



Exploring social determinants of health through small-area mapping of BRFSS variables

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Social determinants of health

World Health Organization

The social determinants of health (SDH) are the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life. These forces and systems include economic policies and systems, development agendas, social norms, social policies and political systems.

http://www.who.int/social_determinants/en/

Economic factors	Housing	Transportation	Education
Food	Access to care	Community design	Social constructs



Leveraging BRFSS and Census

Behavioral Risk Factors Surveillance System

Telephone survey conducted by Oregon Health Authority

Publically available data to the county level

- Demographics
- Chronic disease
- Health behaviors and status
- Health care access

American Community Survey

Paper survey conducted by U.S. Census Bureau

Publically available data to the block group level

- Demographics
- Socioeconomics
- Household composition
- Health insurance



A model for computing small area estimates (SAEs)

- Zhang, X., Holt, J. B., Lu, H., Wheaton, A. G., Ford, E. S., Greenlund, K. J., & Croft, J. B. (2014). Multilevel regression and poststratification for small-area estimation of population health outcomes: a case study of chronic obstructive pulmonary disease prevalence using the behavioral risk factor surveillance system. *American journal of epidemiology*, 179(8), 1025-1033.
- Zhang, X., Holt, J. B., Yun, S., Lu, H., Greenlund, K. J., & Croft, J. B. (2015). Validation of multilevel regression and poststratification methodology for small area estimation of health indicators from the behavioral risk factor surveillance system. *American journal of epidemiology*, 182(2), 127-137.



Predicting health outcomes

Assumption: The probability of an individual's health outcome depends on that individual's

- Age
- Race
- Sex
- County poverty rate
- Other (unknown) county characteristics

Logistic Linear Mixed Effects Model:

$$P(\text{Outcome}_i) \sim [1 \quad \text{Agegroup}_i \quad \text{Race}_i \quad \text{Sex}_i \quad \text{Poverty}_i] \cdot \begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \end{bmatrix} + \mathbf{County}_i + \text{Error}_i$$

Agegroup, Race, Sex, and Poverty are fixed effects; County is a random effect



Adapting the model for Oregon BRFSS data

Zhang, et. al. model

U.S. wide data set

One year of data BRFSS data

States and counties included as random effects

Poverty rates are for whole population

2010 Census demographics

Implemented in SAS using GLIMMIX

Oregon BRFSS model

Oregon wide data set

2 years of data (2014, 2015)

