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Neighborhoods and racial/ethnic differences in ideal cardiovascular health (the Multi-Ethnic Study of Atherosclerosis)

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ABSTRACT

Using data from the Multi-Ethnic Study of Atherosclerosis baseline sample from 2000 to 2002 (N=5263; mean age=62) we examined cross-sectional racial/ethnic differences in ideal CVH, defined by the American Heart Association 2020 Impact Goals as a summary measure of ideal levels of blood pressure, fasting glucose, cholesterol, body mass index, diet, physical activity, and smoking. Using three different analytical approaches, we examined differences before and after adjustment for neighborhood socioeconomic, physical, and social environments. Significant racial/ethnic differences were present for all indicators of ideal CVH (excluding physical activity). Additional adjustments for neighborhood factors produced modest reductions in racial/ethnic differences. Future research is necessary to better understand the impact of neighborhood context on health disparities using longitudinal study designs.

1. Introduction

Persistent and pervasive racial/ethnic differences in health are a major public health concern (Institute of Medicine US Commitee on the Review and Assessment of the NIH's Strategic Research Plan and Budget to Reduce and Ultimately Eliminate Health Disparities et al., 2006; Kelley et al., 2005; Smedley et al., 2003). Racial/ethnic differences in the prevalence of cardiovascular disease (CVD) risk factors and incidence of and mortality due to cardiovascular diseases have been well documented, with blacks disproportionately burdened by adverse outcomes (Go et al., 2014; Mensah et al., 2005). Underlying causes of these differences remain poorly understood, but are most likely generated by multifactorial and multilevel causes that occur over the life-course. Much of the extant literature has focused on individual-level risk factors as explanations for racial/ethnic disparities (genetic, biological, socioeconomic, and psychosocial) (Kramer et al., 2004; Mensah and Dunbar, 2006; Safford et al., 2012). However, more attention has recently been placed on contextual factors such as neighborhood environments.

The increased interest in the intersection of race/ethnicity, neighborhood, and health has emerged in part from the increasing interest in the effects of neighborhoods on health generally. Studies have shown that living in socioeconomically disadvantaged neighborhoods is associated with increased morbidity and mortality, independent of individual-level factors (Borrell et al., 2004; Pickett and Pearl, 2001; Truong and Ma, 2006), and some of the most consistent evidence is from the area of cardiovascular disease (CVD) outcomes. (Borrell et al., 2004; Chaix, 2009; Diez Roux, 2003; Morenoff et al., 2007; Mujahid et al., 2011; Pickett and Pearl, 2001). In the area of CVD, studies have also shown that living in neighborhoods with poor physical environments (e.g. more unhealthy foods on average and fewer opportunities for physical activity) and social environments (e.g. less safety and social cohesion) are associated with increased risk of CVD risk factors such as obesity, diabetes, and hypertension, and fatal and non-fatal CVD

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(Christine et al., 2015; Diez Roux et al., 2016; Kaiser et al., 2016; Kershaw et al., 2015). Studies have also documented that blacks and other racial/ethnic minorities disproportionately reside in neighborhoods that are socioeconomically disadvantaged, and have poor access to health promoting resources. Combined, the aforementioned supports the hypothesis that neighborhood environments may be one underlying cause of racial/ethnic disparities in health. However, there is little empiric investigation explicitly testing this notion (Do et al., 2007; Dubowitz et al., 2008b; Morenoff et al., 2007; Mujahid et al., 2011; Robert and Reither, 2004).

Studies that have empirically investigated the contribution of neighborhood environments to racial/ethnic differences in health have most consistently examined estimates of differences before and after adjustment for neighborhood environments in a multivariable regression model without an explicit discussion of the major challenges and limitations in this approach (Do et al., 2007; Dubowitz et al., 2008b; Mujahid et al., 2011; Robert and Reither, 2004). These challenges include how best to: deal with the non-independence of observations within neighborhoods (Hubbard et al., 2010; Subramanian and O'Malley, 2010), account for the neighborhood context when all relevant factors may not be measured in a given study, and account for insufficient within-neighborhood sample size and variation in exposures and outcomes. A recent review by Schempf et al. (Schempf and Kaufman, 2012) provides an in-depth discussion of these issues, a comparison of analytic approaches that may address these issues, and compares the strengths and limitations of each analytic approach. Studies providing similar comparisons across analytic approaches remain scarce in the literature. (Morenoff et al., 2007; Schempf and Kaufman, 2012).

Given the increased attention to and importance of primordial prevention, as underscored by the recent American Heart Association 2020 Strategic Impact Goals to reduce cardiovascular mortality by 20% and increase ideal cardiovascular health by 20% (Lloyd-Jones et al., 2010), exploring the contribution of neighborhood environments to racial/ethnic differences in CVD risk in a multi-ethnic study is timely (Havranek et al., 2015). Thus, the overall goal of this study was to determine if cross-sectional racial/ethnic differences in ideal cardiovascular health (CVH) indicators were reduced after adjustment for neighborhood environments, and if results were robust to statistical methods of neighborhood adjustment.

