Food Desert Impact on Health

Sundari Arunarasu + Paulina Grzybowicz

Objectives

Sundari:

- ➔ Explore the relationship between access to grocery stores and food services on diabetes, as well as healthcare providers
- ➔ Attempt to identify differences between urban and rural counties in Oregon that influence health outcomes (diabetes prevalence)

Paulina:

- ➔ Showcase the relationship between food deserts and health outcomes in Chicago
- ➔ Explore the specific variables that dictate food deserts (grocery stores, income, food stamps, etc) and their impact on health outcomes
- ➔ Understand significance of these variables + use them to evaluate potential solutions

Food Deserts

*"**Food desert**, an impoverished area where residents lack access to healthy foods. Food deserts may exist in rural or urban areas and are associated with complex geographic and socioeconomic factors, as well as with poor diet and health disorders such as obesity."*

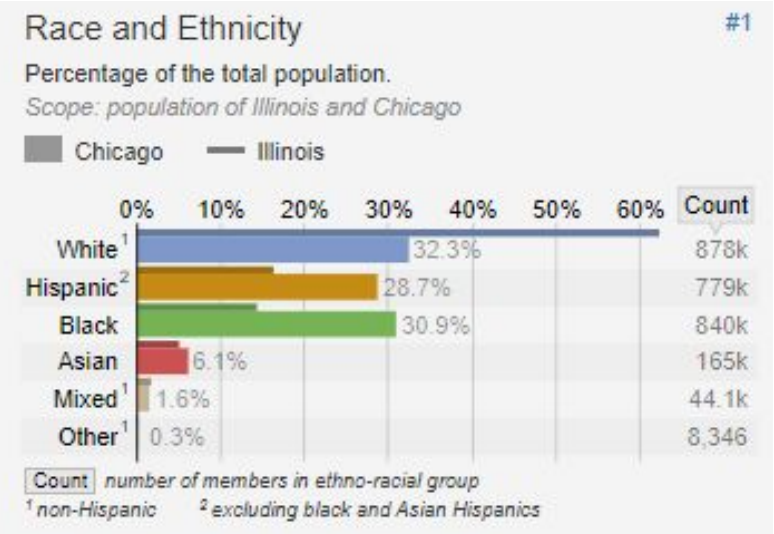
- ➔ No standard definition
- ➔ Grocery store prevalence isn't the only variable
  - ◆ Public transport
  - ◆ Income
  - ◆ Culture
  - ◆ Time (to cook/ to shop)
  - ◆ Nutritional Literacy
  - ◆ Policy (zoning)