Counties included as random effects

Poverty rates exclude ages 18-24

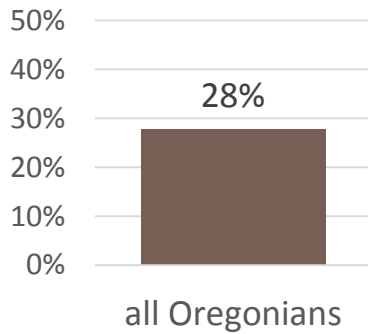
2011-2015 ACS demographics

Implemented in R using glmer

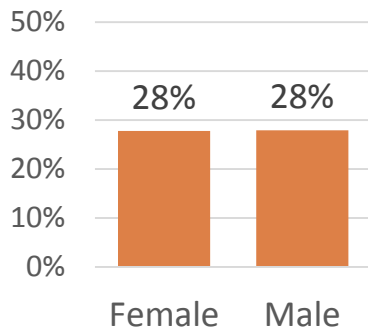


Example 1: Obesity

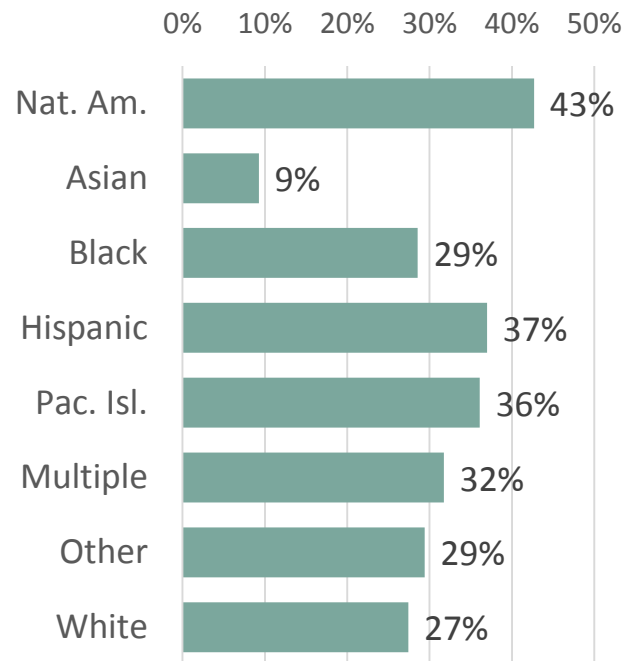
Obesity rate



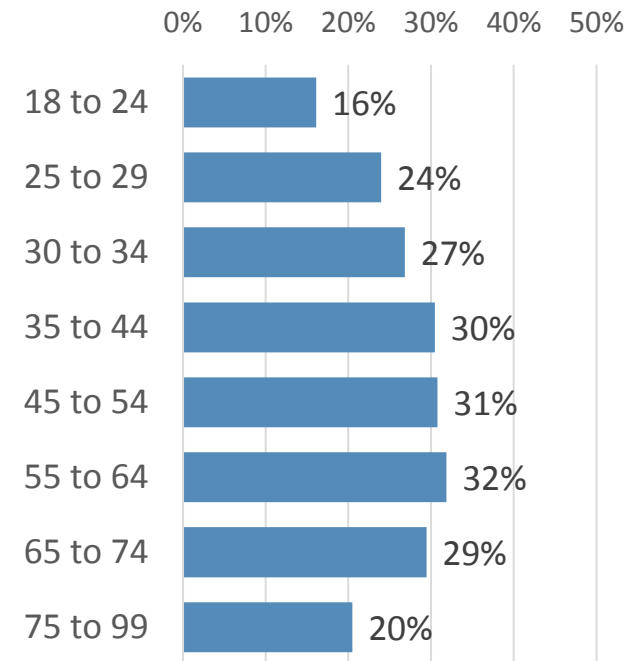
By sex



By race/ethnicity



By age



Data from Oregon 2015 and 2014 BRFSS



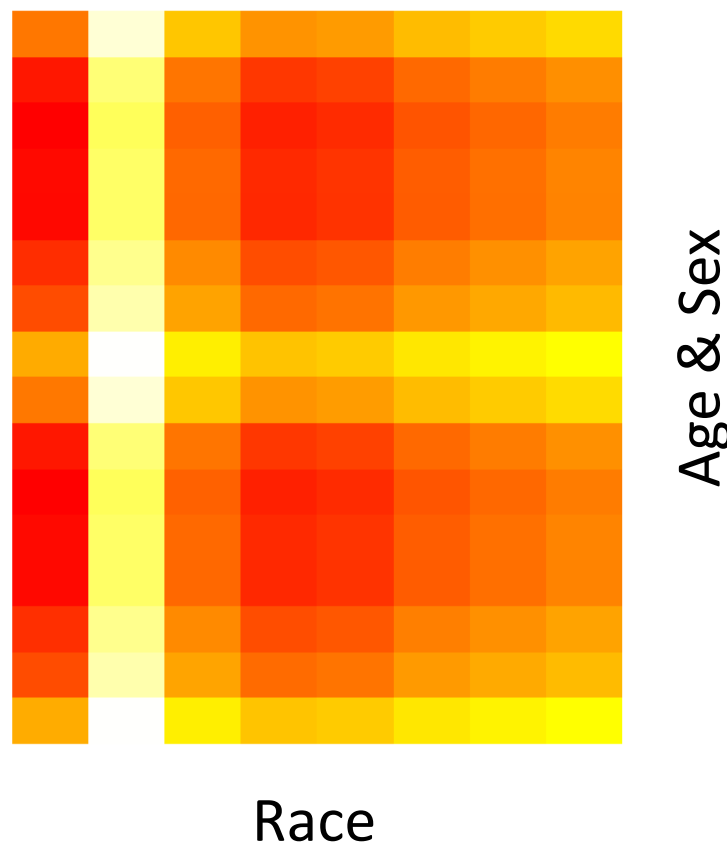
Obesity probabilities

8 Age Groups

8 Race/Ethnicity
Categories

2 Sex Categories

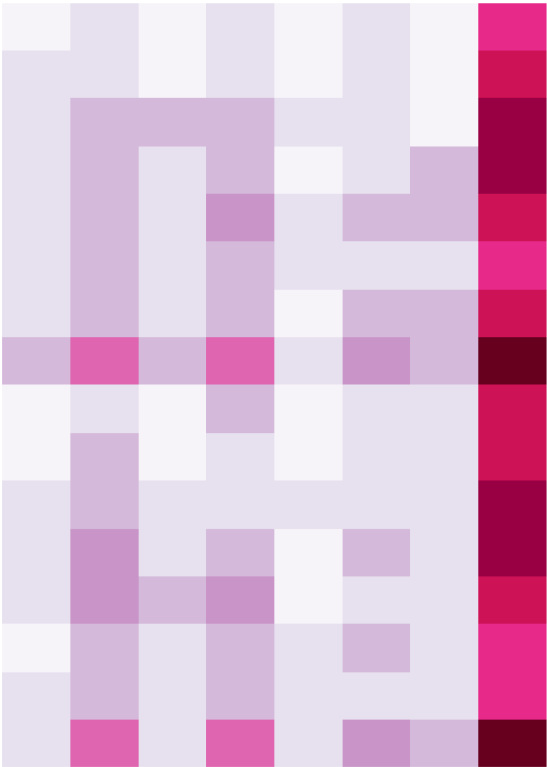
