CENTER for RETIREMENT RESEARCH at BOSTON COLLEGE

THE RELATIONSHIP BETWEEN DISABILITY INSURANCE RECEIPT AND FOOD INSECURITY

Barbara A. Butrica, Stipica Mudrazija, and Jonathan Schwabish

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Center for Retirement Research at Boston College
Hovey House
140 Commonwealth Avenue
Chestnut Hill, MA 02467
Tel: 617-552-1762 Fax: 617-552-0191
https://crr.bc.edu

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Center for Retirement Research at Boston College
Hovey House
140 Commonwealth Ave
Chestnut Hill, MA 02467
Tel: 617-552-1762 Fax: 617-552-0191
https://crr.bc.edu/

Affiliated Institutions:
The Brookings Institution
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Urban Institute

Abstract

This paper examines the relationship between rates of food insecurity, people with disabilities, and awards for the Social Security Disability Insurance (DI) program from 2010 to 2019. It uses unique data on food establishment locations combined with estimates of food insecurity and food prices from Feeding America's *Map the Meal Gap* project, DI award rates from the Social Security Administration, as well as demographic and socioeconomic information from the American Community Survey. The paper documents the geographic variation in rates of disability, DI awards, and food insecurity using maps and regression analyses to explore the relationship between them. By controlling for local access to food (operationalized as the number or share of food establishments), the paper accounts more accurately for the association between disability and food insecurity. The findings are descriptive and should not be interpreted causally.

The paper found that:

- Food insecurity rates are higher in counties with high rates of disability and DI receipt than in those with lower rates of disability and DI receipt. The paper reports that counties with high rates of disability and DI receipt have lower average food costs, but more limited access to food sources than counties with lower rates of disability and DI receipt.
- The paper also finds that counties with high rates of disability and DI receipts have fewer food establishments. Furthermore, counties with high rates of disability and DI receipt also have a larger supply of unhealthy food options.

The policy implications of the findings are:

- Considering the dual challenges of people with disabilities and food insecurity is important to providing services and programs to people and communities in need.
- Understanding how and why people apply for benefits through the DI program (as well as nutrition programs) is likely impacted by food insecurity and access to healthy food.
- There are additional factors to consider when examining the relationship between disability and food insecurity including local policies and structures, other service providers such as nonprofits and community-based organizations, and how different programs are administered and run.

Introduction

Despite a wealth of research into the determinants of food insecurity, and another strand of research on how disability is associated with economic outcomes, our knowledge of the relationship between disability and food insecurity remains limited. Much of the existing research that does explore this relationship relies on publicly available data sources[1] that lack measures of access to food sources, such as grocery stores and restaurants, their geographic location, and their numbers and densities. Those studies that do consider the geographic location of food sources often lack the nongeographic information necessary to understand fully the relationship between disability and food insecurity.

We seek to fill this gap in the literature by using geographic data on food establishments combined with other relevant demographic and economic information. Unlike in previous studies, these data allow us to control for *access* to food—by measuring the availability and accessibility of food establishments—thereby accounting more accurately for the association between disability and food insecurity.

In general, we find that counties having a large share of residents with disabilities or high rates of DI beneficiaries are also limited in their availability and accessibility to food establishments (respectively defined as the number of food establishments per 1,000 residents and the number of food establishments per square mile). Digging deeper, we find that these same counties also have a larger share of food establishments that likely provide unhealthy food options, which include small grocery stores, convenience stores, limited-service restaurants, pharmacies, and gas stations. We find a strong correlation between many of these types of food establishments and disability and DI rates. Importantly, we find a strong correlation between disability and food insecurity even after controlling for access to food.

Understanding the link between disability and food insecurity has potential implications for multiple public assistance programs including the Supplemental Nutrition Assistance Program (SNAP), the National School Lunch and School Breakfast programs, and the Social Security Disability Income and Supplemental Security Income programs, not to mention the

[1] For example, related studies have used the Survey of Income and Program Participation (Sonik et al. 2016; She and Livermore 2007), the Current Population Survey (Coleman-Jensen 2020), Panel Study of Income Dynamics (Huang, Guo, and Kim 2010), and the National Health and Nutrition Examination Survey (Heflin, Altman, and Rodriguez 2018). Guo, Huang, and Porterfield (2018) use the restricted-access National Health Interview Survey to examine the transition to adulthood among people with disabilities.

multitude of nonprofits, food banks, and other community-based organizations that provide assistance and support to people and families who are food insecure or have disabilities. We view this analysis as an early step in better understanding the relationship between disability status and food insecurity.

Existing Literature

The existing literature on the relationship between disabilities and food insecurity appears to have four main findings. First, households with at least one person with a disability have rates of food insecurity that are substantially higher than households in which no one has a disability (see, for example, Brucker et al. 2015; Brucker and Coleman-Jensen 2017; Heflin, Altman, and Rodriguez 2019; She and Livermore 2007). Brucker and Nord (2016), for example, find that young adults with intellectual or developmental disabilities have significantly higher levels of food insecurity, even when controlling for poverty. Coleman-Jensen and Nord (2013) find that food insecurity rates are highest among households with working-age adults who are disabled. And more generally, Gundersen and Ziliak (2015) report a negative association between food insecurity and health status.

Other research has found that adults with disabilities may be food insecure because they have limited financial resources that force trade-offs between buying food and paying for healthcare and other needs (see, for example, Huang, Guo, and Kim 2010; She and Livermore 2007; Nord and Kantor 2006; and the scoping review by Schwartz, Buliung, and Wilson 2019). Gettens and Henry (2019) find that DI beneficiaries mostly support their consumption with their DI payments, which results in low levels of consumption.

Second, the relationship between disability status and food insecurity holds not only for people from low-income households. There are a non-trivial number of people with disabilities who are food insecure and also live in moderate-income households. Because people with disabilities face higher expenses (relating to health care and adaptive equipment, for example) than people without disabilities, they also require higher incomes to meet their basic needs. Coleman-Jensen and Nord (2013) find that 13 percent of households that included an adult not in the labor force because of a disability had incomes that were at least three times the Federal poverty line but were also considered food insecure.

Third, mental health disabilities have larger impacts than physical disabilities on rates of food insecurity. Maynard et al. (2018) find that most of the 39 articles in their meta-analysis of the literature showed associations between depression and food insecurity. They also noted that longitudinal analyses suggest that there may be a bi-directional relationship between mental health and food insecurity—with food insecurity increasing the risk of depression symptoms or diagnosis, as well as depression predicting food insecurity.

And fourth, the effect of disability on food insecurity varies by severity and, to a lesser extent, the type of the disability. Balistreri (2019), for example, finds that children with more complex healthcare needs have about twice the rate of food insufficiency compared with children with no special healthcare needs or children with less complex healthcare needs. Gregory and Coleman-Jensen (2017) find that rates of food insecurity vary across ten major chronic diseases including hypertension/high blood pressure, diabetes, and chronic obstructive pulmonary disease (see also Tarasuk et al. 2013).

Although the existing research has explored the relationship between disability status and food insecurity, there is much less work on the relationship between receipt of DI benefits and food insecurity. Brucker (2016) is one of the few exceptions in the literature. Like other studies, the author finds that young adults with disabilities are more likely to live in households that are food insecure than their counterparts without disabilities (see also Brucker and Nord 2016). The author also finds that even young adults receiving DI were more likely to live in food insecure households. How this translates to the intersection of disability status and food insecurity in adulthood (not to mention the reliance on different kinds of support programs), to our knowledge, has not yet been explored. Improving our understanding of how DI receipt intersects with food insecurity can help us better understand how the DI program supports beneficiaries and the future financial picture of the Social Security system.

We seek to expand the existing research on the relationship between disability and food insecurity by considering *both* disability and DI receipt. In addition, we account for *access* to food in this relationship, which is largely missing from previous studies. Research on the link between food insecurity and food access—such as the finding from Bonanno and Li (2015) that shows an increase in the density of large food stores reduces food insecurity—may be particularly important for people with disabilities. In a report for the Morrison Institute for Public Policy at Arizona State University, Lee and McFadden (2016) note "[t]ransportation

issues, increased risk of poverty, and a lack of support to shop for and prepare healthy meals place people with disabilities at a greater disadvantage of living in food deserts."

Importantly, different from most studies, we consider whether food insecurity and access to food is different for those with and without disabilities or DI benefits. Previous work, by comparison, has explored the impact of disability (or DI beneficiary status) on food insecurity—as we are careful to emphasize throughout, our results should not be viewed through a causal lens but instead through a perspective of the correlation between food insecurity and disability status or DI award receipt. Because close to two in five households with very low food security include an adult with a disability (Coleman-Jensen and Nord 2013), we expect to find differences. In the next section, we explain our access to unique data that enables us to shed light on this important question.

Data

To understand better the relationship between disability status, DI receipt, and food insecurity, we combine data from multiple sources. In this section, we describe those data, our merging method, and additional considerations about those data that readers should be aware of as they consider the findings in the next section.

InfoGroup Business Data (IBD)

The Urban Institute has access to the IBD, which offers a rare opportunity to explore access to food stores among people with disabilities. The IBD is a national database of approximately 25 million business establishments and includes the address, industry, number of employees, and sales volume for each business in every year from 1998 through 2019. The IBD categorizes all businesses in the US by the North American Industry Classification System (NAICS) and the Standard Industrial Classification (SIC) codes. Using the NAICS, we differentiate between different types of food establishments—grocery stores, other grocery (including specialty food) stores, convenience stores, warehouse clubs, full-service restaurants, limited-service restaurants (such as takeout eateries and fast-food restaurants), other restaurants (including cafeterias, buffets, and snack bars), department stores, pharmacies, and gas stations. Using the SIC description, we further limit department stores, pharmacies, and gas stations to include only those whose description (entered in text fields in the data) includes "food markets,"

"grocers-retail," "convenience store," "food products-retail," or "foods-carry out." We also use the IBD location name to ensure that pharmacies include all CVSs, Walgreens, and Rite-Aids, which are known to sell food. Finally, the IBD data contains the number of employees at each site, which enables us to differentiate between smaller grocery stores (less than 50 employees) and larger ones (50 or more employees).[2] Larger grocery stores are more likely to provide healthy food options (Treuhaft and Karpyn 2010) and a large share of food expenditures by households at risk of food insecurity are spent at these kinds of establishments (Gregory, Mancino, and Coleman-Jensen et al. 2019). Appendix Table A1 includes a crosswalk that maps our food store categories to their NAICS codes.