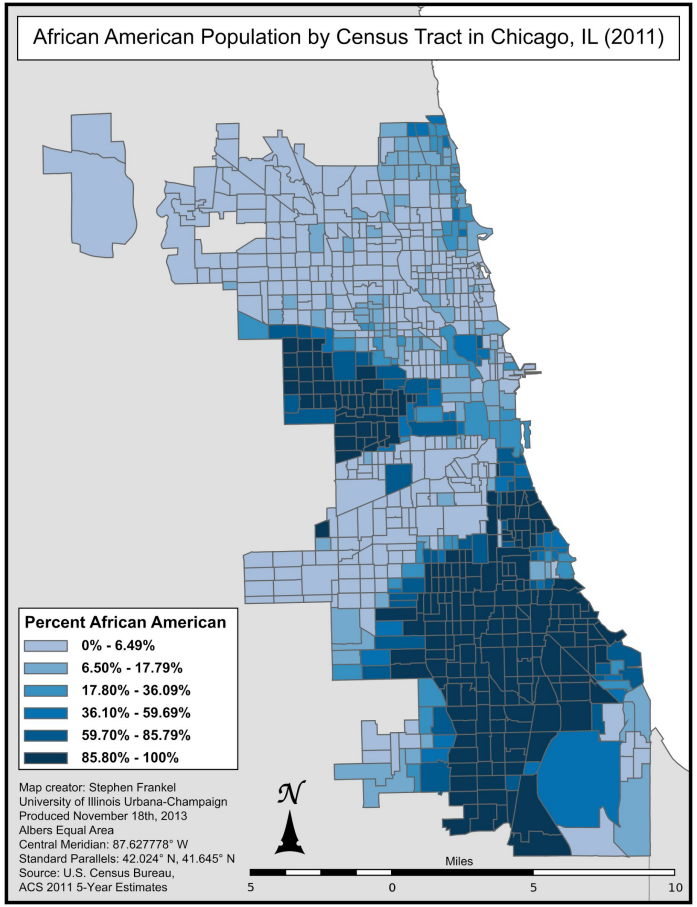
Diet's Impact on Health

- ➔ Food balance is significant contributor to increased rates of obesity
- ➔ Diet-related health outcomes:
  - ◆ Heart disease
  - ◆ Diabetes
  - ◆ High blood pressure
- ➔ Higher-calorie, energy- dense foods are cheaper than low-energy, nutritious foods
- ➔ Lower access to healthy food → increased premature death, chronic health conditions, etc

Chicago Food Deserts

- ➔ Chicago demographics
  - ◆ Split 30/30/30
  - ◆ De facto segregation
    - Housing policy in 1930s/40s
- ➔ Communities of color impacted most by food deserts
  - ◆ Lower SES
  - ◆ More corner stores, less supermarkets
- ➔ Higher rates of obesity + diabetes in southern/western neighborhoods




African American Population by Census Tract in Chicago, IL (2011)
Percent African American
0% - 6.49%
6.50% - 17.79%
17.80% - 36.09%
36.10% - 59.69%
59.70% - 85.79%
85.80% - 100%
Map creator: Stephen Frankel
University of Illinois Urbana-Champaign
Produced November 18th, 2013
Albers Equal Area
Central Meridian: 87.627778° W
Standard Parallels: 42.024° N, 41.645° N
Source: U.S. Census Bureau,
ACS 2011 5-Year Estimates
N
Miles
5
0
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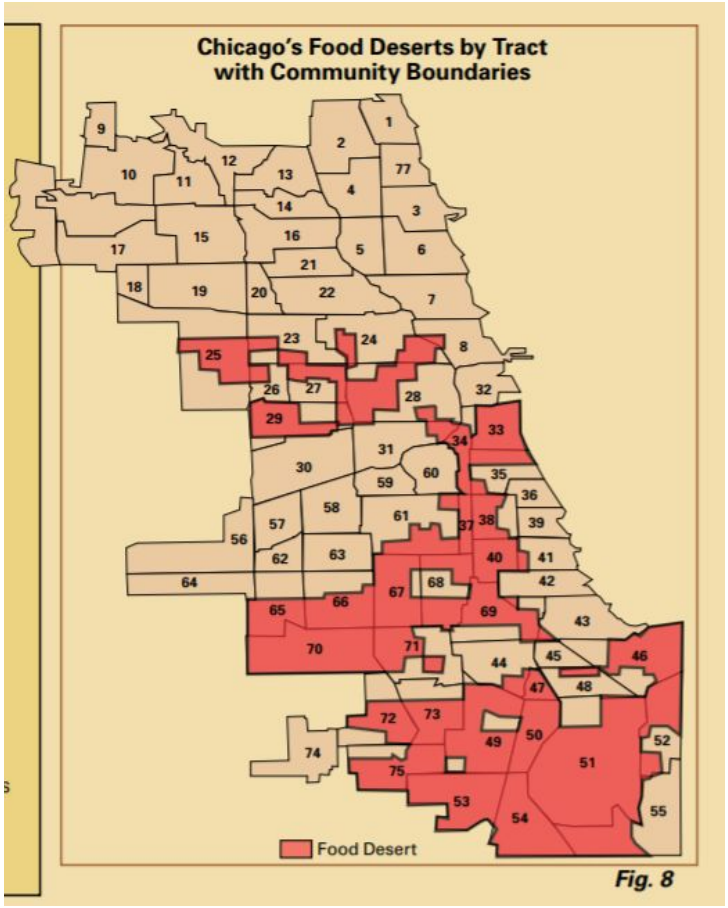
10