128 distinct probabilities



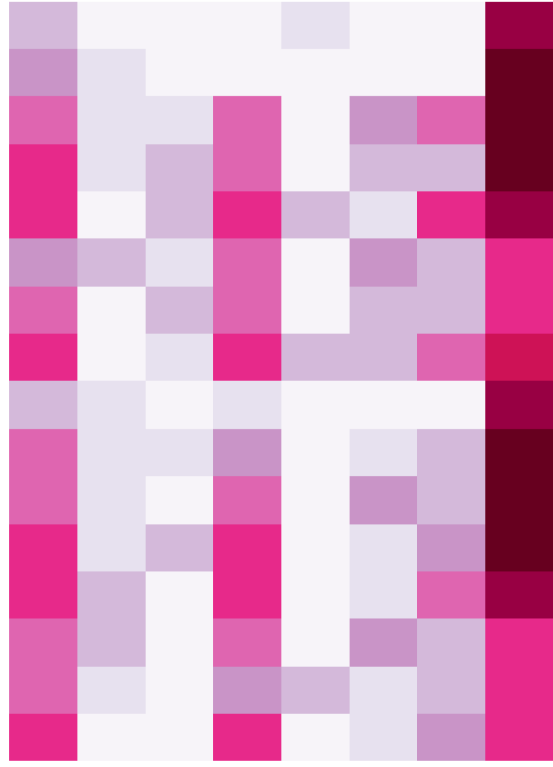


County demographics

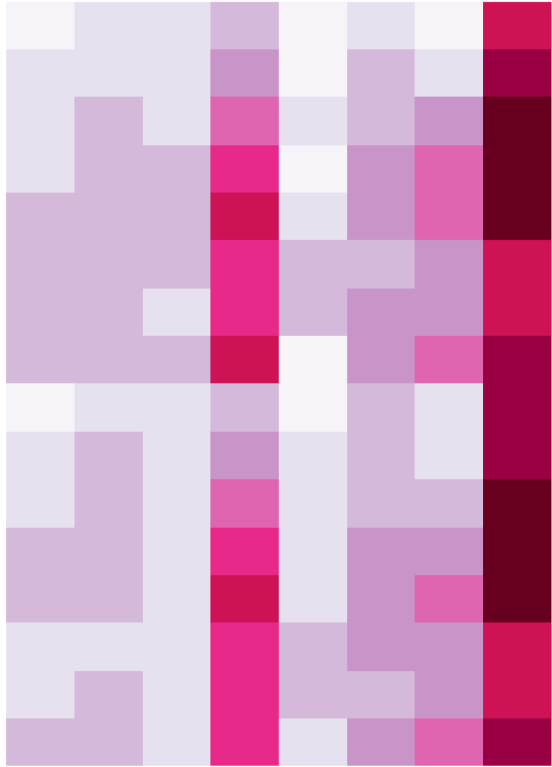
Benton County



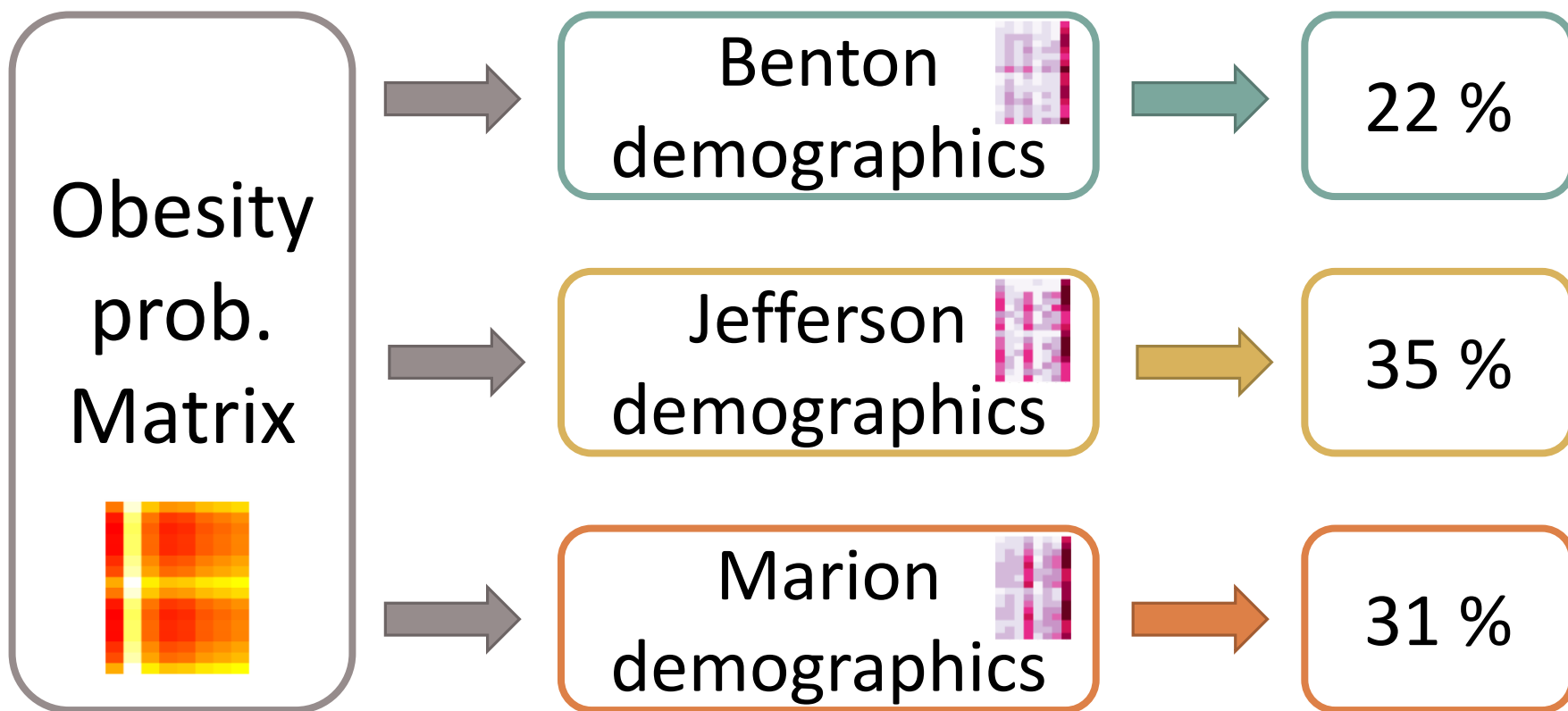
Jefferson County



Marion County



Estimating obesity rates





BRFSS Variables

Chronic disease

Arthritis	Heart attack
Asthma	Heart disease
Cancer	Stroke
COPD	High Blood Pressure
Depression	Obesity
Diabetes	Overweight or obesity

Other variables

- Binge drinking
- Smoking
- Diabetes test
- Health insurance coverage
- General health status
- Mental health status
- Physical health status
- Disability status



Model Limitations

- Potential non-representative samples in BRFSS or in ACS data
 - Model misspecification
 - Systematic or sporadic error in small area estimates
- Potential failure of model assumptions
 - Health outcome poorly correlated with independent variables
 - Health outcome correlated with confounding variables
- Large census tracts' visual prominence doesn't represent their smaller proportion of the population
- Artificial geographic boundaries
- Only possible stratification is by geography
- Statistics categorize but individuals are unique