American Community Survey (ACS)

We use the ACS for population and county-level place characteristics. These include standard demographic and economic controls for age, educational attainment, race and ethnicity, median household income, median house value, and total population, as well as the percent of people in each county who reported having some kind of disability—one of our key variables of interest.

Social Security Administration (SSA)

We obtained the number of people participating in the DI program from SSA from their annual reports (Social Security Administration 2020). We converted these raw numbers to percent of the county population by using population counts from the ACS data.

Map the Meal Gap

We are grateful to *Feeding America* for providing us with county-level rates of food insecurity and thrifty food prices from the *Map the Meal Gap* project (https://map.feedingamerica.org/). The *Map the Meal Gap* project is an annual study conducted by the nonprofit group *Feeding America* since 2011 using the Census Bureau's Current Population Survey (CPS) to estimate food insecurity. The study combines data from various

[2] These thresholds are based on our inspection of the data and observation that many of the grocery stores we know to be large report at least 50 employees.

sources to provide county-level estimates of food insecurity (rates and numbers)[3], food budget shortfalls, and a relative cost-of-food price index.[4] See Feeding America (2021) and Gundersen et al. (2021) for more detail.

Local Area Unemployment Statistics (LAUS)

We use the LAUS data from the BLS for measures of the county unemployment rate.

National Center for Health Statistics (NCHS)

We use the NCHS 2013 urban-rural classification scheme, which distinguishes between metropolitan, micropolitan[5], and non-core areas.

Land Area

We obtain county-level land area (in square meters) from the Census Bureau.

We merged all datasets together at the county-year level. Our final data set includes 3,133 counties for each year 2010 through 2019 for a total of 31,330 county-year observations.

Methods

We estimate a series of regressions to examine the joint relationships between these variables. At the county-level, these regressions capture the association between access to food (measured by the number and density of food establishments) and food insecurity (measured in the *Map the Meal Gap* project) and the share of the population that has a disability (from the ACS data) or is receiving DI benefits (from the SSA), controlling for other economic and demographic characteristics. We emphasize that we are examining the *association* between

[3] In short, the *Map the Meal Gap* project uses state-level CPS data to estimate the relationship between food insecurity and its determinants (e.g., poverty, unemployment, median income, etc.). The model results are then applied to the county level.

[4] The food price values were provided by *Feeding America* and reflect the local equivalent of the national average amount that food secure individuals report spending on a single meal. To localize this average, they use Nielsen pre-tax prices for a market basket that reflects the Thrifty Food Plan (TFP) in every county as well as county and state sales taxes on groceries. The meal cost values can be used as a relative price index to calculate a TFP at a local level, which, for our purposes, is at the county-level. The food insecurity literature has documented an important impact of food prices on food insecurity (Gregory and Coleman-Jensen 2013; Gundersen and Ziliak 2018).

[5] From the CDC reference guide, the concept of a micropolitan statistical area closely parallels that of the MSA, but a micropolitan statistical area comprises nonmetropolitan counties and has a smaller nucleus (CDC 2014).

these factors and not ascribing a causal relationship between any of these factors and rates of disability or DI awards. We are also not estimating a *joint* relationship between these correlates even though there is surely some interaction and overlap between them. That is, we are not looking at food affordability *and* accessibility of healthy foods simultaneously—we simply do not know enough about the food establishments in our data to know for certain, for example, that grocery stores carry healthier foods than convenience stores. Furthermore, grocery stores and restaurants are fundamentally different businesses with respect to affordability, and future research could explore those differences in greater detail.

We also recognize that additional factors such as federal, state, and local policies may have important impacts on these relationships. For example, SSA policy around placement and utilization of intake offices has been shown to have an important impact on applications for DI benefits (Deshpande and Li 2019). Federal and state guidelines set forth by the US Department of Agriculture determine access, eligibility, and benefits for a variety of nutrition programs such as SNAP. Finally, there are a host of other factors that vary locally, including health behaviors (including obesity and smoking; see, e.g., Dwyer-Lindregn et al. 2014 and Schimmel Hyde et al. 2021), environmental factors (such as air quality and lead exposure; see, e.g., Environmental Protection Agency 2020), and the characteristics of an area (such as walkability and availability of public transit; see, e.g., Conderino et al. 2021 and Cooksey-Stowers et al. 2017).

Our baseline regression model takes the following form:

$$Disability_{gt} = \beta_0 + \beta_1 FoodEstab_{gtj} + \beta_2 FoodInsecurity_{gt} + \beta_2 FoodPrice_{gt} + \beta_3 X_{gt} + \delta_t + \eta_g + \varepsilon_{gt}$$

where $Disability_{gt}$ measures the share of people with disabilities or the share receiving DI benefits in county g in year t. $FoodEstab_{gtj}$ captures the number and density of various food establishments j in county g in year t. $FoodInsecurity_{gt}$ is the food insecurity rate and $FoodPrice_{gt}$ is the average price per meal, both from the *Map the Meal Gap* project, and X_{gt} includes time-varying county-level demographic and socioeconomic characteristics. These characteristics are age, educational attainment, race and ethnicity, homeownership, median household income, median house value, the unemployment rate, and total population. Fixed effects δ_t captures unobserved characteristics that vary by year but not county (i.e., year fixed

effects), and η_g captures unobserved characteristics that vary by county but not year (i.e., county fixed effects).

While we believe that it is important to approach this analysis using both the share of people with disabilities and the share of people receiving DI benefits, there are real and important differences between them. First, the measures come from different sources (Census Bureau and SSA) and are collected in different ways (household survey and administrative records). Second, the two measures are presumably (though not necessarily) related since those receiving DI are likely a subset of the population reporting disabilities. Differences between the rates can occur because some people's disabilities are not severe enough to warrant receiving DI benefits or some people who might qualify for DI don't know about the program or are unable to apply for the program. Further research could explore the differences between these two populations and how those differences relate to (and interact with) access to food and food insecurity.

We normalize $FoodEstab_{gtj}$ in two different ways to represent access to food using the taxonomy conceptualized by Penchansky and Thomas (1981).[6] One set of models uses the number of food establishments per 1,000 residents to capture the *availability* or supply of food sources. Another set of models uses the number of food establishments per square mile to capture the *accessibility* or location of food sources. Of course, these measures are limited because availability and accessibility aggregated to the county-level will not reflect disparities in access to food within counties. Finally, we also estimate the models separately for "rural" and urban/micropolitan areas to further understand how density impacts access to food. We designate counties as "rural" if their NCHS classification is "non-core."

Results

In this section, we present our main results, both descriptive and visual, as well as our estimated regressions. We discuss each set of findings in turn.

[6] The authors' taxonomy includes availability, accessibility, accommodation, affordability, and acceptability. Our analyses capture availability, accessibility, and affordability.

Descriptive Results

Table 1 presents summary statistics of food costs, food insecurity rates, and food establishments in 2019 for counties with and without high rates of disability or DI receipt. Throughout the paper, we describe counties whose disability or DI receipt rates are at or above the 75th percentile for all counties in a given year as having "high" disability or DI receipt rates. We describe those whose rates are below the 75th percentile as having "lower" disability or DI receipt rates. Consistent with other studies, we find that food insecurity rates are higher (around 4.5 percentage points) in counties with high rates of disability and DI receipt than those with lower rates of disability and DI receipt. We also find that counties with high rates of disability and DI receipt have lower average food costs, but more limited access to food sources than counties with lower rates of disability and DI receipt.[7]

Map 1 shows the geographic patterns of food insecurity in counties above and below the 75th percentile of the DI receipt distribution). Mirroring other findings[8], high-DI receipt counties (shown in shades of blue)—and the associated high rates of food insecurity—tend to be clustered in the southeastern part of the United States and in the Appalachia region in southern West Virginia and eastern Kentucky. We also see that most counties in Maine are considered high-DI receipt counties, as are many counties in Michigan and New Mexico. Counties in yellow are those with lower-DI receipt (i.e., rates of DI receipt below the 75th percentile). They are scattered throughout the country and include several counties with high rates of food insecurity located along the Arizona-New Mexico border and in South Dakota.

On average, there are only 2.69 food establishments per 1,000 residents in counties with high rates of DI receipt, but 2.99 food establishments per 1,000 residents in counties with lower rates of DI receipt (Table 1). Differences in access to food establishments are more pronounced when considering the number per square mile. On average, there are only 0.24 food establishments per square mile in counties with high rates of DI receipt, but 1.19 food establishment per square mile in counties with lower rates of DI receipt. High DI areas have fewer food options to support the size of their population and their food options are more spread

[7] Of course, *average* food costs are not the same as *relative* food costs. Although the food price data included in the model takes national meal costs and local area tax rates into account, two counties with the same average food costs will have different relative costs if one county is wealthier than the other.
[8] See Schimmel Hyde et al. (2020, 2021).

out than in lower DI areas. This may be especially challenging if those with disabilities have limited mobility and limited transportation options.

We look at the total number of food establishments in each county in Map 2, distinguishing between high- and lower-DI receipt counties. Here, high-DI receipt counties (again in shades of blue) have fewer total food establishments per person and vary slightly across the country. Most counties (599 or 76 percent of all these counties) have between 2 and 4 total food establishments per 1,000 people. Lower-DI receipt counties have more food establishments overall as well as more counties with more establishments—there are 217 counties (or 9 percent of the total) that have between 4 and 6 establishments per 1,000 people.