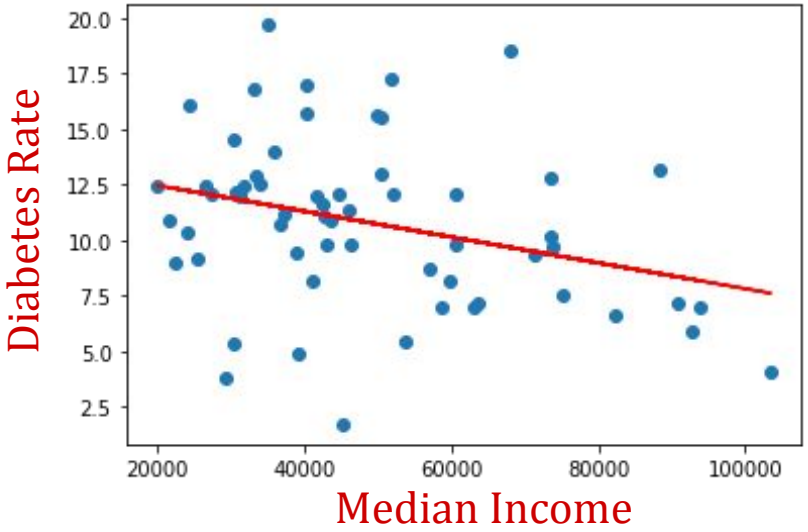

Chicago's Food Deserts by Tract
with Community Boundaries
Food Desert
Fig. 8

Chicago: Data Collection

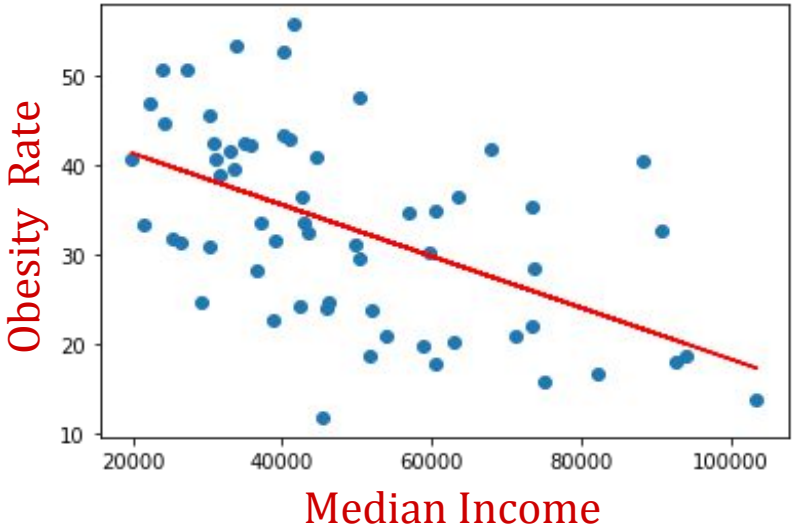
- ➔ Data by Chicago Neighborhood
- ➔ U.S Census
  - ◆ Population
  - ◆ Racial Distribution
- ➔ City of Chicago Data
  - ◆ Median Income
  - ◆ Unemployment Rate
  - ◆ Number of Grocery Stores
  - ◆ Urban Farms
  - ◆ Food Carts
- ➔ Chicago Health Atlas
  - ◆ Food Stamps
  - ◆ Limited Food Access
  - ◆ Food Insecurity
  - ◆ Household Emergency Food Use
  - ◆ Diabetes Rate
  - ◆ Diabetes Related Deaths
  - ◆ Obesity Rate
  - ◆ Diet-Related Deaths

