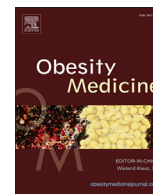




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## Cardiovascular disease and access to nutritious food for safety net patients



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### ABSTRACT

**Introduction:** Cardiovascular disease (CVD) is the second leading cause of death in Alameda County, CA. Poor quality diet has been identified as an important contributor.

**Methods:** This study assessed the association between the neighborhood modified retail food environment index (mRFEI), an indicator of patients' access to nutritious foods, and CVD diagnosis in Alameda County using data of patients seen at Highland Hospital between July 1, 2013 and June 30, 2014, (n = 39,533). Patient addresses were linked to neighborhood level data (e.g. education level, median household income) and mRFEI. CVD diagnosis was based on ICD9 principal diagnosis codes given on initial hospital visit.

**Results:** Logistic regressions modeled the CVD mRFEI association, considering covariates. CVD diagnosed patients were more likely to reside in neighborhoods with a lower ratio of healthy to unhealthy food options (adjusted OR = 0.97; 95% CI: 0.96–0.99).

**Conclusions:** Our findings suggest nutritious food availability may play a role in the distribution of CVD.

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The prevalence of obesity has been increasing at alarming rates in the United States (US) over the past few decades (Mokdad et al., 2001). This is true for its associated comorbidities, including hypertension, diabetes, metabolic syndrome and hyperlipidemia (Field et al., 2001; Gregg et al., 2005). The estimated annual healthcare burden for obesity and its associated comorbidities is over \$150 billion (Finkelstein et al., 2009). Recently, the built environment and expressly the retail food environment have been implicated in the rise of these diet-related illnesses, particularly obesity (Roberts, 2008). These environments have been associated with stark racial, ethnic and socioeconomic disparities in obesity rates (Robert and Reither, 2004). The unequal socioeconomic and racial/ethnic distribution of diet-related illnesses may be in part explained by unequal access to affordable nutritious food (Ball et al., 2009).

The term “food desert” is used to describe an environment characterized by a lack of access to nutritious food, and, in contrast, easy access to calorie dense but nutrient poor foodstuffs (Beaulac et al., 2009). These areas have a relative absence of “healthy” retail food outlets and presence of “unhealthy” ones. “Healthy” retail stores sell foods such as fresh fruits and vegetables and whole grains, and include supermarkets, grocery stores, farm stands, and farmers' markets. “Unhealthy” stores (e.g. fast food outlets and convenience stores (Block and Kouba, 2006)) sell little to no fresh, unprocessed food and are stocked largely with calorie-dense nutrient-poor foods. If they have healthy food options at all, the prices for these items tend to be higher than at grocery stores.

“Food desert” conditions contribute to poor dietary behaviors and diet-related illnesses. These geographic spaces are most commonly found in communities facing other critical disadvantages, including lower educational attainment, limited access to health services, and higher rates of unemployment (Beaulac et al., 2009; Bedore, 2013; Budzynska et al., 2013; Frndak, 2014). In addition, “food deserts” primarily impact communities predominantly made up of racial and ethnic minorities (Powell et al., 2007).

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A study of nearly 700 US census tracts found that the wealthiest neighborhoods had twice the number of supermarkets compared to the low-income neighborhoods, with four times more supermarkets in predominantly white versus black neighborhoods (Moore and Diez Roux, 2006). Another study, across multiple states, found that over 30% of whites live in a census tract with a supermarket compared to less than 10% of blacks (Morland et al., 2002). Other studies have found that predominantly higher-income white communities, compared to communities of color, are more likely to have food stores that sell nutritious and affordable food (Sloane et al., 2003; Jetter and Cassady, 2006; Bodor et al., 2008).