In addition to having more limited access to food establishments, Table 1 shows that counties with high rates of disability and DI receipt have a different mix of food establishments than other counties. They have more convenience stores and gas stations and fewer full-service restaurants per 1,000 residents than counties with lower rates of DI receipt. Counties with high rates of disability and DI receipt also have more small grocery stores (fewer than 50 employees), which are likely to have more limited food options, than counties with lower rates of DI receipt. This disparity in healthy food options is more evident in Table 2, which shows the distribution of food establishments. In counties with high rates of disability and DI receipt, food establishments are more likely to be small grocery stores, convenience stores, and gas stations, and less likely to be larger grocery stores and full-service restaurants. Next, we compare the share of all food establishments that are likely to provide more healthy food options, which we classify as larger grocery stores, warehouse clubs, full-service restaurants, and department stores, with all those that are likely to have more unhealthy food options, including smaller grocery stores, convenience stores, limited-service restaurants, pharmacies, and gas stations. Among all food establishments, the bottom panel of Table 2 shows that 59.1 percent of establishments fall in the "likely unhealthy" group and 32.3 percent fall in the "likely healthy" group in counties with a high percentage of DI beneficiaries.[9] In contrast, 45.5 percent are "likely unhealthy", and 40.5 percent are "likely healthy" in counties with a lower percentage of DI beneficiaries.

[9] We believe our definition of "likely healthy" and "likely unhealthy" food establishments follows conventional wisdom and there is some evidence in the literature (e.g., Bonanno and Li (2015) and the citations within Treuhaft, Karpyn (2010)) to support this taxonomy. Of course, changing these classifications—or having even better data on the exact types of foods provided in each type of establishment—might affect our conclusions. Small grocery stores may be the exception to this classification because they often offer a wider variety of foods than gas stations but may still not be able to offer a full array of healthy foods such as fruits, vegetables, and lean proteins.

In Map 3, we take a closer look at these "likely unhealthy" food establishments around the country, again distinguishing between the two DI density categories. Here, we see an especially high density of these establishments in the high-DI counties (the darkest blue colors), particularly in the Appalachia region of the country, as well as in parts of Arkansas, Mississippi, and Alabama. There is a scattering of counties with a high concentration of unhealthy establishments across the country, especially in pockets in Ohio and Alaska, and running vertically through the center of the country.

These same patterns generally hold even accounting for differences in the urbanization of counties. With one exception, food availability and accessibility are more limited in both "rural" and urban/micropolitan counties with high disability and DI receipt than in those with lower disability and DI receipt (Table 3). The exception is that there are significantly more total food establishments per square mile in "rural" counties with high rates of DI receipt than in "rural" counties with lower DI rates. The largest difference between these two types of counties is in full-service restaurants—we find there are 1.26 full-service restaurants per 1,000 residents in "rural" counties compared with 0.88 full-service restaurants per 1,000 residents in urban/micropolitan counties. Also note that differences in the availability (i.e., per capita) of food establishments by high and lower disability and DI rates are larger in "rural" counties than in urban/micropolitan counties, while differences in the accessibility (i.e., per square mile) of food establishments by disability and DI rates are larger in urban/micropolitan counties than in "rural" counties.

Table 4 shows the distribution of food establishments for counties with high and lower rates of disability and DI receipt and how the distribution varies for "rural" and urban/micropolitan counties. As before, we find that counties with a high prevalence of disability and DI receipt have a larger percentage of food establishments that are likely unhealthy and a smaller percentage of food establishments that are likely healthy. However, these differences are significantly more pronounced in urban/micropolitan counties than in "rural" counties. In urban/micropolitan counties, for example, food establishments that are likely unhealthy account for 58.8 percent of all food establishments in counties with high rates of DI receipt and 45.3 percent of all food establishments in counties with lower rates of DI receipt—a difference of 13.5 percentage points. In "rural" counties, food establishments that are likely unhealthy account for 59.8 percent of all food establishments in counties with high rates of DI

receipt and 50.5 percent of all food establishments in counties with lower rates of DI receipt—a difference of 9.4 percentage points.

What we do not know from these tabulations and the forthcoming regression analysis, is *where* people eat food or do their food shopping. While we can identify the specific addresses of the food establishments in our data, we do not know the specific addresses of people with disabilities (or receiving DI), so we cannot see exactly where people need to travel to make their food purchases. This is potentially important because we do not know if people are crossing county lines to do their food shopping and whether that behavior is more or less likely in rural or urban areas. Again, this is an area ripe for further research—by combining SSA administrative data on DI receipt, which presumably has address information of DI beneficiaries, with our IDB data, we could at least get a better sense of *specific* access and availability to food establishments.

Regression Results

Previous literature has confirmed the relationship between disability and food insecurity. Our descriptive results also suggest a relationship between disability or DI receipt, and food access. Next, we consider the relationship between disability and food insecurity, controlling for access to food and other factors. Table 5 presents the coefficients from fixed effects models of the county-level disability rate for the primary variables of interest (see Appendix Table A2 for the full results). Models 1-3 use the number of food establishments per 1,000 residents and models 4-6 use the number of food establishments per square mile. As in previous studies, we find a positive correlation between food insecurity and disability. Regarding the availability (supply) of food establishments, Model 1 shows that small grocery stores and department stores are positively and significantly correlated, and warehouse clubs are negatively and significantly correlated with disability rates (shaded cells). However, "rural" counties appear to drive these results (Model 2). For urban/micropolitan counties, in contrast, convenience stores, limited-service restaurants, and gas stations are positively correlated with disability rates (Model 3).[10]

Regarding the accessibility (location) of food establishments, Model 4 shows a positive association with disability rates for convenience stores and limited-service restaurants, and a

[10] We also estimated the main regressions (Table 5) by dropping the bottom and top 1 percent of counties ranked by the population in 2019. Those results were largely similar to the ones reported here.

negative association with disability rates for warehouse clubs and full-service restaurants. Somewhat surprising is that large grocery stores are also positively and significantly correlated with disability rates. This finding could be due to any number of factors including access to transportation and the location of these establishments; additional research could explore specific areas in greater detail to see how transportation access and availability may affect these results. Again, there are some notable differences between "rural" and urban/micropolitan counties. Accessibility to convenience stores and gas stations is positively correlated with disability rates in "rural" counties, but not in urban/micropolitan counties. In urban/micropolitan counties, limited-service restaurants are positively correlated with disability and full-service restaurants are negatively correlated with disability. In contrast, restaurant location is not correlated with disability in "rural" counties.

Table 6 presents the coefficients from fixed effects models of DI receipt (see Appendix Table A3 for the full results). Again, models 1-3 use the number of food establishments per 1,000 residents and models 4-6 use the number of food establishments per square mile. It is interesting to note that food insecurity is correlated with DI participation overall and in urban/micropolitan counties, but it is uncorrelated with DI participation in "rural" counties. Turning to the coefficients on food establishments, we generally find smaller point estimates and fewer that are statistically significant than in the models of disability rates (table 5); however, most of the signs on the coefficients are the same between the models. As noted previously, there is no reason to expect the results to be the same because the disability and DI populations and the underlying data sources differ.

Model 1 shows that the availability of small grocery stores, convenience stores, other restaurants (such as buffets), and gas stations is positively and significantly associated with the county-level DI beneficiary rate, while the supply of large grocery stores is negatively and significantly associated with rates of DI receipt. "Rural" counties seem to be the main driver of these results as is evidenced by Model 2. In contrast, small grocery stores and other restaurants are the only food establishments that are correlated (positively) with the share of DI beneficiaries in urban/micropolitan counties (Model 3).

Regarding accessibility, small grocery stores and gas stations are the only food establishments associated (positively) with the share of DI beneficiaries (Model 4). As with disability (table 5), we find large differences between "rural" and urban/micropolitan counties.

Notably, we find that access to food establishments is more highly correlated with the DI beneficiary rate in "rural" counties than in urban/micropolitan counties. In "rural" counties, small grocery stores and gas stations have a significant positive relationship with rates of DI receipt, while large grocery stores, specialty grocery stores, and full-service restaurants have a significant negative relationship with rates of DI receipt. Unexpected is that pharmacies also have a statistically significant negative relationship with rates of DI receipt in "rural" counties.

Select County Profiles

Table 7 profiles the disability, DI receipt, and food establishments of several illustrative counties across the country in 2019. They range in population and area from Los Angeles, CA, which is large in both population and area to Billings, ND, which is small in population, and to Hickman, KY, which is small in area. We explore these counties only to demonstrate the variation in the different components of this analysis and how a more detailed look at specific areas of the country (requiring, of course, more geographically detailed disability and DI data) could provide greater insight into the challenges people with disabilities face accessing healthy foods.

Among the counties profiled, Hickman, KY has the highest percentage of residents with disabilities (24.3 percent) and the highest percentage of DI beneficiaries (6.2 percent). It also has the highest food insecurity rate (14.3 percent) and the lowest average cost per meal ($2.79). Consistent with our previous findings, it also has a relatively limited number of food establishments—only 2.44 food establishments per 1,000 residents and 0.05 food establishments per square mile. Not only are the availability and accessibility of food establishments limited, but more than half (54.5 percent) of them likely provide mostly unhealthy food options. Of the 11 food establishments we identify in this county, more than half are small grocery stores, conveniences stores, limited-service restaurants, and gas stations. Again, we do not know what kind of food these establishments sell; however, because of their size or the nature of their primary business (e.g., selling gasoline), it seems likely that their food selection is fairly limited and primarily convenient—qualities often associated with unhealthy foods.

In contrast, Billings, ND has a lower-than-average disability rate (13.8 percent) and very low DI rate (0.5 percent). Its food insecurity rate is the lowest of the counties profiled (5.6 percent) and its average cost per meal is the highest ($3.70). It has the largest supply of food

establishments (13.02 per 1,000 residents) but is one of the least food accessible (0.01 food establishments per square mile). Yet only a quarter (25.0 percent) of its food establishments are likely unhealthy.

Los Angeles, CA and Providence, RI—the two largest counties we include—sit somewhere in the middle of these other two counties. About 10 percent of people in Los Angeles have a disability but only 1.5 percent are receiving DI benefits. The percentage point gap between the share of people with disabilities and the DI award rate are lower in these two counties than across the country or in the other two counties we identified. Compared with the country as a whole, both counties have more food establishments per capita (3.26 and 3.15, compared with 2.92) and per square mile (8.11 and 4.89 compared with 0.95). While the share of likely unhealthy food establishments in Providence is on par with the nation (39.8 versus 38.9 percent), it is significantly lower in Los Angeles (30.6 percent).