General Socioeconomic Status Food Health

Chicago: Visualizations and Trends

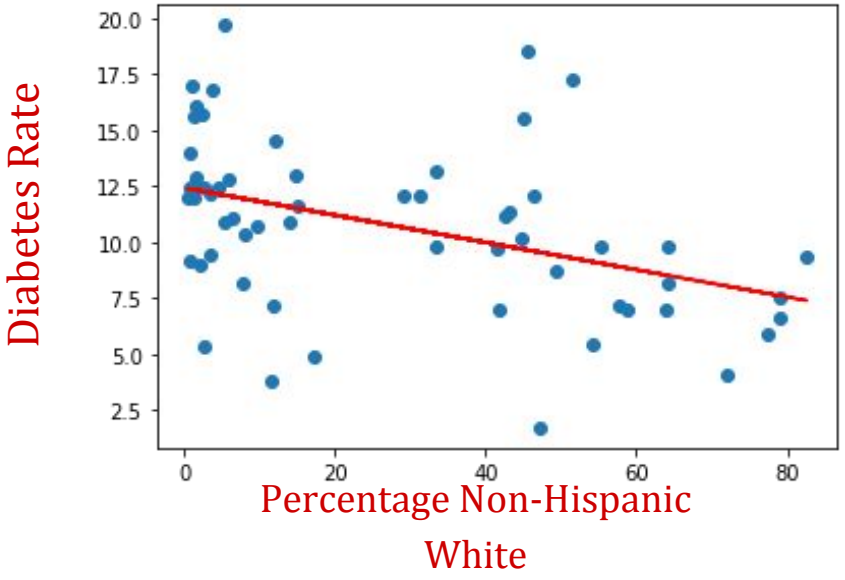


$R^2 = 0.09948359220222736$

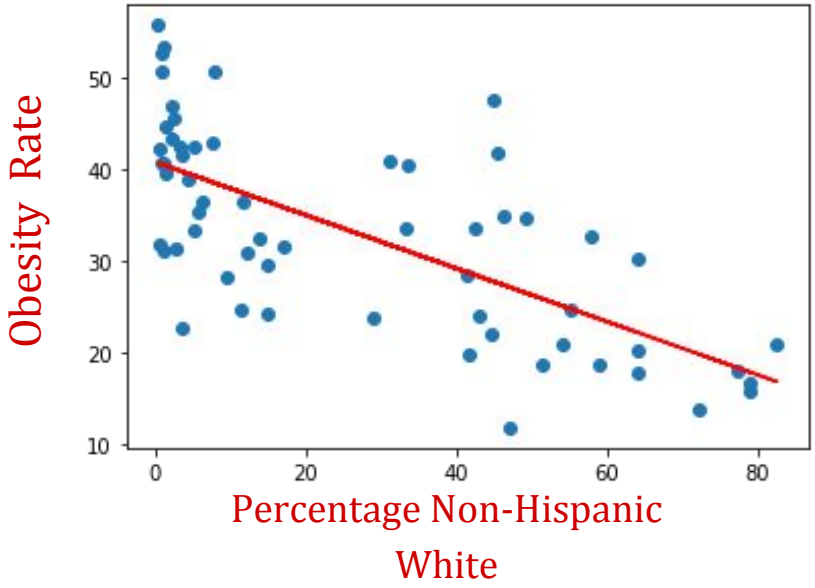


$R^2 = 0.285551651010049$

Chicago: Visualizations and Trends



R^2 = 0.051527334360804 59



R^2 = 0.4786339243941223

Chicago: Findings

Relationship to Diabetes Rates

- **SES Indicators**
  - Poverty Rate, Unemployment Rate, Education Level
  - Median Income
- **Food Related**
  - Food Stamps
  - Easy Access To Food, Grocery Store #
- **Clear Racial Patterns**
  - Higher White Populations, Lower Rates
  - Higher Black/Hispanic Populations, Higher Rates
- In general, all relationships to Obesity Rate stronger

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Chicago: Mediation Analysis

Idea: Food Access (and other Food-Desert Variables) act as a mediator between SES and Diabetes Rate

Process:

1. **Baron + Kenny's steps**
   a. **3 sets of regressions**
2. **Sobel Test or Bootstrapping**
   a. **Test Significance**

Results:

X: Median Income	Y: Diabetes Rate	P = 0.0141
X: Median Income	M: Easy Access to Food	P = 5.289e-10
X+M: Median Income + % Easy Access to Food	Y: Diabetes Rate	$X \rightarrow Y$ p = 0.299 $M \rightarrow Y$ p = 0.299
Significance Test		Weakens $X \rightarrow Y$

