery and infant birth were subsequently deemed matches.

Once the linkage was finalized, we estimated a structural equation model, a method that accommodates the simultaneous estimation of multiple pathways (Bollen 1989). Figure 1 depicts the conceptual model guiding our study: preconception neighborhood (the neighborhood in which the mother lived at the time of sibling 1’s birth) is linked with the concurrent neighborhood (the neighborhood in which the mother lived at the time of sibling 2’s birth), and is also allowed to have a direct effect on the birth outcomes of sibling 2. Dashed lines (linking the concurrent neighborhood to offspring’s birth outcome) is the focus of past research; solid lines (linking preconception neighborhood with adverse birth outcome and linking preconception neighborhood with concurrent neighborhood) are the focus of the present study. We estimate the structural equation model using maximum likelihood estimation in Mplus 7 and estimate total, direct, and indirect effects to identify pathways through which preconception neighborhood environment operates directly and indirectly on offspring’s birth outcome.

FIGURE 1 ABOUT HERE

FINDINGS

Table 1 presents descriptive statistics of all study variables. Census-tract level variables indicate an average preconception neighborhood disadvantage score of -.14 and an average preconception neighborhood affluence score of .27. The average concurrent neighborhood disadvantage score is -.15; that of concurrent neighborhood affluence is .27. With respect to individual-level covariates, roughly one-quarter of the analytic sample was represented by each category of maternal education (less than high school, high school, some college, and Bachelor's degree or higher) and just over half (53.6%) of deliveries were expected to be paid by public (versus private) insurance. The racial/ethnic composition of births in the analytic sample is diverse: roughly one quarter (26.5%) are non-Hispanic White, half (51.7%) are Hispanic, 13.6% are non-Hispanic Asian, and 6.3% are non-Hispanic Black. Less than 2% of births were to mothers in any other racial/ethnic category. Just under one-tenth (9.5%) of all births were preterm. These statistics closely match those of all births in the state of California between 2005 and 2010 (see Appendix A).

TABLE 1 ABOUT HERE

Figure 2 presents select estimates from the structural equation model linking preconception neighborhood disadvantage and affluence to offspring preterm birth. (All estimates are presented in Table 2, except for covariances between all exogenous variables which were included in the estimation but are not shown). Unstandardized betas are shown in regular font, followed by standardized betas in parentheses (and italic font). The path linking concurrent neighborhood disadvantage and preterm birth is statistically significant and in the expected direction, such that a 1 standard deviation (SD) increase in neighborhood disadvantage is associated with a 5% increase in the odds of preterm birth [*b* = .05, odds ratio (OR) = e^b = 1.05]. A 1 SD increase in neighborhood affluence is associated with a 5% decrease in the odds of preterm birth (*b* = -.05, OR = .95). Both estimates are consistent in the magnitude and level of statistical significance demonstrated in past research (Kane et al. 2017; Messer et al. 2006). Path dependence between prenatal and concurrent neighborhood disadvantage is observed (*b* = .71, *p* < .001), as well as path dependence between prenatal and concurrent neighborhood affluence (*b* = .81, *p* < .001). These estimates are consistent with what we hypothesized based on past research.

Preconception neighborhood disadvantage, though not preconception neighborhood affluence, is associated with offspring preterm birth, above and beyond all other pathways estimated here. A 1 SD increase in neighborhood disadvantage is associated with a 3% increase in the odds of preterm birth (*b* = .03, OR = 1.03).

