Health and Place 52 (2018) 101–109

Contents lists available at ScienceDirect

Health & Place

journal homepage: www.elsevier.com/locate/healthplace

Associations between cumulative neighborhood deprivation, long-term mobility trajectories, and gestational weight gain

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ARTICLE INFO

Keywords:
Pregnancy weight change
Neighborhood characteristics
Longitudinal study

ABSTRACT

Existing research on neighborhood environment and gestational weight gain (GWG) focuses on point-in-time measures of neighborhood context. This precludes understanding how long-term exposure to adverse neighborhood environments influences GWG. We estimated associations between average exposure to and trajectories of long-term neighborhood socioeconomic deprivation and risk of inadequate or excessive GWG. Using data from 5690 full-term, singleton pregnancies in the 1979 National Longitudinal Survey of Youth, we estimated associations between cumulative deprivation and GWG, overall and by race/ethnicity, controlling for individual and residential covariates. A one standard deviation unit (8-point) increase in neighborhood deprivation increased risk of inadequate GWG (Relative Risk (RR): 1.08; 95% Confidence Interval (CI): 1.00–1.16) for all women and excessive GWG (RR: 1.11; 95% CI 1.02–1.21) for white women. Persistent low deprivation (RR: 0.78; 95% CI: 0.64–0.94) and upward mobility (RR: 0.76; 95% CI: 0.61–0.96), compared to persistent high deprivation, reduced risk of inadequate GWG. Persistent low deprivation also reduced risk of excessive GWG (RR: 0.84; 95% CI: 0.71–0.98). Long-term neighborhood deprivation contributes to patterns of GWG over women's life course.

1. Introduction

Weight gained during pregnancy is linked to poor health outcomes in both women and their children (Rasmussen and Yaktine, 2009; Margerison-Zilko et al., 2010). Both low and high gestational weight gain (GWG) increase risk of adverse outcomes including low birth weight, preterm birth, maternal postpartum weight retention, and obesity in mother and child (Rasmussen and Yaktine, 2009; Margerison-Zilko et al., 2010; Deputy et al., 2015). Guidelines developed by the Institute of Medicine (IOM) to help women avoid adverse outcomes have proven difficult to achieve (Rasmussen and Yaktine, 2009). Excessive GWG is more prevalent (41–51%) than adequate GWG (23–34%), and inadequate GWG impacts a substantial minority of women (17–28%) (Deputy et al., 2015). Interventions based on individual-level risk factors for inadequate and excessive GWG have achieved only moderate success (Headen et al., 2012). Considering the wider context surrounding pregnant women may bolster the success of such interventions (Headen et al., 2012).

Literature consistently links neighborhood context to adverse birth outcomes, such as low birth weight and preterm birth, (Ncube et al., 2016) but few studies have investigated GWG. These studies suggest positive associations between neighborhood factors, such as neighborhood socioeconomic deprivation, (Mendez et al., 2013) social spaces, and neighborhood physical incivilities, (Laraia et al., 2007; Vinikoor-Imler et al., 2011; Messer et al., 2012) and GWG. However, these findings rely on point-in-time neighborhood measures, which do not reflect risk accumulation. Neighborhood environments are theorized to impact health through both material deprivation pathways, which deprive women of immediate health resources needed for well-being, and bio-behavioral stress pathways, which dysregulate key biological systems over prolonged periods of wear and tear (Culhane and Elo, 2005). Longitudinal assessments of neighborhood environments are needed to improve insight into how neighborhoods influence GWG.

Histories of discrimination and social stratification in the US disproportionately expose racial/ethnic minorities to chronically disadvantaged neighborhoods compared to their white counterparts (Williams and Collins, 2001; Firebaugh and Acciai, 2016; Osypuk et al., 2009). A well-established body of literature has shown that black and Latino neighborhoods have higher poverty over time, despite trends in declining racial/ethnic inequality in poverty over time, and are still

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https://doi.org/10.1016/j.healthplace.2018.05.007
Received 20 July 2017; Received in revised form 18 May 2018; Accepted 23 May 2018

more likely to be geographically segregated from white neighborhoods (Williams and Collins, 2001; Firebaugh and Acciai, 2016; Osypuk et al., 2009). Furthermore, across these disadvantaged neighborhoods, experiences of socioeconomic disadvantage vary by race/ethnicity (Williams and Collins, 2001). Black neighborhoods are more likely to be characterized by long-term economic disinvestment resulting in a lack of health promoting resources, goods, and services (Firebaugh and Acciai, 2016; Osypuk et al., 2009). Paired with the consistent trends in racial residential segregation, these patterns give rise to pockets of concentrated poverty (Williams and Collins, 2001; Firebaugh and Acciai, 2016; Osypuk et al., 2009; Wodtke, 2013).

While Latino populations similarly reside in socioeconomically disadvantaged neighborhoods and experience similar levels of racial residential segregation, (Osypuk et al., 2009; Onésimo Sandoval and Jennings, 2012) these neighborhoods are often not characterized by same level of economic disinvestment due to the presence of culturally tailored resources (Onésimo Sandoval and Jennings, 2012; Ramey, 2013). Ethnic enclaves, which often coincide with disadvantaged Latino neighborhoods, also provide social networks and support that buffer negative impacts of these neighborhoods, (Onésimo Sandoval and Jennings, 2012; Ramey, 2013; Do et al., 2017) although the extent of this buffering has been shown to vary by immigrant status and ethnic origin (Do et al., 2017). Taken together, evidence suggests that extended residence in black compared to Latino disadvantaged neighborhoods can have different implications for health, resulting in racial/ethnic differences in associations between chronic neighborhood deprivation and GWG.