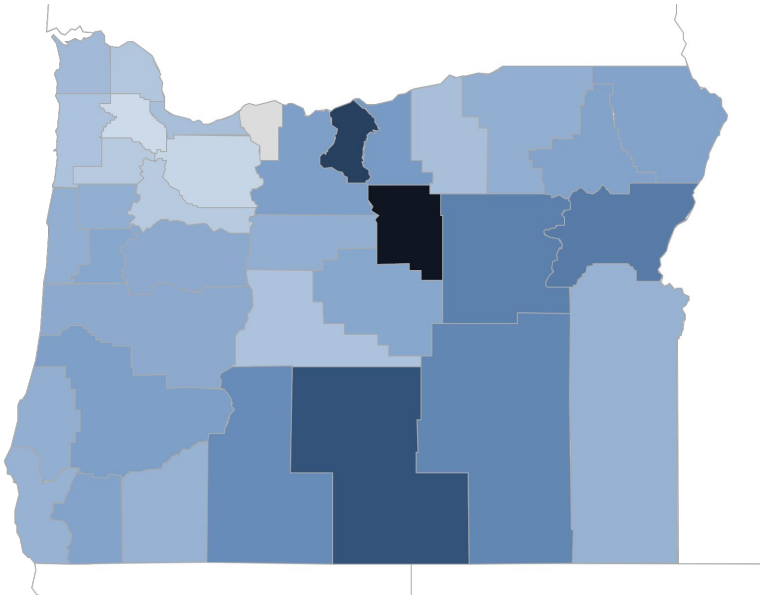
Chicago: Mediation Analysis

X: Median Income	Y: Obesity Rate	p = 1.03e-06
X: Median Income	M: Easy Access to Food	P = 4.57e-09
X+M: Median Income + % Easy Access to Food	Y: Obesity Rate	X → Y p = 0.114 M → Y p = 5.41e-0.5
Significance Test		Significant

X: Poverty Rate	Y: Diabetes Rate	P = 0.0322
X: Poverty Rate	M: Easy Access to Food	P = 2.39e-09
X+M: Poverty + % Easy Access to Food	Y: Diabetes Rate	X → Y p = 0.822 M → Y p = .0516
Significance Test		Significant

Portland: Selected variables

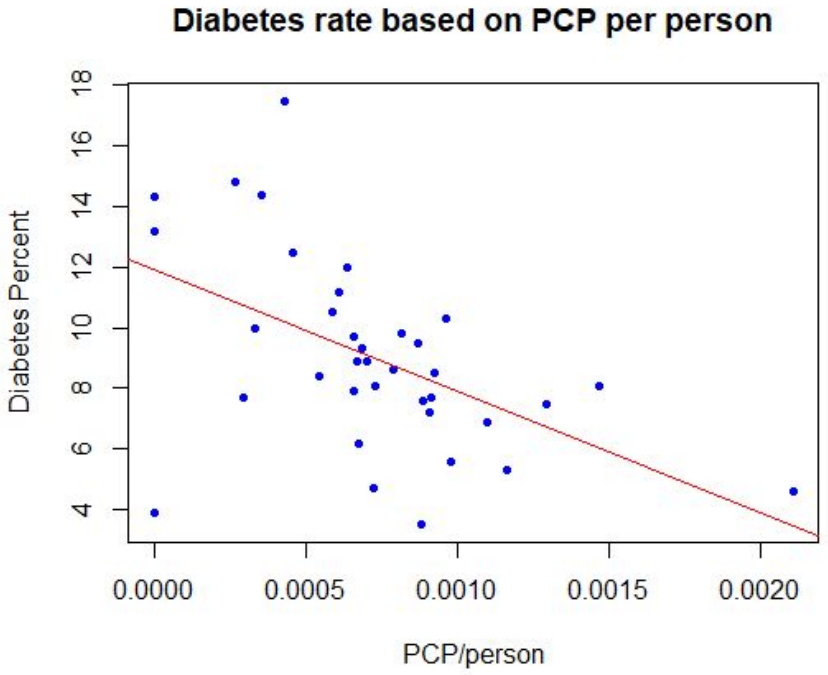
- ➔ Originally planned to look at how environmental factors and access affect diabetes rates in counties (grocery stores, food services, hospitals)
- ➔ Expanded data collection to other factors:
  - ◆ HS graduation rate, poverty, percent obesity, unemployment, physical activity, income, food insecurity