Figure 1 shows the positive association between rates of food insecurity and DI beneficiaries for all counties in the country with these selected counties highlighted in yellow.

Discussion

With nearly 10 million people receiving DI benefits, 35 million Americans estimated to be food insecure, and 34 million people in poverty in 2019, there is a clear and obvious need to understand better how these factors are linked together. In this paper, we capture more accurately the relationship between disability and food insecurity by accounting for *access* to food using two measures and a unique data set of food establishments that is more up to date than other publicly available data sources. We find that counties with a large share of residents with disabilities and high DI participation are also limited in their availability and accessibility to food establishments. These same counties also have a larger share of food establishments that likely provide mostly unhealthy food options, based on the assumption that certain categories of food outlets have limited availability of fruits, vegetables, lean proteins, and dairy and a greater abundance of snack foods and sugar-sweetened beverages. Importantly, we find a strong correlation between disability and food insecurity even after controlling for access to food. A 1 percentage point increase in the food insecurity rate is correlated with a 0.961 percentage point (6.1 percent) increase in the disability rate and a 0.012 percentage point (0.3 percent) increase in the DI beneficiary rate.

Understanding the areas in which high rates of disability and access to food or food insecurity are concentrated may highlight the potential for targeted interventions that could assist workers, families, and children. SSA, as well as the USDA and various nonprofit and other stakeholder groups, could use this information to target both pre- *and* post-entitlement supports for affected people and communities.

Our multivariate analysis sheds some light on the relationship between disability and food insecurity. The models incorporate predictors that are readily available from public sources as well as the restricted InfoGroup data that contains location-specific information on food establishments across the country. *It is important to note that we assign a correlation interpretation to our results and do not make any claims about causality in the outcomes that we observe.*

There are caveats to this analysis that are worth considering. First, our measures of food access, food insecurity, and food prices are incomplete. We are not able to look consistently at affordability *and* accessibility of healthy foods. In some cases, such as large grocery stores, we assume that they are better able to carry healthier foods, but we are unable to say much about their affordability with our data. In other cases, such as fast-food restaurants, we assume that they carry both less healthy and more affordable foods. Second, any comparisons along the metric of affordability are incomplete—comparing affordability of restaurants to grocery stores, for example, is more complicated than a simple price comparison. Third, there are a slew of unmeasured factors that we have not accounted for in our modeling including, for example, administrative policies in the DI program, or factors that might be difficult to measure systematically such as social networks or access to food banks.

As such, it may be important to extend the work conducted here along several dimensions. First, better, more consistent data measured at a more granular geographic level (e.g., administrative SSA data with specific addresses for DI beneficiaries) could generate more accurate accessibility information. Second, data on different types of disabilities could be used to improve our understanding of *who* is applying for DI benefits and how those types of disabilities (and health status more generally) are correlated with measures of food insecurity. Third, other measures of access to food (especially healthy food) such as access to food banks and other nonprofits, as well as rates of program uptake, would broaden the perspective on the nutrition safety net for needy families. And finally, incorporating qualitative information would

add richness to the analysis—speaking with disability and nutrition advocates, state and local program administrators, and, of course, people with disabilities, and people and families who are food insecure.

Conclusion

In this paper, we account for *access* to food—by measuring the availability and accessibility of food stores and restaurants within each county—in the relationship between rates of disability and DI beneficiaries, and food insecurity. In general, we find that counties having a large share of residents with disabilities or high rates of DI beneficiaries are also limited in their availability and accessibility to food establishments. Digging deeper, we find that these same counties also have a larger share of food establishments that likely provide unhealthy food options. These include small grocery stores, convenience stores, limited-service restaurants, pharmacies, and gas stations. We find a strong correlation between many of these types of food establishments and disability and DI beneficiary rates. Importantly, we find a strong correlation between disability and food insecurity even after controlling for access to food. Our results should not be interpreted through a causal lens, however, as they only indicate a correlation between these factors. Linked data, more geographically-specific data, and more information on specific types of disabilities would all be ways to extend this line of research.

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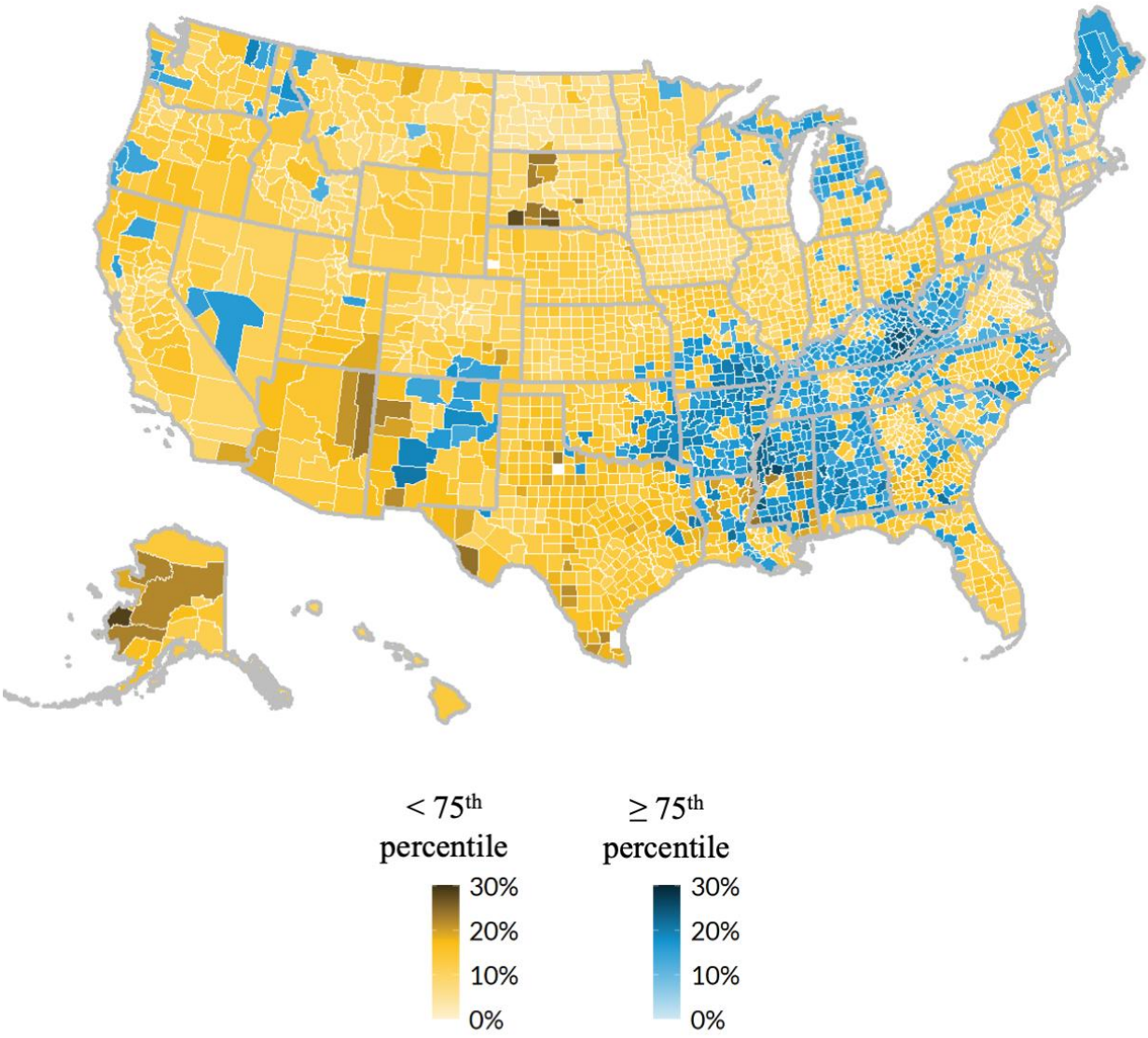
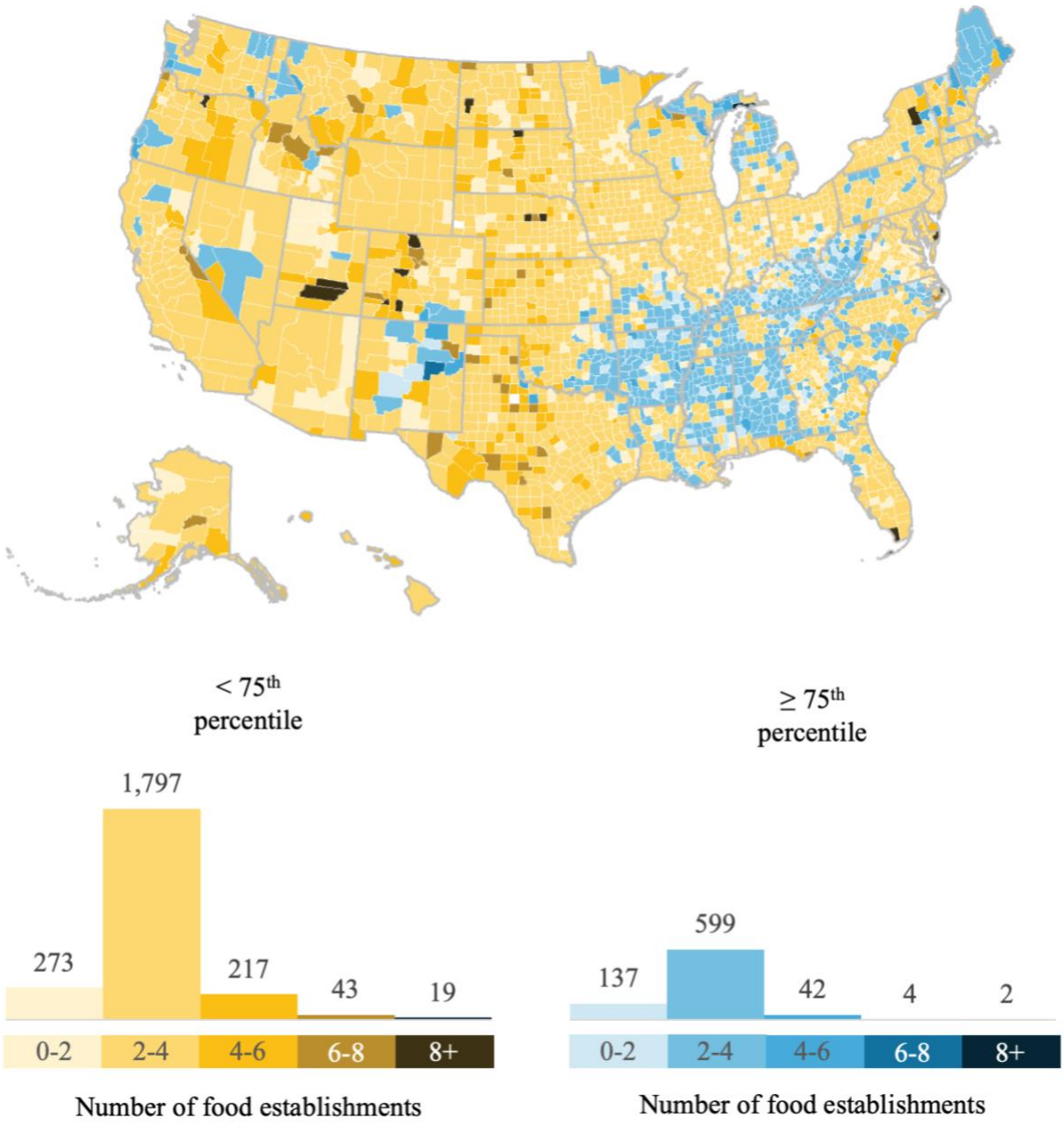
Maps