Mapping Small Area Estimates

- Cities and towns
- County subdivisions
- ***Census tracts***
- Census block groups



Example 2: Smoking and Tobacco Retail Outlets


Benton County has one of the lowest tobacco use rates in the state

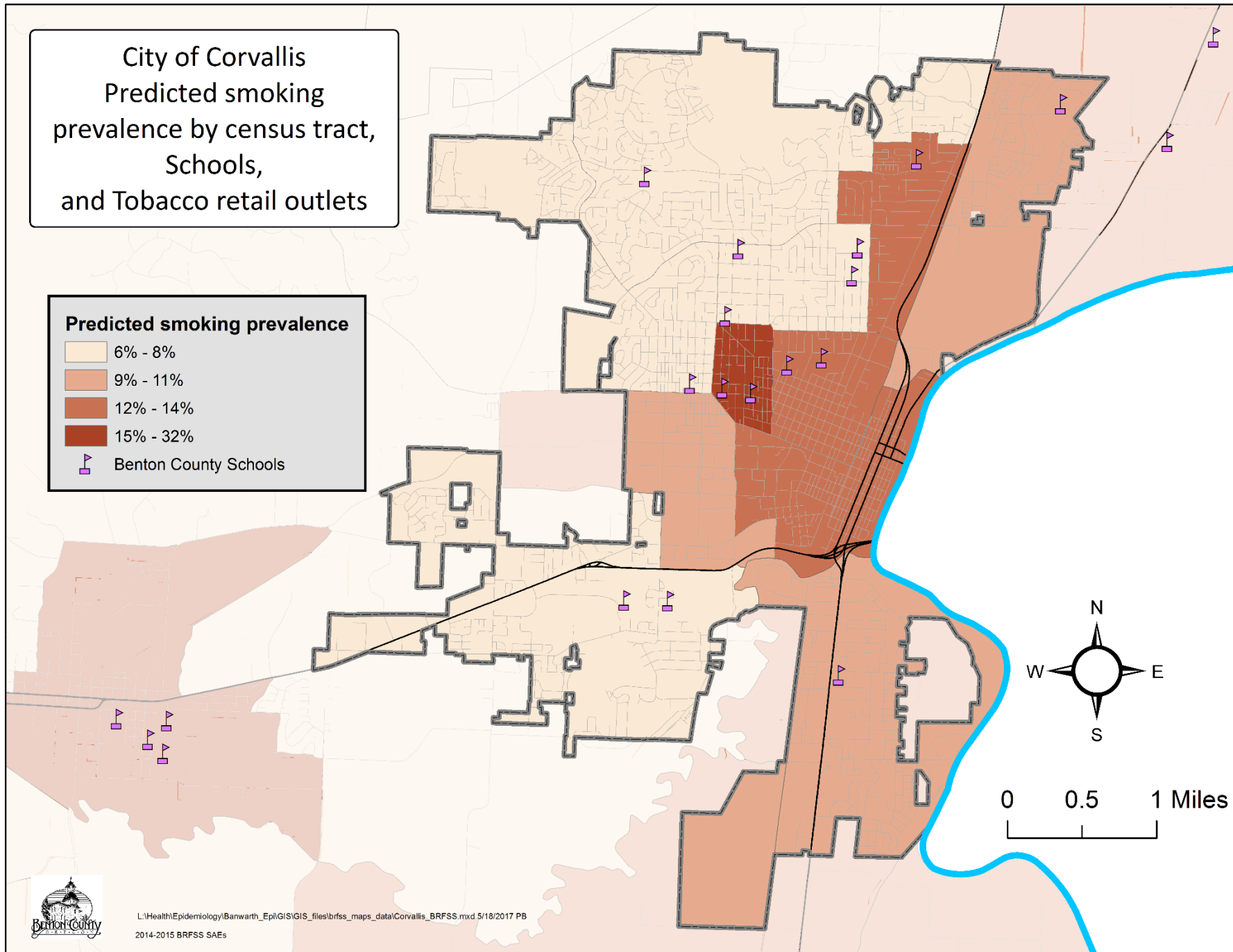
Only 10 percent of Benton County residents smoke cigarettes