2. Methods

2.1. Study population

MESA is a prospective study of 6,814 adults of diverse racial/ethnic backgrounds (self-identified race/ethnicity as non-Hispanic white, non-Hispanic black, Hispanic, and non-Hispanic Chinese) from six study sites (Los Angeles County, California; Chicago, Illinois; Baltimore City and County, Maryland; St. Paul, Minnesota; Forsyth County, North Carolina; New York City, New York) (Bild et al., 2002). Study participants were 45–84 years of age and free from clinical cardiovascular disease at baseline (August 2000 to July 2002). A detailed description of the study recruitment procedures and methods has been previously described (Bild et al., 2002).

Our cross-sectional analyses are restricted to the MESA participants who provided consent to participate in the ancillary MESA Neighborhood Study (N=6191). Institutional review board approval was received at each of the MESA study sites.

2.2. Study variables

2.2.1. Study outcomes

We examined seven indicators of ideal CVH as defined by the American Heart Association 2020 Impact Goals (Lloyd-Jones et al., 2010) using either study questionnaire or clinical examination at baseline (2000–2002). Each indicator was categorized as poor, intermediate, and ideal based on established criteria and are defined in Table 1 (Lloyd-Jones et al., 2010). Cholesterol and fasting blood glucose were measured from a 75 mL fasting blood sample obtained at the baseline clinical examination. Blood pressure (BP) was measured as the average of the second and third readings after five minutes resting in a seated position. BMI was assessed using measurements of height and weight obtained during clinical examination (BMI=height, m/weight, kg^2). Smoking was based on self-reported data from study questionnaires and combined questions on whether a participant smoked in the past 30 days and the lifetime number of cigarettes smoked to create categories of never, current, and former smoking. We estimated minutes of moderate and vigorous exercise from walking, conditioning, and leisure-time activities based on participant's assessment of the time and frequency spent on activities during a typical week in the past month (Ainsworth et al., 1999; Bertoni et al., 2009). We estimated five components of healthy diet using a 120-item food frequency questionnaire (Block et al., 1990), including high intake of healthy foods (fruits and vegetables; fish; whole grains) and low intake of unhealthy foods/nutrients (sugar sweetened beverages; sodium) similar to prior studies (Lloyd-Jones et al., 2010; Rasmussen-Torvik et al., 2013).

We also created three summary measures of ideal CVH as the sum of each individual component score for health behaviors, health factors, and overall cardiovascular health. For the overall CVH measure, which ranged in value between 0 and 14, we created three categories based on the distribution of the data: poor (score of 0–8); intermediate (score of 9–10); and ideal (score of 11–14). In analyses we consider the 7 indicators of ideal CVH and 3 summary measures as dichotomous variables (1=ideal; 0=intermediate/poor).

2.3. Key covariates of interest

2.3.1. Neighborhood-level covariates

Neighborhoods were defined as census tracts based on previous work indicating good agreement across individuals residing within the same tract in relation to our neighborhood characteristics of interest (Mujahid et al., 2007). Three neighborhood-level socioeconomic indicators were derived from the 2000 U.S. Census based on methods previously described (Mujahid et al., 2008). The indicators combine 16 variables representing the dimensions of family structure, area crowding, residential stability, education, employment, occupation, and income/wealth) based on a principle components analysis with varimax orthogonal rotation to reduce the potential for multicollinearity in analytic models. The three factors account for 70% of the total variance.

We calculated two physical environment indicators to represent physical activity and healthy food environment. Using data from the National Establishment Time Series Data (NETS) (Walls & Associates, 2012), we calculated kernel densities of all indoor and outdoor recreational facilities (excluding parks) around MESA participants' home addresses at baseline year of enrollment. Facilities were defined using established Standardized Industrial Codes (SIC) based on prior work (Gordon-Larsen et al., 2006; Powell et al., 2007). We supplemented kernel densities with resident reports of the physical activity environment. MESA participants and an informant sample of non-MESA area residents were asked four items on whether or not their neighborhood (defined as the area within about a 20 min walk or 1 mile from the home) was conducive to physical activity (Echeverria et al., 2004; Mujahid et al., 2007). We averaged across these items to create an overall score (Cronbach's alpha=0.65). The kernel density and survey measure of physical activity environment were each standardized and aggregated to create an overall physical activity indicator for which higher scores represent a better physical activity environment. We used a similar process to create an overall indicator of neighborhood healthy foods (Auchincloss et al., 2012). Neighborhood social environment was characterized using survey items assessing neighbor-