Map 1. *Percentage of County-Level Food Insecure Residents in 2019, by Areas with Low and High Rates of DI Receipt*



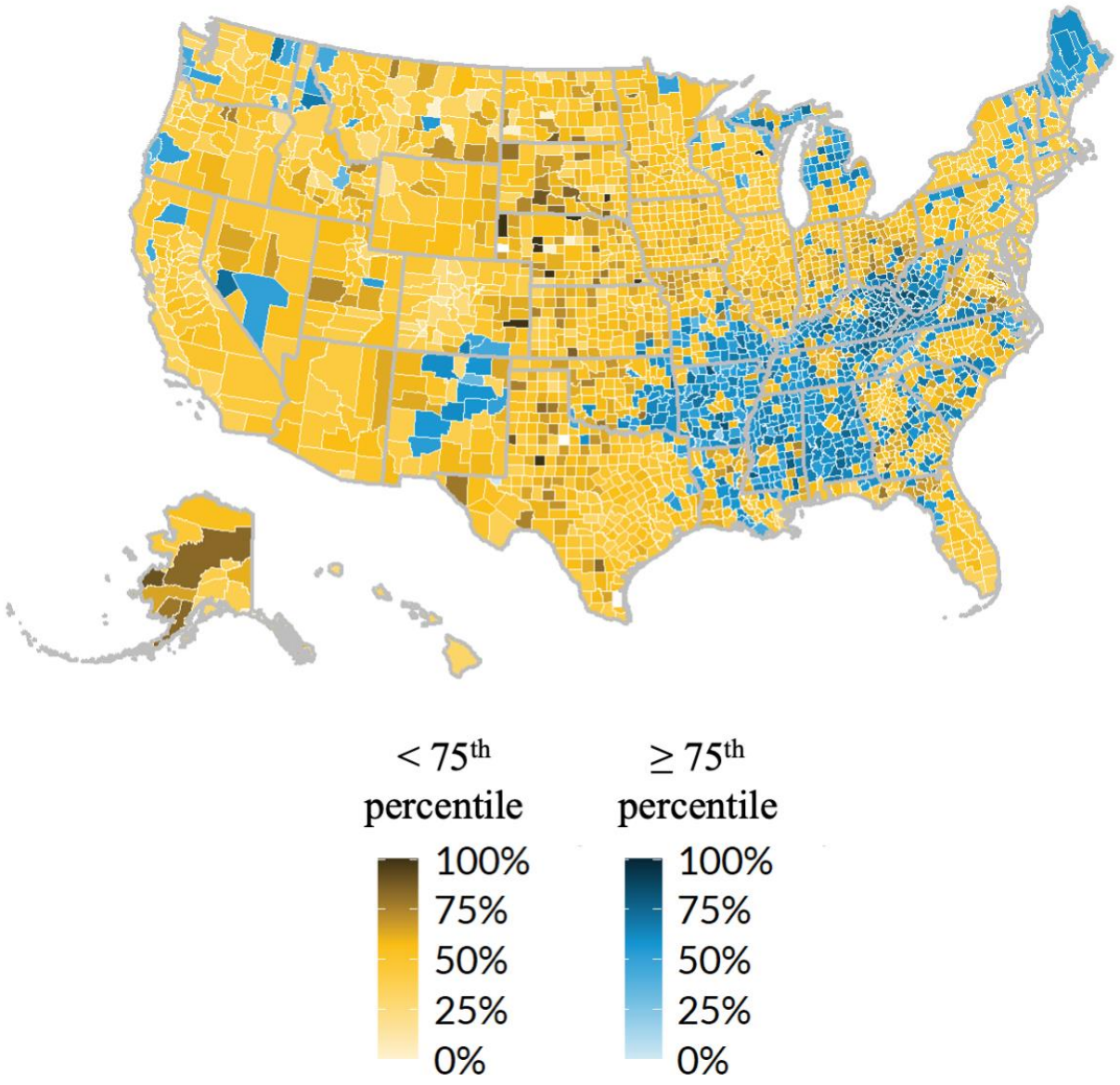
Note: Percentiles based on the distribution of rates of disability or DI receipt awards across the country.
Source: Authors' calculations using merged data. See text for details.

Map 2. *Number of Food Establishments (per 1,000 people) in 2019, by Areas with Low and High Rates of DI Receipt*



Note: Percentiles based on the distribution of rates of disability or DI receipt awards across the country.
Source: Authors' calculations using merged data. See text for details.

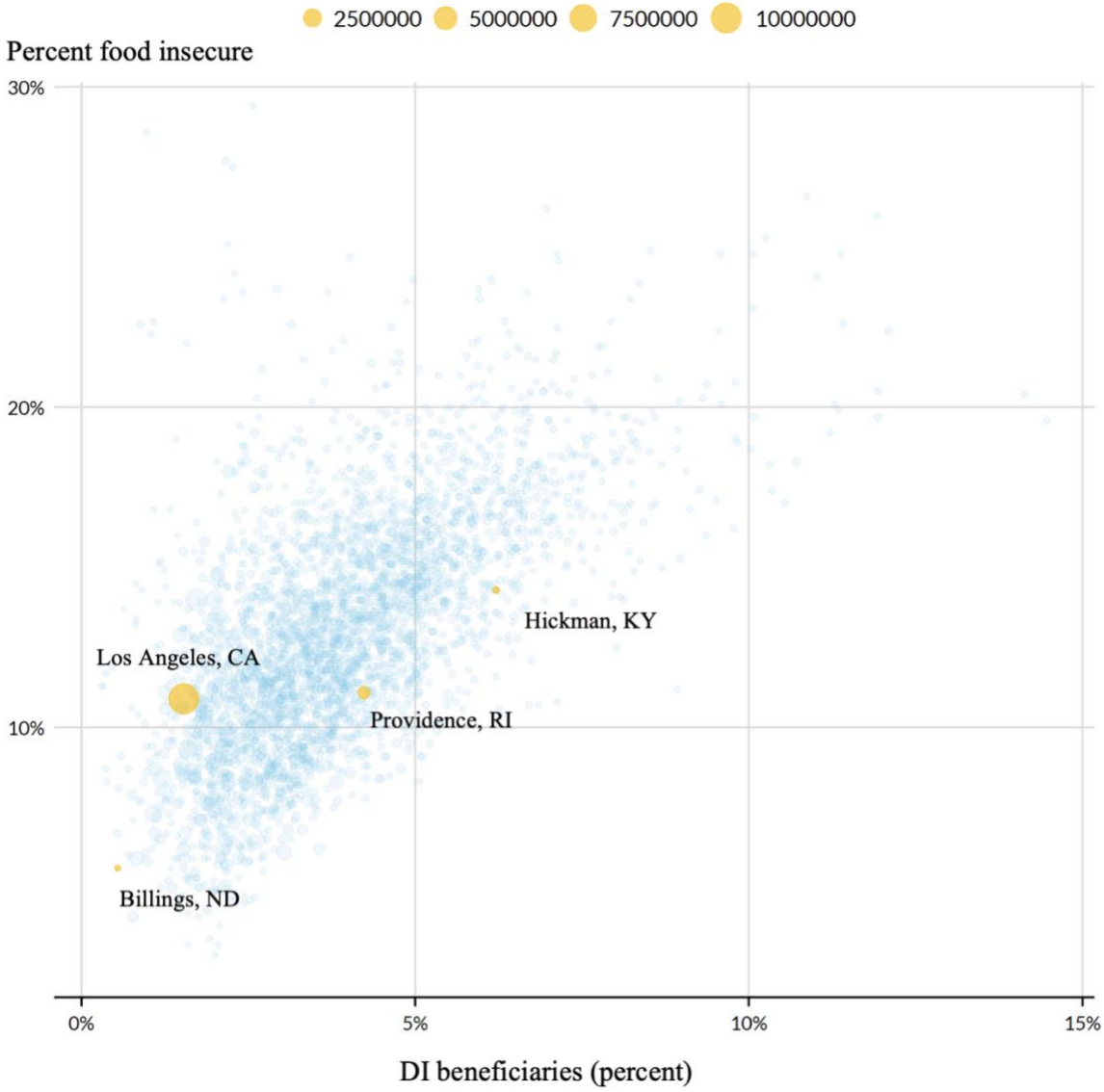
Map 3. *Percentage of Food Establishments That Are "Likely Unhealthy" in 2019, by Areas with Low and High Rates of DI Receipt*



Note: Percentiles based on the distribution of rates of disability or DI receipt awards across the country. "Likely Unhealthy" establishments are defined as grocery stores with fewer than 50 employees; convenience stores; limited-service restaurants; pharmacies; and gas stations.
Source: Authors' calculations using merged data. See text for details.