City of Corvallis
Predicted smoking
prevalence by census tract,
Schools,
and Tobacco retail outlets

Predicted smoking prevalence

- 6% - 8%
- 9% - 11%
- 12% - 14%
- 15% - 32%

 Benton County Schools



City of Corvallis
Predicted smoking
prevalence by census tract,
Schools,
and Tobacco retail outlets


Predicted smoking prevalence


6% - 8%

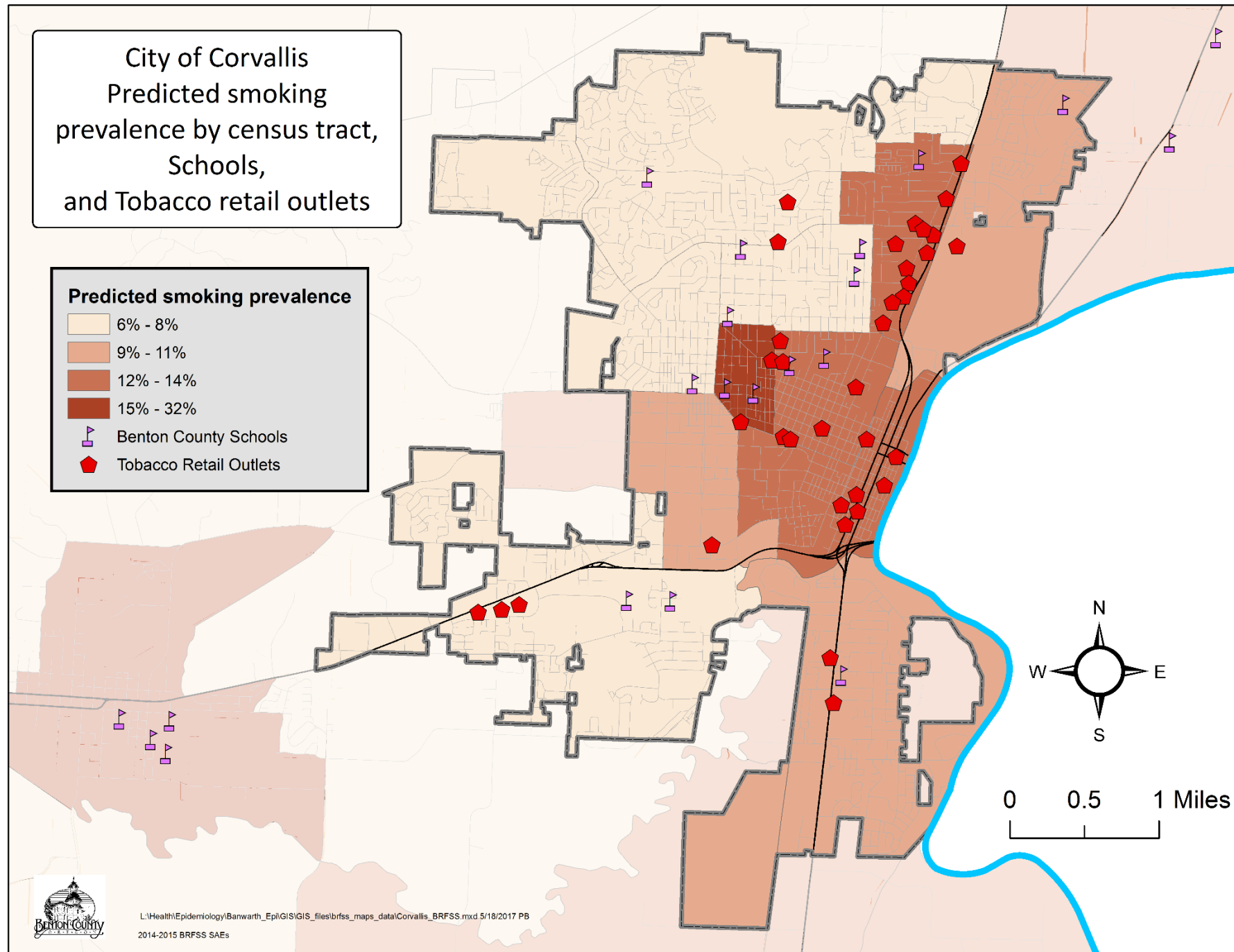
9% - 11%

12% - 14%

15% - 32%

 Benton County Schools

 Tobacco Retail Outlets





Example 3: Diabetes and access to grocery stores

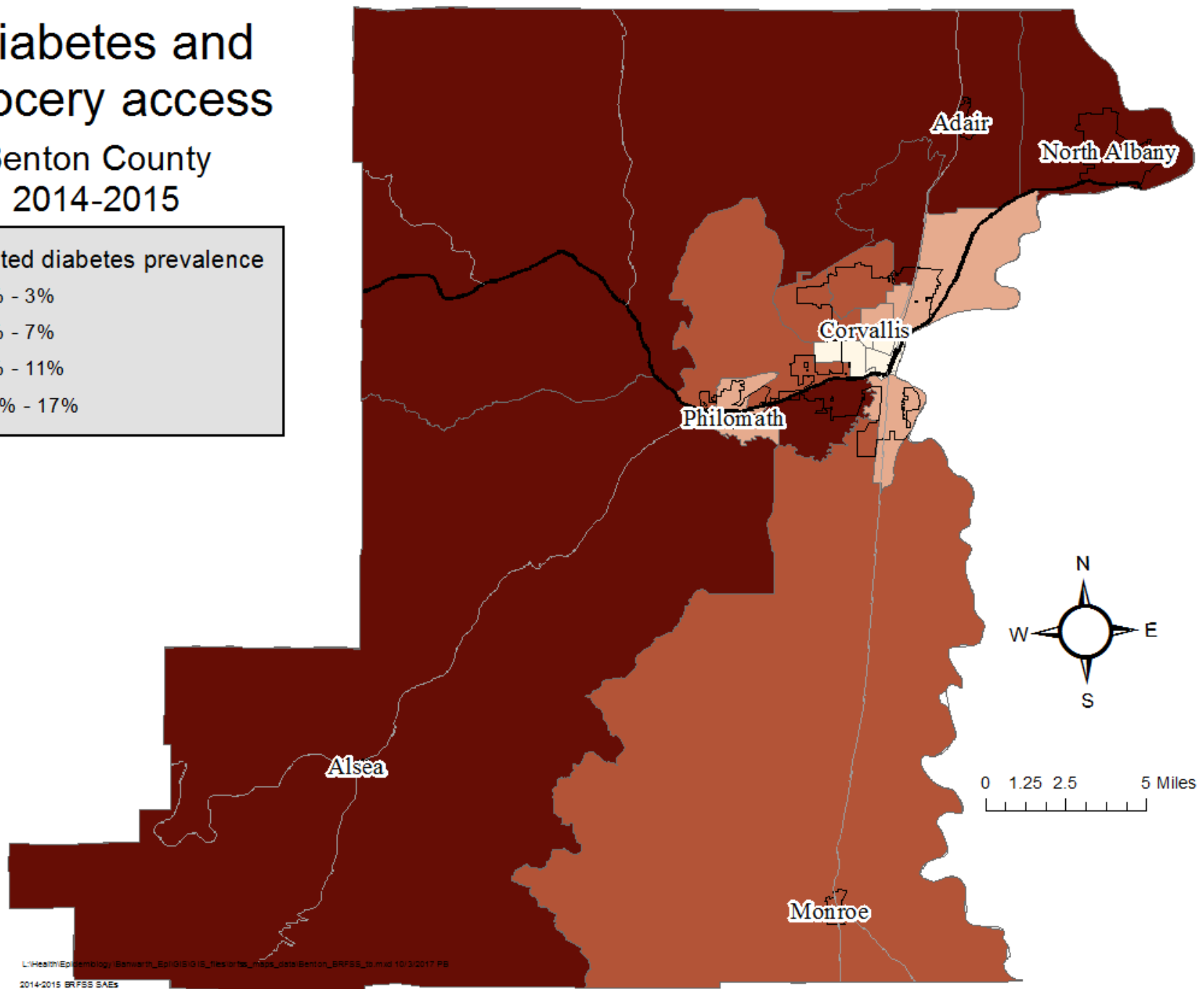
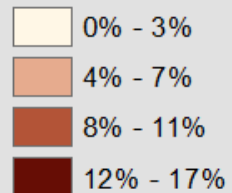
Seven percent of Benton County residents have been diagnosed with diabetes