FIGURE 2 ABOUT HERE

TABLE 2 ABOUT HERE

Table 3 presents a summary of direct and indirect effects linking preconception neighborhood disadvantage and affluence to offspring preterm birth (Panel A; based on model depicted in Figure 2 and Table 2), and low birth weight (Panel B; based on a separate model estimated, not shown but available upon request). The first coefficient shown represents the direct effect of preconception neighborhood disadvantage on preterm birth (unstandardized *b* = .029); this also appears in Figure 2 and Table 2. The second coefficient represents the indirect effect linking the two (preconception neighborhood disadvantage → concurrent neighborhood disadvantage → preterm birth), and is statistically significant (*b* = .04, *p* < .001). The third coefficient represents the direct effect of preconception neighborhood affluence on preterm birth (*b* = -.02); the fourth represents the direct effect (preconception neighborhood affluence → concurrent neighborhood affluence → preterm birth) and is statistically significant ($b = -.04$, $p < .001$).

Findings presented in Panel B (for low birth weight) somewhat correspond to those in Panel A (for preterm birth). Preconception neighborhood disadvantage has a statistically significant direct effect on low birth weight ($b = .05$, $p < .01$), but no indirect effect operating through concurrent neighborhood disadvantage. Preconception neighborhood affluence does not have a statistically significant direct effect on low birth weight, but does influence low birth weight indirectly, through the path linking preconception and concurrent neighborhood affluence, and then concurrent neighborhood affluence and low birth weight ($b = -.04$, $p < .05$).

DISCUSSION

Grounded in life course epidemiology, the goal of our study was to estimate, for the first time, the association between the maternal preconception neighborhood environment (during emerging and young adulthood) and offspring PTB. To do so, we devised a new approach to identify preconception neighborhoods using population-level data, by linking consecutive births to the same mother over time and identifying sibling 1's concurrent neighborhood environment as the preconception neighborhood environment for sibling 2.

Our study makes two key contributions to the literature. First, we observe a direct effect of preconception neighborhood disadvantage on the risk of preterm birth that is robust to the inclusion of: numerous covariates and a pathway linking concurrent neighborhood disadvantage and preterm birth. This suggests that preconception neighborhood disadvantage has a unique and independent effect on the risk of preterm birth. Furthermore, we replicated all analyses by predicting another adverse birth outcome, low birth weight. This finding held: we observed a direct effect of preconception neighborhood disadvantage on the risk of low birth weight, above and beyond all other covariates and pathways.

Second, we observed a cumulative (indirect) pathway linking preconception neighborhood affluence to concurrent neighborhood affluence and, ultimately, to the risk of preterm birth. This cumulative pathway was also replicated in supplementary analyses exploring the risk of low birth weight. This is consistent with past research demonstrating that cumulative exposure to deleterious neighborhood environments predicts low birthweight percentile for gestational age (Kramer, Dunlop and Hogue 2014).

Both findings are also consistent with a chain of risks life course epidemiological model (Kuh and Shlomo 2004). Not only does living in a high-disadvantage (or low-affluent) neighborhood increase the risk of subsequent exposure to high-disadvantage (or low-affluent) neighborhood, and these exposures accumulate over time (finding #2), but preconception neighborhood disadvantage also has an additive effect on later-observed adverse birth outcomes (finding #1). This new evidence is suggestive of an effect of sustained exposure to differential neighborhood environments on an offspring's adverse birth outcome.