Food environment index: measures limited access to healthy foods and food insecurity

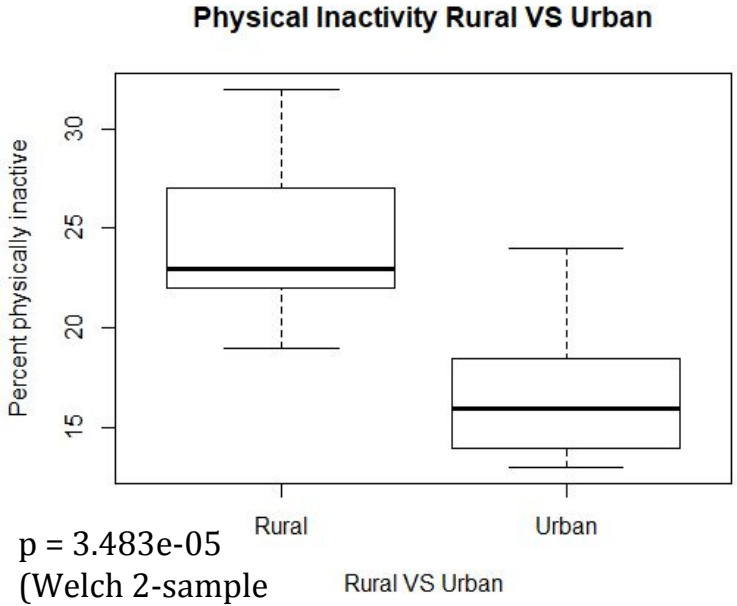
Portland: Findings

- Original variables:
  - Percent with limited access to healthy foods (R = 0.20) and grocery stores per person (R = -0.16) not statistically significant (p>>0.05)
  - Food services per person (R = -0.45) and primary care providers (PCP) per person (R = -0.51) were more significant relationships