To build on existing work, we use data from a national cohort of women to examine associations between cumulative neighborhood deprivation and GWG, and determine whether they vary by race/ethnicity. We hypothesize that higher cumulative neighborhood deprivation will increase risk of inadequate and excessive GWG, associations will be stronger among all racial/ethnic minorities, but associations for Black women will be stronger than those for Latina women. Completion of this study can aid in the development of structural interventions to improve weight gain outcomes maternal and child health over the life course.

2. Methods and materials

2.1. Subjects

We used data from the 1979 National Longitudinal Survey of Youth (NLSY79). Details on the NLSY79 can be found elsewhere (Bureau of Labor Statistics, 1979). Briefly, the NLSY79 is a nationally-representative cohort of 12686 men and women recruited at age 14–21 and followed longitudinally from 1979 to 2012. Blacks, Hispanic/Latino/Spanish (referred to as Latino/a going forward), and economically disadvantaged whites were oversampled. Participants were interviewed annually from 1979 to 1994 and biennially from 1994 to 2012 (Bureau of Labor Statistics, 1979).

Starting in 1986, women were asked about pregnancies occurring between interviews, and information about pregnancies occurring before 1986 was retrospectively collected (Bureau of Labor Statistics, 1979). We restricted our sample to singleton, full term gestations ranging from 37 to 42 weeks, with non-missing information on both exposure and outcome. We restricted our sample to full-term births in order to appropriately apply the IOM GWG guidelines (Rasmussen and Yaktine, 2009). This resulted in an analytic sample of 5690 pregnancies to 3300 women. The [University] Committee for Protection of Human Subjects approved this study.

2.2. Analytic variables

2.2.1. Exposure

Census tracts approximated neighborhood boundaries. Census tracts are sociodemographically homogeneous areas containing an average of 4000 individuals per tract (US Census Bureau, 2014). Census tract boundaries, obtained through the GeoLytics, Inc Neighborhood Change Database,(Tatian, 2014) were standardized to year 2010 for consistency. We measured neighborhood deprivation using socioeconomic data from the 1980, 1990, and 2000 US census as well as the 2006–2010 American Community Survey (5-year estimates). We used geometric interpolation (Tatian, 2014) to predict data for inter-censal years. We constructed a deprivation index for each census tract for each year based on an eight-item index (% adults in management/professional occupations, % unemployed, % crowded households, % families in poverty, % female headed households with dependents, % households on public assistance, % families earning < $30,000, % adults < high school) developed by Messer et al. (2006a). We used factor analysis to reduce items into a weighted index score after confirming that all items loaded onto one factor (eigenvalue range: 4.19–5.29). We then transformed this index to range from 0 to 100, with higher values indicating more deprivation. Deprivation index scores were linked to NLSY79 data using women's census tract at time of interview.

We created two measures of cumulative neighborhood deprivation. First, in order to measure overall accumulation of deprivation, we averaged neighborhood deprivation index scores from 1979 to the closest interview year prior to giving birth for women with at least two index scores over follow-up. This resulted in an up to 2-year lag between measurement of neighborhood deprivation index score and time of birth. Second, in order to measure patterns of deprivation accumulation over time, we created mobility trajectories. Six long-term trajectories were selected “a priori” based on existing literature: persistent low deprivation, persistent moderate deprivation, persistent high deprivation, upward mobility, downward mobility, and mixed-mobility deprivation. We included the persistent low deprivation, persistent high deprivation, upward mobility, and downward mobility trajectories based on prior research linking these trajectories to adverse birth outcomes (Collins et al., 2009, 2008, 2011, 2015). We additionally included a persistent moderate deprivation trajectory to capture women's lifetime experience of “middle class” status. To create long-term trajectories, we categorized each annual measure of continuous neighborhood deprivation into tertiles and classified women based on amount of time spent in each deprivation category over follow-up. Threshold values for tertiles over time varied based on neighborhood deprivation distribution for each year (Supplementary Table 1). Women were categorized as persistently low deprivation, moderate deprivation, or high deprivation if they stayed in the lowest, middle, or highest tertile of deprivation, respectively, for at least 90% of follow-up. We chose this threshold based on the assumption that brief deviations from a specific deprivation level were not qualitatively different than continuous residence within that deprivation level. Next, women were classified into the upward mobility trajectory if they continuously moved into less deprived neighborhoods over time. This includes women who, at least once over follow-up, moved to a neighborhood categorized in a lower deprivation tertile than the deprivation tertile of the previous year and then continued to reside in neighborhoods within the same or lower deprivation tertile. Similarly, for downward mobility, women were classified into this trajectory if they moved to a neighborhood within a higher deprivation tertile at least once over follow-up and then continued to reside in neighborhoods within the same or higher deprivation tertile for the duration of follow-up. All remaining women were classified within the mixed-mobility group.

2.2.2. Outcome

We calculated GWG as the difference between women's self-reported weight prior to pregnancy and their weight immediately before delivery for each pregnancy. Because length of recall differed for pregnancies occurring before and after 1986, we assessed reliability of prepregnancy weight by comparing it to women's non-pregnant weight at the closest interview prior to pregnancy. Reliability was high across