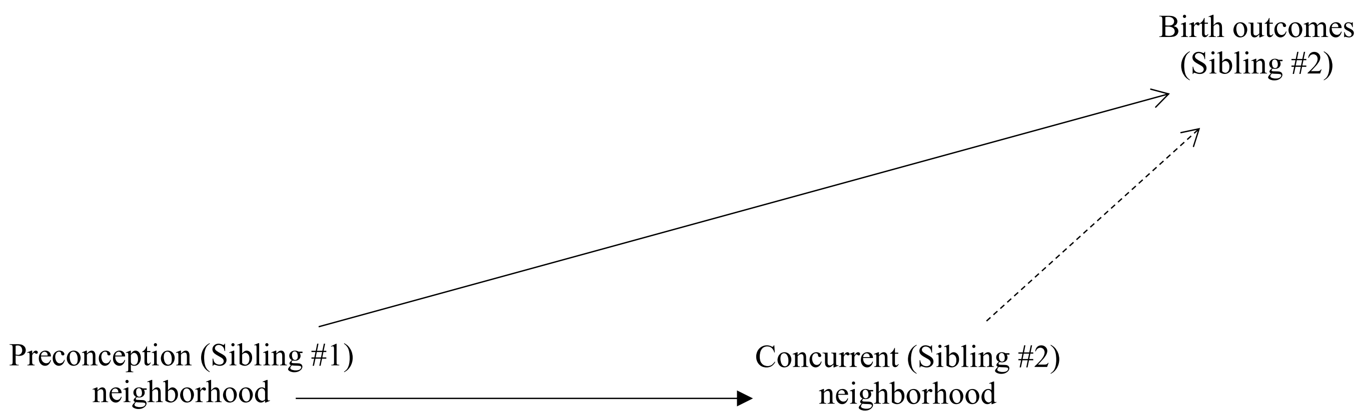
Future Plans

Before PAA we plan to replicate these analyses with other adverse birth outcomes including small-for-gestational age, birthweight percentile by gestational age, and (continuous) birthweight (controlling for gestational age). We also plan to replicate Figure 2 using causal mediation modeling, a variant of structural equation modeling that allows us to assess the causal nature of the estimated pathways. Our team has implemented this method in the past and found it to be a useful addition to research nested within life course epidemiology (Kane et al. 2017). Our preliminary work using this approach suggests that study findings hold up in the more stringent context of a marginal structural model.

Conclusion

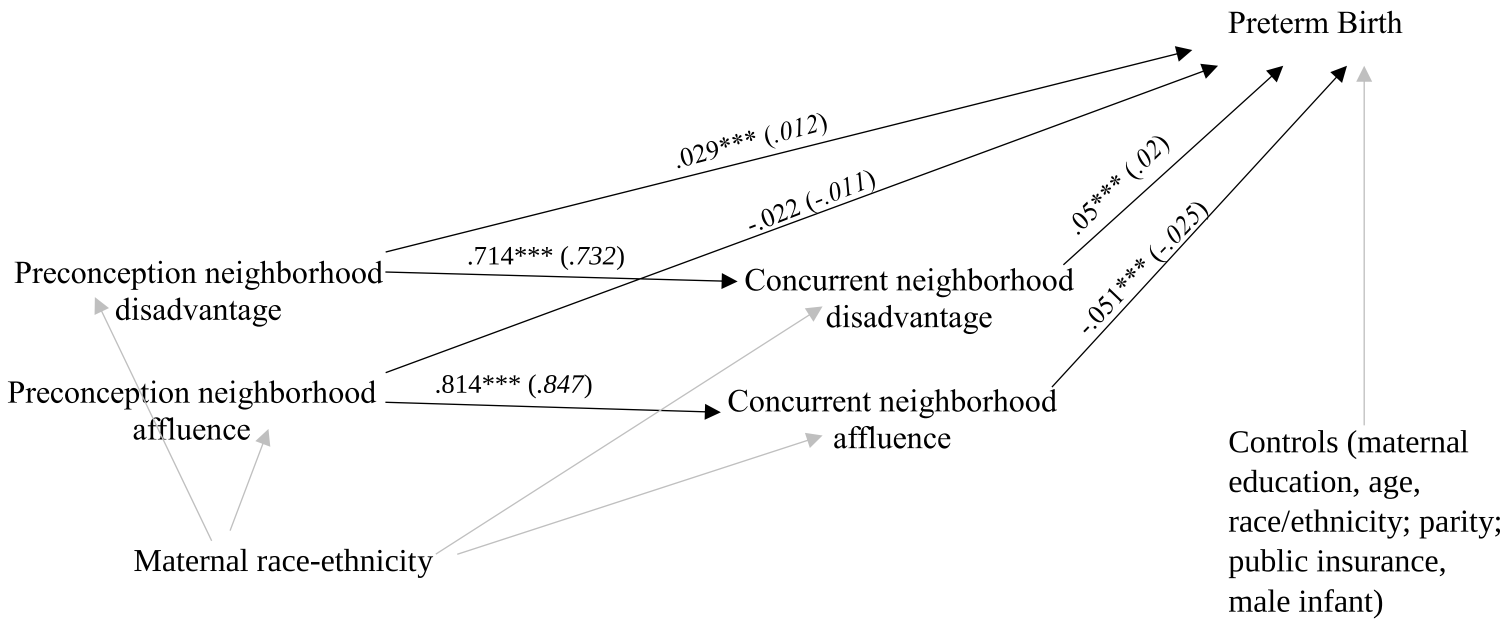
Broadly speaking, study findings add to the growing body of literature linking maternal early life exposures with offspring adverse birth outcomes, including (but not limited to) preterm birth (Gavin et al. 2012; Harville et al. 2010; Kane 2015; Kane et al. 2018; Strutz et al. 2014a; Strutz et al. 2012, 2014b), and also push this literature in the direction of accounting not only for the family environment, but for the neighborhood environment as well (an area that has not yet received much attention in the literature). The chain of risks observed here suggest interventions should begin much earlier than the prenatal period, in order to minimize the risk of offspring preterm birth.