Figure

Figure 1. *DI Beneficiary Rate and Food Insecurity is Positively Associated*



Note: Size of circle represents population in each county; yellow circles represent those counties listed in Table 7.
Source: Author's calculations using data from the U.S. Social Security Administration and Feeding America.

Tables

Table 1. *County-Level Food Statistics in 2019, by Areas with Low and High Rates of Disability and DI Receipt*

	% Disabled		% DI Beneficiaries	
	< 75th Percentile	**≥ 75th Percentile**	**< 75th Percentile**	**≥ 75th Percentile**
% Food Insecure	12.0%	16.6%	12.0%	16.5%
Mean Cost Per Meal	$3.22	$3.08	$3.22	$3.07
Number Per 1,000 Residents				
Grocery	0.31	0.38	0.32	0.35
< 50 Employees	0.27	0.34	0.28	0.31
50+ Employees	0.05	0.04	0.05	0.04
Missing	0.00	0.00	0.00	0.00
Grocery Other	0.15	0.11	0.16	0.10
Convenience Store	0.32	0.38	0.33	0.37
Warehouse Club	0.00	0.00	0.00	0.00
Restaurant Full Service	1.05	0.93	1.08	0.84
Restaurant Limited Service	0.71	0.65	0.70	0.68
Restaurant Other	0.18	0.12	0.19	0.10
Department Store	0.01	0.01	0.01	0.01
Pharmacy	0.02	0.02	0.02	0.02
Gas Station	0.19	0.25	0.19	0.23
Total Food Establishments	**2.94**	**2.84**	**2.99**	**2.69**
Number Per Square Mile				
Grocery	0.11	0.02	0.10	0.03
< 50 Employees	0.09	0.02	0.09	0.02
50+ Employees	0.02	0.00	0.02	0.00
Missing	0.00	0.00	0.00	0.00
Grocery Other	0.06	0.01	0.06	0.01
Convenience Store	0.07	0.02	0.07	0.03
Warehouse Club	0.00	0.00	0.00	0.00
Restaurant Full Service	0.53	0.05	0.52	0.07
Restaurant Limited Service	0.31	0.05	0.30	0.08
Restaurant Other	0.11	0.01	0.10	0.01
Department Store	0.00	0.00	0.00	0.00
Pharmacy	0.01	0.00	0.01	0.00
Gas Station	0.02	0.01	0.02	0.02
Total Food Establishments	**1.22**	**0.16**	**1.19**	**0.24**

Notes: Percentiles defined on the distribution of DI awards across the country. Shaded cells are those for which counties ≥ 75th percentile are greater than for counties < 75th percentile.
Source: Authors' calculations using merged data. See text for details.

Table 2. *Distribution of Food Establishments in 2019, by Areas with Low and High Rates of Disability and DI Receipt*

	% Disabled		% DI Beneficiaries	
	< 75th Percentile	**≥ 75th Percentile**	**< 75th Percentile**	**≥ 75th Percentile**
Grocery	8.5%	11.3%	8.4%	11.3%
< 50 Employees	6.6	9.7	6.6	9.6
50+ Employees	1.8	1.6	1.8	1.6
Missing	0.0	0.0	0.0	0.0
Grocery Other	5.3	4.2	5.3	4.1
Convenience Store	7.3	12.9	7.2	13.0
Warehouse Club	0.2	0.0	0.2	0.1
Restaurant Full Service	38.1	31.6	38.3	30.3
Restaurant Limited Service	27.8	26.8	27.7	28.4
Restaurant Other	8.6	4.5	8.6	4.6
Department Store	0.2	0.3	0.2	0.3
Pharmacy	1.2	0.9	1.2	1.0
Gas Station	2.9	7.4	2.8	7.1
Total Food Establishments	100.0	100.0	100.0	100.0

	% Disabled		% DI Beneficiaries	
	< 75th Percentile	**≥ 75th Percentile**	**< 75th Percentile**	**≥ 75th Percentile**
Likely Healthy	40.3%	33.5%	40.5%	32.3%
Likely Unhealthy	45.8%	57.7%	45.5%	59.1%
Unknown	13.9%	8.8%	14.0%	8.6%

Notes: Percentiles based on the distribution of rates of disability or DI receipt across the country. "Likely Healthy" establishments are defined as grocery stores with 50 or more employees; warehouse clubs; and full-service restaurants. "Likely Unhealthy" establishments are defined as grocery stores with fewer than 50 employees; convenience stores; limited-service restaurants; pharmacies; and gas stations. Shaded cells are those for which counties ≥ 75th percentile are greater than for counties < 75th percentile.
Source: Authors' calculations using merged data. See text for details.

Table 3. *County-Level Food Statistics in 2019, by Areas with Lower and High Rates of Disability and DI Receipt and by "Rural" and Urban/Micropolitan*

	% Disabled				**% DI Beneficiaries**			
	"Rural"		**Urban/Micropolitan**		**"Rural"**		**Urban/Micropolitan**	
	< 75th Percentile	**≥ 75th Percentile**	**< 75th Percentile**	**≥ 75th Percentile**	**< 75th Percentile**	**≥ 75th Percentile**	**< 75th Percentile**	**≥ 75th Percentile**
%Food Insecure	12.2%	16.9%	11.9%	16.2%	12.5%	17.0%	11.8%	15.8%
Cost Per Meal	$3.20	$3.07	$3.23	$3.10	$3.20	$3.07	$3.24	$3.07
Number Per 1,000 Residents								
Grocery	0.45	0.42	0.24	0.30	0.47	0.38	0.24	0.31
< 50 Employees	0.41	0.39	0.19	0.26	0.43	0.35	0.19	0.27
50+ Employees	0.04	0.03	0.05	0.04	0.04	0.03	0.05	0.04
Missing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grocery Other	0.17	0.12	0.14	0.10	0.18	0.11	0.15	0.09
Convenience Store	0.40	0.41	0.28	0.34	0.41	0.39	0.28	0.35
Warehouse Club	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Restaurant Full Service	1.22	0.99	0.95	0.82	1.26	0.88	0.96	0.79
Restaurant Limited Service	0.58	0.61	0.78	0.70	0.58	0.63	0.77	0.73
Restaurant Other	0.16	0.12	0.19	0.11	0.17	0.09	0.20	0.10
Department Store	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Pharmacy	0.01	0.01	0.03	0.02	0.01	0.02	0.03	0.02
Gas Station	0.27	0.28	0.14	0.21	0.28	0.26	0.14	0.20
Total Food Establishments	**3.27**	**2.97**	**2.76**	**2.62**	**3.35**	**2.76**	**2.77**	**2.60**

Table 3. *County-Level Food Statistics in 2019, by Areas with Lower and High Rates of Disability and DI Receipt and by "Rural" and Urban/Micropolitan (continued)*

	"Rural"		Urban/Micropolitan		"Rural"		Urban/Micropolitan	
	< 75th Percentile	**≥ 75th Percentile**	**< 75th Percentile**	**≥ 75th Percentile**	**< 75th Percentile**	**≥ 75th Percentile**	**< 75th Percentile**	**≥ 75th Percentile**
Number Per Square Mile								
Grocery	0.01	0.01	0.16	0.03	0.01	0.02	0.17	0.04
< 50 Employees	0.01	0.01	0.14	0.02	0.01	0.02	0.14	0.03
50+ Employees	0.00	0.00	0.02	0.01	0.00	0.00	0.03	0.01
Missing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grocery Other	0.00	0.00	0.09	0.01	0.00	0.00	0.10	0.01
Convenience Store	0.01	0.01	0.10	0.04	0.01	0.02	0.10	0.05
Warehouse Club	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Restaurant Full Service	0.04	0.03	0.79	0.09	0.03	0.04	0.82	0.11
Restaurant Limited Service	0.03	0.02	0.46	0.09	0.02	0.04	0.47	0.11
Restaurant Other	0.00	0.00	0.16	0.01	0.00	0.00	0.17	0.02
Department Store	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pharmacy	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.00
Gas Station	0.01	0.01	0.03	0.02	0.00	0.01	0.03	0.02
Total Food Establishments	**0.10**	**0.09**	**1.83**	**0.30**	**0.07**	**0.15**	**1.88**	**0.36**

Notes: Percentiles defined on the distribution of DI awards across the country. Shaded cells are those for which counties ≥ 75th percentile are greater than for counties < 75th percentile.
Source: Authors' calculations using merged data. See text for details.

Table 4. *Distribution of Food Establishments in 2019, by Areas with Lower and High Rates of Disability and DI Receipt and by "Rural" and Urban/Micropolitan*

	% Disabled				% DI Beneficiaries			
	"Rural"		Urban/Micropolitan		"Rural"		Urban/Micropolitan	
	< 75th Percentile	≥ 75th Percentile	< 75th Percentile	≥ 75th Percentile	< 75th Percentile	≥ 75th Percentile	< 75th Percentile	≥ 75th Percentile
Grocery	11.5%	12.9%	8.3%	10.2%	11.4%	13.3%	8.3%	10.4%
< 50 Employees	9.9	11.5	6.5	8.5	9.7	11.9	6.4	8.6
50+ Employees	1.6	1.4	1.9	1.7	1.6	1.4	1.9	1.8
Missing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grocery Other	5.9	4.4	5.3	4.1	5.9	4.2	5.3	4.
Convenience Store	12.2	13.9	7.2	12.2	12.1	14.2	7.0	12.5
Warehouse Club	0.0	0.0	0.2	0.1	0.0	0.0	0.2	0.1
Restaurant Full Service	36.1	32.1	38.1	31.3	36.6	31.	38.3	30.
Restaurant Limited Service	21.5	23.4	28.	29.1	21.	24.3	28.	30.1
Restaurant Other	4.9	3.8	8.7	5.	5.2	3.3	8.8	5.1
Department Store	0.2	0.3	0.2	0.2	0.2	0.4	0.2	0.2
Pharmacy	0.5	0.6	1.2	1.1	0.5	0.7	1.2	1.2
Gas Station	7.3	8.5	2.7	6.7	7.2	8.7	2.7	6.4
Total Food Establishments	100.	100.	100.	100.	100.	100.	100.	100.

