TECHNICAL APPENDIX

The Devastating Consequences of Unequal Food Access: The Role of Race and Income in Diabetes
Union of Concerned Scientists, 2016

Methods

Data

This study uses the *Food Environment Atlas* (hereafter referred to as the *Atlas*), a cross-sectional data set from the United States Department of Agriculture (USDA) Economic Research Service. The *Atlas* is publicly available and contains rich data on a number of county-level indicators from 2012, including health outcomes; food outlet availability; food access; food insecurity; physical activity levels; and socioeconomic characteristics such as demographic composition, income and poverty levels, county size, and metropolitan status. Only counties in the continental United States were used in this study (N=3,143). Additionally, we obtained county-level educational attainment data from the U.S. Census Bureau's County Population Estimates. After controlling for missing data, the total sample size for this study was 3,132 counties. Institutional review board approval was not required for this study because the data set is publicly available and does not reveal any individual's confidential information.

Variables

The outcome variable of interest for this study was the percentage of adults (aged 20 and older) with diabetes in a county, excluding gestational diabetes. Diabetes rates in the *Atlas* are obtained from the Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance System (BRFSS) for 2012. The BRFSS does not differentiate between Type 1 and Type 2 diabetes; however, approximately 90 to 95 percent of diabetes cases in the United States are Type 2 and considered preventable (CDC 2014). The two explanatory variables of interest were (1) the number of healthy food outlets in a county per 1,000 people and (2) the number of

unhealthy food outlets in a county per 1,000 people. We categorized grocery stores, supercenters, specialized food stores, and farmers markets as healthy food outlets. The *Food Atlas* defines grocery stores as establishments that sell food as their primary business function. Supercenters are defined as establishments that sell food and groceries, as well as merchandise. Specialized food stores are defined as bakeries, meat and seafood markets, dairy stores, and produce markets. Farmers markets are defined as establishments with at least two vendors selling food products directly to customers. Even though grocery stores, supercenters, and specialized food stores sell unhealthy foods, they also offer more fresh and fewer processed foods than unhealthy food outlets (Glanz et al. 2007). Additionally, they offer more foods listed in the USDA's *Dietary Guidelines for Americans* than do unhealthy food outlets (Baker et al. 2006). Therefore, we categorized these food stores as healthy food outlets.

We categorized fast food restaurants and convenience stores as unhealthy food outlets. The *Food Atlas* defines fast food restaurants as establishments that provide food to customers who order and pay before eating. Full service restaurants are defined as establishments in which customers order, are served food while seated, and pay after eating. Convenience stores are defined as establishments that sell a limited selection of food. Previous studies examining access to food outlets and health outcomes have categorized fast food restaurants and convenience stores as unhealthy food outlets (Rundle et al. 2009; Zick et al. 2009; Wang et al. 2008).

To assess the differential effects of access to healthy and unhealthy food outlets by racial and economic county composition, we constructed four binary variables: (1) higher-than-average percentage of residents of color, (2) lower-than-average percentage of residents of color, (3) lower-income counties, and (3) higher-income counties. First, the percentage of residents of color was calculated for all counties by summing the percentage of African Americans, Hispanics, Asians, American Indians or Alaskan Natives, and Hawaiian or Pacific Islanders in a

county. We then coded counties as "higher-than-average percentage of residents of color" if the percentage of residents of color was greater than the all-county average. Second, we coded counties as "lower-income" if median annual household income was below the all-county average.

We controlled for multiple county-level characteristics, including county obesity rates; percentage of households with no car and low access to a supermarket or grocery store; percentage of the population receiving Supplemental Nutrition Assistance Program (SNAP) benefits; number of authorized SNAP stores per 1,000 county residents; number of recreational facilities per 1,000 county residents; poverty rate; percentage of population aged 65 years or older; percentage of population under the age of 18; percentage of population with a high school degree; and the ratio of a county's metropolitan to nonmetropolitan areas.

Statistical Analysis

We performed analyses with the statistical software program Stata: Release 12. We used the following model to assess whether access to certain food outlets correlated with diabetes rates and whether this correlation had a greater impact on more-diverse and lower-income counties:

$$\boldsymbol{y} = \mathbf{X\beta} + \boldsymbol{\varepsilon}$$

The diabetes rate is represented by y and the independent variables are represented by x. The vector y has dimension nx1, where n is the number of counties. The matrix x has dimension nxk, where k represents the number of independent variables. The vector of coefficients, β, has a dimension of kx1 and was estimated using ordinary least squares. We estimated this equation separately for (1) all counties, (2) counties with higher-than-average percentages of residents of color, (3) counties with lower-than-average percentages of residents of color, (4) lower-income counties, and (5) higher-income counties.

References:

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