Figure 1. Conceptual Model Linking Preconception Neighborhood Environment to Adverse Birth Outcomes, Using a Sibling-Linked Approach



Note: Dashed lines indicate the focus of past research; solid lines indicate the contribution of the present study.

Figure 2. Estimates from the Structural Equation Model Linking Preconception Neighborhood Disadvantage and Affluence to Preterm Birth



Note: Unstandardized betas are shown in regular font, followed by standardized betas in parentheses and italic font. Covariances between all exogenous variables are estimated but not shown.

Table 1. Descriptive Statistics

	Percent (%) or Mean
Neighborhood-level variables (n = 6,442 census tracts)	
Preconception neighborhood disadvantage (SD = .59, range = -1.36, 2.42)	-.14
Preconception neighborhood affluence (SD = .89, range = -1.73, 2.80)	.27
Concurrent neighborhood disadvantage (SD = .58, range = -1.37, 2.42)	-.15
Concurrent neighborhood affluence (SD = .88, range = -1.35, 2.88)	.27
Individual-level variables (n = 450,408 infants)	
Maternal education	
Less than high school	25.52%
High school (*reference*)	24.92%
Some college	21.29%
Bachelor's degree or higher	25.25%
Other	3.01%
Public insurance was expected to pay for delivery	53.56%
Maternal age	
Less than 20	3.87%
20-24	22.39%
25-29 (*reference*)	27.96%
30-34	26.95%
35-39	15.68%
40+	3.15%
Parity	2.48
Male infant	51.23%
Maternal race/ethnicity	
Non-Hispanic White (*reference*)	26.47%
Non-Hispanic Black	6.28%
Hispanic	51.70%
Non-Hispanic Asian	13.64%
Other	1.91%
Outcomes	
Preterm birth	9.53%
Low birth weight	4.49%

Source: Sibling-linked file, California birth records, 2005-2010
Notes: SD indicates standard deviation

Table 2. Estimates from the Structural Equation Model Linking Preconception Neighborhood Disadvantage and Affluence to Preterm Birth