	% Disabled				% DI Beneficiaries			
	"Rural"		Urban/Micropolitan		"Rural"		Urban/Micropolitan	
	< 75th Percentile	≥ 75th Percentile	< 75th Percentile	≥ 75th Percentile	< 75th Percentile	≥ 75th Percentile	< 75th Percentile	≥ 75th Percentile
Likely Healthy	37.9%	33.8%	40.4%	33.3%	38.4%	32.7%	40.6%	32.1%
Likely Unhealthy	51.3%	58.0%	45.6%	57.5%	50.5%	59.8%	45.3%	58.8%
Unknown	10.8%	8.2%	14.0%	9.1%	11.2%	7.5%	14.1%	9.1%

Notes: Percentiles based on the distribution of rates of disability or DI receipt awards across the country. "Likely Healthy" establishments are defined as grocery stores with 50 or more employees; warehouse clubs; and full-service restaurants. "Likely Unhealthy" establishments are defined as grocery stores with fewer than 50 employees; convenience stores; limited-service restaurants; pharmacies; and gas stations. Shaded cells are those for which counties ≥ 75th percentile are greater than for counties < 75th percentile.

Source: Authors' calculations using merged data. See text for details.

Table 5. *Fixed Effects Regression Results of the County-Level Disability Rate*

	Uses Number of Food Establishments Per 1,000 Residents			Uses Number of Food Establishments Per Square Mile		
	All	**"Rural"**	**Urban/ Micropolitan**	**All**	**"Rural"**	**Urban/ Micropolitan**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Grocery Size < 50 Employees	0.003*	0.003	0.005	-0.001	-0.021	0.000
	(0.002)	(0.002)	(0.004)	(0.001)	(0.021)	(0.001)
Grocery Size 50+ Employees	-0.001	-0.002	-0.000	0.009**	-0.047	0.011**
	(0.005)	(0.007)	(0.008)	(0.004)	(0.040)	(0.004)
Grocery Size Missing	0.069	0.025	0.141*	0.181***	3.230	0.137**
	(0.046)	(0.041)	(0.081)	(0.060)	(3.437)	(0.058)
Grocery Other	0.002	0.003	-0.002	-0.002	0.012	-0.002**
	(0.002)	(0.002)	(0.004)	(0.001)	(0.009)	(0.001)
Convenience Store	0.000	-0.001	0.005**	0.006*	0.035**	0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.017)	(0.002)
Warehouse Club	-0.082***	-0.073**	-0.086	-0.081**	-2.763***	-0.070*
	(0.028)	(0.031)	(0.055)	(0.038)	(0.748)	(0.039)
Restaurant Full Service	0.000	0.000	0.001	-0.000**	0.003	-0.000***
	(0.001)	(0.001)	(0.002)	(0.000)	(0.003)	(0.000)
Restaurant Limited Service	-0.001	-0.004	0.004*	0.002**	0.001	0.002**
	(0.002)	(0.002)	(0.002)	(0.001)	(0.013)	(0.001)
Restaurant Other	-0.002	-0.002	-0.002	0.002	-0.009	0.001
	(0.002)	(0.003)	(0.003)	(0.003)	(0.014)	(0.002)
Department Store	0.024***	0.026***	0.019	0.013	0.775	0.000
	(0.007)	(0.008)	(0.017)	(0.019)	(0.569)	(0.018)
Pharmacy	0.017	0.003	0.020	-0.004	0.073*	-0.004*
	(0.010)	(0.017)	(0.012)	(0.003)	(0.038)	(0.002)
Gas Station	0.002	0.001	0.006*	0.006	0.075***	-0.002
	(0.002)	(0.002)	(0.003)	(0.009)	(0.028)	(0.007)
% Food Insecure	0.961***	0.935***	1.005***	0.963***	0.941***	1.001***
	(0.034)	(0.047)	(0.041)	(0.035)	(0.048)	(0.041)
Cost Per Meal	-0.000	-0.002	0.001	-0.000	-0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R-Squared	0.284	0.260	0.340	0.282	0.260	0.336
N	31,330	13,290	18,040	31,330	13,290	18,040

Notes: All regressions include demographic and socioeconomic controls, year fixed effects, and county fixed effects. Shaded cells are statistically significant results for the food establishment variables. See Appendix Table A3 for full regression results. (*p < 0.10, **p < 0.05, ***p < 0.01) Shaded cells are statistically significant results for the food establishment, food insecurity, and food cost variables.

Source: Authors' calculations using merged data. See text for details.

Table 6. *Fixed Effects Regression Results of the County-Level Rate of DI Receipt*

	Uses Number of Food Establishments Per 1,000 Residents			Uses Number of Food Establishments Per Square Mile		
	All	**"Rural"**	**Urban/ Micropolitan**	**All**	**"Rural"**	**Urban/ Micropolitan**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Grocery Size < 50 Employees	0.001***	0.001***	0.003***	0.001*	0.020***	0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.005)	(0.000)
Grocery Size 50+ Employees	-0.002*	-0.002*	-0.001	-0.001	-0.016***	-0.001
	(0.001)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)
Grocery Size Missing	0.001	0.002	-0.000	-0.011	0.204	-0.004
	(0.004)	(0.004)	(0.011)	(0.016)	(0.220)	(0.016)
Grocery Other	0.000	0.000	0.000	-0.000	-0.010***	-0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.004)	(0.000)
Convenience Store	0.001**	0.001**	0.000	-0.000	0.007	-0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.004)	(0.001)
Warehouse Club	-0.005	-0.007	-0.006	-0.006	-0.188	-0.008
	(0.008)	(0.013)	(0.007)	(0.006)	(0.425)	(0.006)
Restaurant Full Service	0.000	0.000	-0.000	-0.000	-0.004***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Restaurant Limited Service	-0.000	-0.000	-0.001	-0.000	0.001	-0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.003)	(0.000)
Restaurant Other	0.002***	0.002***	0.003***	-0.000	0.001	-0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.003)	(0.000)
Department Store	-0.003	-0.004	-0.007	-0.009	-0.262	-0.007
	(0.003)	(0.002)	(0.009)	(0.013)	(0.168)	(0.014)
Pharmacy	0.001	-0.000	0.003	0.000	-0.016**	0.001
	(0.002)	(0.003)	(0.002)	(0.001)	(0.007)	(0.001)
Gas Station	0.001***	0.001***	0.001	0.003*	0.013**	0.002
	(0.000)	(0.000)	(0.001)	(0.002)	(0.007)	(0.002)
% Food Insecure	0.012**	0.003	0.027***	0.012**	0.004	0.027***
	(0.005)	(0.007)	(0.007)	(0.005)	(0.007)	(0.007)
Cost Per Meal	0.001***	0.001***	0.000***	0.001***	0.001***	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-Squared	0.266	0.186	0.414	0.260	0.181	0.405
N	31,330	13,290	18,040	31,330	13,290	18,040

Notes: All regressions include demographic and socioeconomic controls, year fixed effects, and county fixed effects. Shaded cells are statistically significant results for the food establishment, food insecurity, and food cost variables. See Appendix Table A3 for full regression results. (*p < 0.10, **p < 0.05, ***p < 0.01).

Source: Authors' calculations using merged data. See text for details.

Table 7. *Place Characteristics of Illustrative Counties in 2019*

	Average Over All Counties	Los Angeles, CA	Hickman, KY	Billings, ND	Providence, RI
FIPS code		6037	21105	38007	44007
Population	103,630	10,100,000	4,510	922	635,737
Area in Square Miles	1,118	4,059	242	1,148	409
% Disabled	16.0%	9.9%	24.3%	13.8%	13.8%
% DI Beneficiaries	4.0%	1.5%	6.2%	0.5%	4.2%
Percentage point difference	12.0	8.4	18.1	13.3	9.6
% Food Insecure	13.2%	10.9%	14.3%	5.6%	11.1%
Mean Cost Per Meal	$3.18	$3.57	$2.79	$3.70	$3.63
Food Establishments					
Total Per 1,000 Residents	2.92	3.26	2.44	13.02	3.15
Total Per Square Mile	0.95	8.11	0.05	0.01	4.89
% Total Likely Healthy	38.1%	46.2%	36.4%	58.3%	44.3%
% Total Likely Unhealthy	38.9%	30.6%	54.5%	25.0%	39.8%
% Total Unknown	8.3%	10.2%	9.1%	16.7%	15.9%

Note: "Likely Unhealthy" establishments are defined as grocery stores with fewer than 50 employees; convenience stores; limited service restaurants; pharmacies; and gas stations.
Source: Authors' calculations using merged data. See text for details.