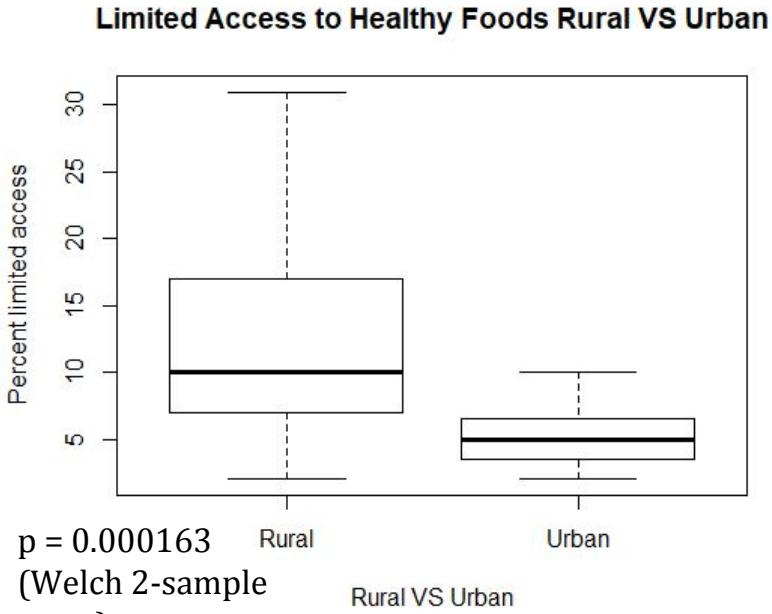


Portland: Findings

➔ Differences between rural and urban counties



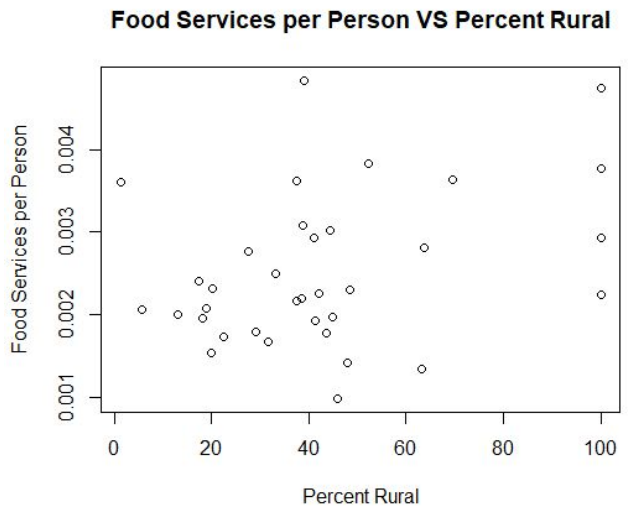
p = 3.483e-05
(Welch 2-sample t-test)

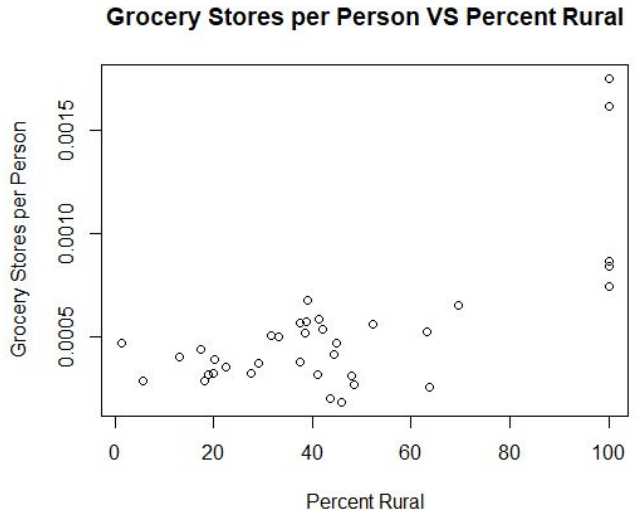


p = 0.000163
(Welch 2-sample t-test)

Portland: Interesting Findings

- ➔ Lack of relationship between food insecurity and diabetes prevalence
- ➔ Positive relationship between number of grocery stores and food services and percent rurality of a county





Portland: Mediation

- Physical Inactivity (X) → Percent Obesity (M) → Diabetes Rate (Y)
  - X on Y: Physically inactive percent + Diabetes rate (p=0.0465)
  - X on M: Physically inactive percent + Percent obesity (p=0.00455)
  - ACME (Average Causal Mediation Effect): 0.1525 with p = 0.004 found to be significant
  - Proportion mediated: 0.652
- Causal Mediation Analysis:

	Estimate 95%	CI Lower 95%	CI Upper	p-value
ACME	0.1525	0.0303	0.32	0.004 **
ADE	0.0778	-0.1378	0.29	0.460
Total Effect	0.2303	0.0360	0.45	0.028 *
Prop. Mediated	0.6519	0.0876	2.62	0.032 *

Portland: Notes

- ➔ Due to small sample size (n=36), lack of relationships between certain variables could be due to low power of statistical tests
- ➔ Some counties have very low populations (ex: Wheeler with 1344 people), and so their data might not be very accurate and/or could be skewed easily when using percents

- ➔ When using ML models, because of small sample size, data is prone to overfitting and not making accurate predictions for test sets versus training sets

Moving Forward

Sundari

- ➔ Looking at different ML models and comparing accuracy between them
  - ◆ Using the most important/significant variables VS all collected variables
- ➔ Attempting to make final conclusions about diabetes prevalence in Oregon counties from data analysis and ML models

Paulina

- ➔ Trends/Results from Mediation Analysis to guide ML model
  - ◆ Which variables to use
- ➔ Exploring several different regression techniques within ML to create a model that accurately predicts a community area's diabetes rate
- ➔ Make some conclusions about potential solutions based upon these results