	Unstandardized beta	Standard error
Preconception neighborhood disadvantage --> PTB	.029*	.012
Preconception neighborhood affluence --> PTB	-.022	.013
Concurrent neighborhood disadvantage --> PTB	.050***	.012
Concurrent neighborhood affluence --> PTB	-.051***	.014
Preconception neighborhood disadvantage --> Concurrent neighborhood disadvantage	.714***	.001
Preconception neighborhood affluence --> Concurrent neighborhood affluence	.814***	.001
Maternal education --> PTB (*ref* = high school)		
Less than high school	.004	.014
Some college	-.053***	.015
Bachelor's degree or higher	-.243***	.019
Other education	.001	.031
Public insurance to pay for delivery --> PTB (*ref* = private ins.)	.103***	.013
Maternal age --> PTB (*ref* = 25-29)		
Less than 20	.332***	.026
20-24	.087***	.015
30-34	.031*	.015
35-39	.160***	.017
40+	.387***	.029
Maternal race-ethnicity --> PTB (*ref* = non-Hispanic White)		
Non-Hispanic Black	.427***	.021
Non-Hispanic Asian	.141***	.018
Hispanic	.043**	.015
Parity --> PTB	.206***	.011
Male infant --> PTB (*ref* = female)	.150***	.010
Maternal race-ethnicity --> Concurrent neighborhood disadvantage (*ref* = nH White)		
non-Hispanic Black	.255***	.004
non-Hispanic Asian	.018***	.002
Hispanic	.180***	.002
Maternal race-ethnicity --> Concurrent neighborhood affluence (*ref* = nH White)		
non-Hispanic Black	-.181***	.004
non-Hispanic Asian	-0.001	.002
Hispanic	-.192**	.002

Source: Sibling-linked file, California birth records, 2005-2010
Notes: ***$p < .001$; **$p < .01$; $p < .05$

Table 3. Direct and Indirect Effects from the Structural Equation Model Linking Preconception Neighborhood Disadvantage and Affluence to Adverse Birth Outcomes (Preterm Birth and Low Birth Weight)

Panel A. Preterm Birth (PTB)	Unstandardized beta (standard error)	*z* statistic
Preconception neighborhood disadvantage		
Direct Effect: Preconception neighborhood disadvantage → PTB	.029 (.012)*	2.511
Indirect Effect: Preconception neighborhood disadvantage → Concurrent neighborhood disadvantage → PTB	.035 (.008)***	4.205
Preconception neighborhood affluence		
Direct Effect: Preconception neighborhood affluence → PTB	-.022 (.013)	-1.629
Indirect Effect: Preconception neighborhood affluence → Concurrent neighborhood affluence → PTB	-.041 (.011)***	-3.756
Panel B. Low Birth Weight (LBW)	**Unstandardized beta (standard error)**	***z* statistic**
Preconception neighborhood disadvantage		
Direct Effect: Preconception neighborhood disadvantage → LBW	.048 (.017)**	2.87
Indirect Effect: Preconception neighborhood disadvantage → Concurrent neighborhood disadvantage → LBW	.019 (.012)	1.636
Preconception neighborhood affluence		
Direct Effect: Preconception neighborhood affluence → LBW	.001 (.019)	.055
Indirect Effect: Preconception neighborhood affluence → Concurrent neighborhood affluence → LBW	-.039 (.016)*	-2.508

Source: Sibling-linked file, California birth records, 2005-2010

Notes: ***$p < .001$; **$p < .01$; $p < .05$

Appendix A. Comparison between characteristics of mothers with one birth, and those with more than one birth, during the period 2005-2010

	Mothers with one birth (2005-2010)	Mothers with more than one birth (2005-2010)
	%	%
Race/ethnicity		
NH White	27.68	29.00
NH Black	5.90	6.22
NH Asian	13.12	11.56
Hispanic	51.09	51.16
Age		
Age < 20 years	9.77	14.08
20-24	20.33	28.50
25-29	25.08	28.55
30-34	24.44	20.66
35-40	15.62	7.49
Age ≥ 40 years	4.77	0.72
Education		
Some HS or less	26.71	30.60
High school	24.70	24.62
Some college	22.18	19.21
BA degree or more	23.03	22.68
Payment source for delivery		
Medi-Cal	45.73	49.01
Private	46.74	44.50
Sample size	1,860,393	752,298

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