Appendix Table A1. *Crosswalk Between NAICS Code and Food Establishment Categories Analyzed*

NAICS Code	NAICS Description	Study Category
445	**Food and Beverage Stores**	
4451	Grocery Stores	
445110	Supermarkets and Other Grocery (except Convenience) Stores	Grocery
445120	Convenience Stores	Convenience Store
4452	Specialty Food Stores	Grocery Other
722	**Food Services and Drinking Places**	
722511	Full-Service Restaurants	Restaurant Full
722513	Limited-Service Restaurants	Restaurant Limited
722514	Cafeterias, Grill Buffets, and Buffets	Restaurant Other
722515	Snack and Nonalcoholic Beverage Bars	Restaurant Other
452	**General Merchandise Stores**	
4522	Department Stores	
452210	Department Stores	Department Store
4523	General Merchandise Stores, including Warehouse Clubs and Supercenters	
452311	Warehouse Clubs and Supercenters	Warehouse Club
447	**Gasoline Stations**	
4471	Gasoline Stations	
447110	Gasoline Stations with Convenience Stores	
447190	Other Gasoline Stations	Gas Station
446	**Health and Personal Care Stores**	
4461	Health and Personal Care Stores	
446110	Pharmacies and Drug Stores	Pharmacy

Appendix Table A2. *Fixed Effects Regression Results of the County-Level Disability Rate*

	Uses Number of Food Establishments Per 1,000 Residents			**Uses Number of Food Establishments Per Square Mile**		
	All	**"Rural"**	**Urban/ Micropolitan**	**All**	**"Rural"**	**Urban/ Micropolitan**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Grocery Size < 50 Employees	0.003*	0.003	0.005	-0.001	-0.021	0.000
	(0.002)	(0.002)	(0.004)	(0.001)	(0.021)	(0.001)
Grocery Size 50+ Employees	-0.001	-0.002	-0.000	0.009**	-0.047	0.011**
	(0.005)	(0.007)	(0.008)	(0.004)	(0.040)	(0.004)
Grocery Size Missing	0.069	0.025	0.141*	0.181***	3.230	0.137**
	(0.046)	(0.041)	(0.081)	(0.060)	(3.437)	(0.058)
Grocery Other	0.002	0.003	-0.002	-0.002	0.012	-0.002**
	(0.002)	(0.002)	(0.004)	(0.001)	(0.009)	(0.001)
Convenience Store	0.000	-0.001	0.005**	0.006*	0.035**	0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.017)	(0.002)
Warehouse Club	-0.082***	-0.073**	-0.086	-0.081**	-2.763***	-0.070*
	(0.028)	(0.031)	(0.055)	(0.038)	(0.748)	(0.039)
Restaurant Full Service	0.000	0.000	0.001	-0.000**	0.003	-0.000***
	(0.001)	(0.001)	(0.002)	(0.000)	(0.003)	(0.000)
Restaurant Limited Service	-0.001	-0.004	0.004*	0.002**	0.001	0.002**
	(0.002)	(0.002)	(0.002)	(0.001)	(0.013)	(0.001)
Restaurant Other	-0.002	-0.002	-0.002	0.002	-0.009	0.001
	(0.002)	(0.003)	(0.003)	(0.003)	(0.014)	(0.002)
Department Store	0.024***	0.026***	0.019	0.013	0.775	0.000
	(0.007)	(0.008)	(0.017)	(0.019)	(0.569)	(0.018)
Pharmacy	0.017	0.003	0.020	-0.004	0.073*	-0.004*
	(0.010)	(0.017)	(0.012)	(0.003)	(0.038)	(0.002)
Gas Station	0.002	0.001	0.006*	0.006	0.075***	-0.002
	(0.002)	(0.002)	(0.003)	(0.009)	(0.028)	(0.007)
% Food Insecure	0.961***	0.935***	1.005***	0.963***	0.941***	1.001***
	(0.034)	(0.047)	(0.041)	(0.035)	(0.048)	(0.041)
Cost Per Meal	-0.000	-0.002	0.001	-0.000	-0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
% Ages 18-64	0.101***	0.093***	0.124***	0.104***	0.094***	0.126***
	(0.025)	(0.028)	(0.048)	(0.025)	(0.030)	(0.048)
% Ages 65+	0.282***	0.304***	0.224***	0.285***	0.306***	0.227***
	(0.031)	(0.039)	(0.041)	(0.032)	(0.041)	(0.042)
% HS Diploma	-0.066***	-0.047**	-0.096***	-0.067***	-0.049**	-0.097***
	(0.015)	(0.020)	(0.019)	(0.015)	(0.020)	(0.019)
% Some College	-0.031*	-0.028	-0.031	-0.033**	-0.030	-0.032
	(0.016)	(0.022)	(0.021)	(0.016)	(0.022)	(0.020)
% College Graduates	-0.082***	-0.075***	-0.092***	-0.083***	-0.076***	-0.095***
	(0.018)	(0.024)	(0.024)	(0.018)	(0.024)	(0.024)
% Black	0.041*	0.044	0.025	0.041	0.044	0.026
	(0.025)	(0.040)	(0.023)	(0.025)	(0.039)	(0.023)
% Hispanic	0.053**	0.063*	0.006	0.054**	0.064*	0.015

	(0.027)	(0.035)	(0.030)	(0.027)	(0.035)	(0.031)
% Homeowners	0.073***	0.074***	0.069***	0.072***	0.074***	0.068***
	(0.011)	(0.014)	(0.013)	(0.011)	(0.014)	(0.014)
% Unemployed	-0.492***	-0.474***	-0.526***	-0.494***	-0.476***	-0.525***
	(0.024)	(0.037)	(0.027)	(0.025)	(0.037)	(0.027)
Median Income	0.044***	0.042***	0.048***	0.045***	0.042***	0.047***
	(0.004)	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)
Median Home Value	-0.007***	-0.007	-0.008***	-0.007**	-0.006	-0.008***
	(0.003)	(0.005)	(0.003)	(0.003)	(0.005)	(0.003)
Total Population	0.000***	0.012	0.000**	0.000***	0.011	0.000*
	(0.000)	(0.008)	(0.000)	(0.000)	(0.008)	(0.000)
Constant	-0.172***	-0.178***	-0.183***	-0.174***	-0.180***	-0.176***
	(0.030)	(0.039)	(0.041)	(0.031)	(0.041)	(0.041)
R-Squared	0.284	0.260	0.340	0.282	0.260	0.336
N	31,330	13,290	18,040	31,330	13,290	18,040

Notes: All regressions include year fixed effects and county fixed effects. Shaded cells are statistically significant results for the food establishment, food insecurity, and food cost variables. (*p < 0.10, **p < 0.05, ***p < 0.01).
Source: Authors' calculations using merged data. See text for details.

Appendix Table A3. *Fixed Effects Regression Results of the County-Level Rate of DI Receipt*

	Uses Number of Food Establishments Per 1,000 Residents			Uses Number of Food Establishments Per Square Mile		
	All (1)	"Rural" (2)	Urban/ Micropolitan (3)	All (4)	"Rural" (5)	Urban/ Micropolitan (6)
Grocery Size < 50 Employees	0.001***	0.001***	0.003***	0.001*	0.020***	0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.005)	(0.000)
Grocery Size 50+ Employees	-0.002*	-0.002*	-0.001	-0.001	-0.016***	-0.001
	(0.001)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)
Grocery Size Missing	0.001	0.002	-0.000	-0.011	0.204	-0.004
	(0.004)	(0.004)	(0.011)	(0.016)	(0.220)	(0.016)
Grocery Other	0.000	0.000	0.000	-0.000	-0.010***	-0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.004)	(0.000)
Convenience Store	0.001**	0.001**	0.000	-0.000	0.007	-0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.004)	(0.001)
Warehouse Club	-0.005	-0.007	-0.006	-0.006	-0.188	-0.008
	(0.008)	(0.013)	(0.007)	(0.006)	(0.425)	(0.006)
Restaurant Full Service	0.000	0.000	-0.000	-0.000	-0.004***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Restaurant Limited Service	-0.000	-0.000	-0.001	-0.000	0.001	-0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.003)	(0.000)
Restaurant Other	0.002***	0.002***	0.003***	-0.000	0.001	-0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.003)	(0.000)
Department Store	-0.003	-0.004	-0.007	-0.009	-0.262	-0.007
	(0.003)	(0.002)	(0.009)	(0.013)	(0.168)	(0.014)
Pharmacy	0.001	-0.000	0.003	0.000	-0.016**	0.001
	(0.002)	(0.003)	(0.002)	(0.001)	(0.007)	(0.001)
Gas Station	0.001***	0.001***	0.001	0.003*	0.013**	0.002
	(0.000)	(0.000)	(0.001)	(0.002)	(0.007)	(0.002)
% Food Insecure	0.012**	0.003	0.027***	0.012**	0.004	0.027***
	(0.005)	(0.007)	(0.007)	(0.005)	(0.007)	(0.007)
Cost Per Meal	0.001***	0.001***	0.000***	0.001***	0.001***	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
% Ages 18-64	0.017**	0.012	0.036***	0.018**	0.014*	0.036***
	(0.007)	(0.008)	(0.011)	(0.007)	(0.008)	(0.012)
% Ages 65+	-0.005	-0.011	0.021**	-0.004	-0.009	0.019**
	(0.009)	(0.012)	(0.008)	(0.009)	(0.012)	(0.009)
% HS Diploma	-0.008**	-0.008*	-0.009**	-0.008**	-0.008*	-0.011***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
% Some College	-0.010***	-0.015***	-0.005	-0.011***	-0.014***	-0.007*
	(0.004)	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)
% College Graduates	-0.003	-0.003	-0.004	-0.002	-0.002	-0.005
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)
% Black	0.000	-0.010	0.012*	0.001	-0.009	0.013*
	(0.005)	(0.006)	(0.007)	(0.005)	(0.006)	(0.007)

% Hispanic	-0.027**	-0.028	-0.018*	-0.025*	-0.026	-0.018
	(0.013)	(0.017)	(0.010)	(0.013)	(0.017)	(0.012)
% Homeowners	-0.002	-0.002	-0.000	-0.001	-0.002	-0.000
	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
% Unemployed	-0.002	0.001	-0.009*	-0.002	0.001	-0.008
	(0.005)	(0.007)	(0.005)	(0.005)	(0.007)	(0.005)
Median Income	-0.000	0.001	-0.003**	-0.000	0.001	-0.003**
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Median Home Value	-0.006***	-0.005***	-0.006***	-0.006***	-0.005***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Total Population	-0.000***	-0.004	-0.000***	-0.000***	-0.004	-0.000**
	(0.000)	(0.002)	(0.000)	(0.000)	(0.002)	(0.000)
Constant	0.045***	0.053***	0.032***	0.045***	0.052***	0.033***
	(0.005)	(0.007)	(0.010)	(0.005)	(0.007)	(0.011)
R-Squared	0.266	0.186	0.414	0.260	0.181	0.405
N	31,330	13,290	18,040	31,330	13,290	18,040

Notes: All regressions include year fixed effects and county fixed effects. Shaded cells are statistically significant results for the food establishment, food insecurity, and food cost variables. (*p < 0.10, **p < 0.05, ***p < 0.01).
Source: Authors' calculations using merged data. See text for details.

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