Dietary patterns and obesity are risk factors for cardiovascular disease (CVD), the leading cause of mortality worldwide (World Health Organization, 2014). CVD describes a range of conditions that result in heart attacks, angina and/or stroke (<http://www.mayoclinic.org/diseases-conditions/heart-disease/basics/definition/con-20034056>). Although there is evidence of an association between food environments and these CVD risk factors (Seligman et al., 2010; Parker et al., 2010), the literature is scant and it remains unknown whether the food environment is linked to CVD diagnosis. The aim of this study is to address that link, shedding light on the association between the retail food environment and CVD diagnosis, particularly among populations disproportionately affected by the obesity epidemic. This study assessed the association between patient's access to nutritious food in their neighborhoods and CVD diagnosis status in Alameda County, California. Highland Hospital is the safety net provider in Alameda County (which contains the cities of Oakland and Berkeley) (Community Assessment Planning Education and Evaluation Unit, 2010). We hypothesized that patients residing in neighborhoods with a lower proportion of retail food outlets offering healthy options would be associated with a higher likelihood of being diagnosed with CVD, even after taking into consideration the patients' race/ethnicity and the socioeconomic composition of the neighborhood, defined as the census tract.

## 1. Methods

### 1.1. Study setting

Highland Hospital is a safety-net hospital that serves low-income residents of Alameda County. Of the 1,578,891 people

residing in Alameda County, 52% are white, 86% have a high school degree or higher, 31% are foreign born and 43% speak a language other than English at home (United States Census Bureau, 2013).

### 1.2. Data description

This study examined existing data compiled for the California Office of Statewide Health, Planning and Development (OSHPD) from all inpatients, outpatients, and emergency department (ED) patients seen at Highland Hospital in Oakland, CA between July 1, 2013 and June 30, 2014. All patients who lived in Alameda County and for whom a geocoded address match was available were included in this study sample ( $n = 39,533$ ). Geocoded matches were unavailable for patients with missing or partially missing addresses, including those whose street number or zip code could not be found, and for patients with PO boxes listed instead of home addresses. Data examined included the address, age, sex, race/ethnicity, and principle diagnosis using ICD-9 code for each patient from their initial visit to Highland Hospital during the study period.

Patient addresses were geocoded to be matched to 310 unique Alameda County 2010 census tracts using ArcGIS software. Census tracts are small geographical subdivisions within counties that are updated on a 10-year basis and used as a unit of analysis by the United States Census Bureau. Based on their census tract, patients were matched to publicly available data from the 2012 American Community Survey for census-tract level sex, age, race/ethnicity, median household income, and education level.

### 1.3. Measures

CVD diagnosis was the primary outcome. CVD diagnosis (1 = yes, 0 = no) was categorized at the patient level using patients' ICD-9 principal diagnosis code following the methodology outlined by Cardi et al. (2009).

The Modified Retail Food Environment Index (mRFEI), available at the census tract level from the Food and Drug Administration (FDA), was the primary independent variable. The mRFEI is an indicator of patients' spatial access to nutritious foods, as it measures the proportion of stores, within a census tract or  $\frac{1}{2}$  mile from the tract boundary, that are classified as healthy or less healthy, based on the general food offerings sold by these categories of retailers (Childrens Food Environment State Indicator Report, 2011). In other

**Table 1**  
Descriptive characteristics of highland hospital patients, July 1, 2013–June 30, 2014.

	No CVD diagnosis (N = 37,969)	CVD diagnosis (N = 1564)	P-value
<i>Patient characteristics</i>			
Age (Mean, SD)	39.9 (16.6)	55.1 (13.0)	<0.001
Female (%)	50.5	39.4	<0.001
<i>Race/ethnicity</i>			
White (%)	14.5	15.9	<0.001
Black (%)	34.2	44.5	
Asian (%)	12.7	15.3	
Hispanic/Latino (%)	32.2	18.6	
Other (%)	6.4	5.8	
<i>Insurance status</i>			
Private	3.1	3.0	0.471
Public	89.9	90.9	
Other	0.4	0.2	
Uninsured	6.6	6.0	
<i>Neighborhood characteristics</i>			
Median household income (Mean, SD) <sup>a</sup>	\$51,643.57 (\$23,534.59)	\$51,584.59 (\$23,172.18)	<0.001
Proportion of residents with a high school degree or equivalent (%) <sup>a</sup>	42.2	42.0	<0.001
mRFEI (Mean, SD) <sup>b</sup>	8.3 (6.1)	8.1 (6.1)	<0.001

<sup>a</sup> Data source: American Communities Survey, 2012.

<sup>b</sup> Data source: USDA.

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