The average Benton County resident lives 2.3 miles from the nearest grocery store

Diabetes and grocery access

Benton County
2014-2015

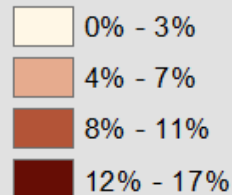
Estimated diabetes prevalence



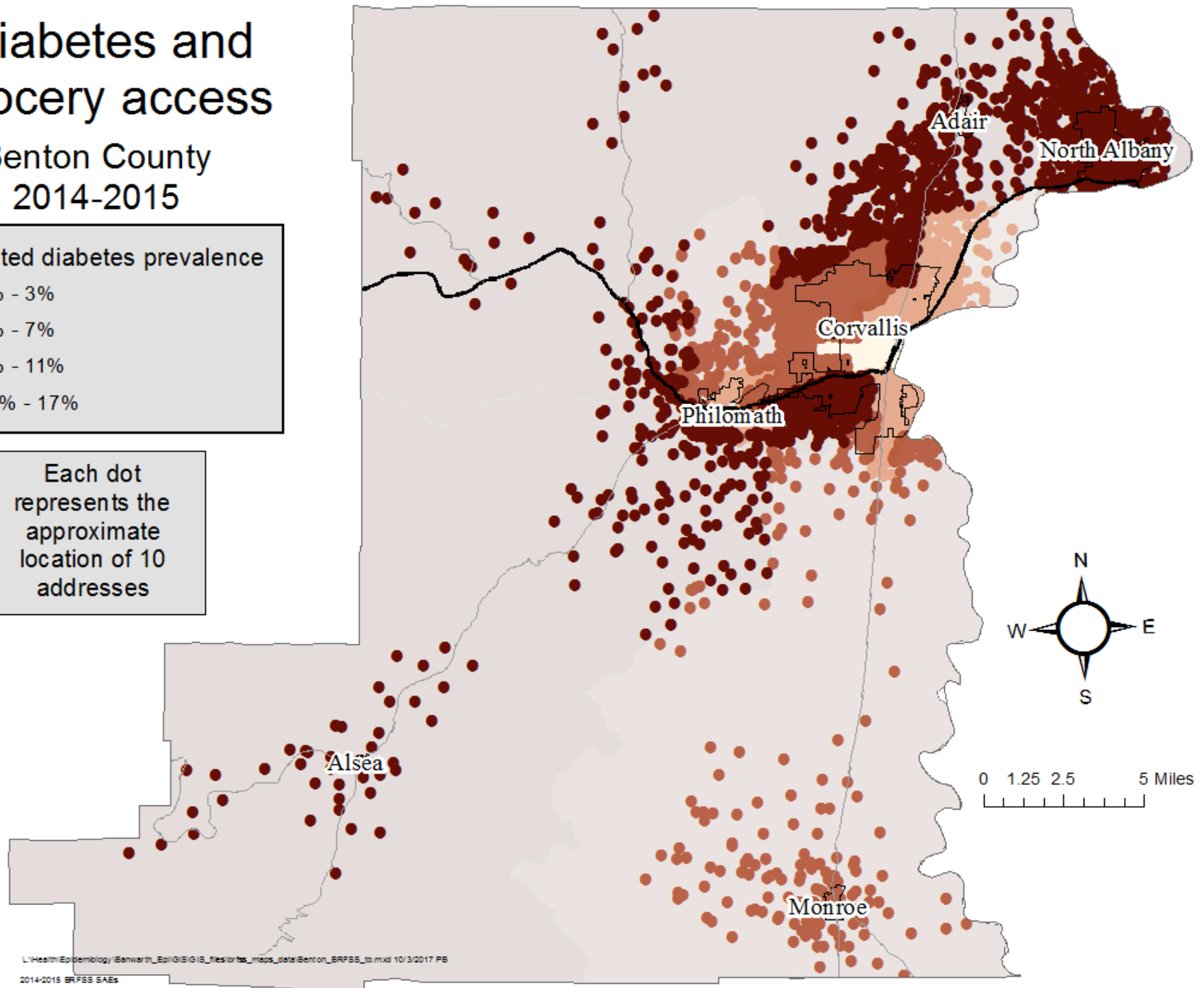
Diabetes and grocery access

Benton County
2014-2015

Estimated diabetes prevalence



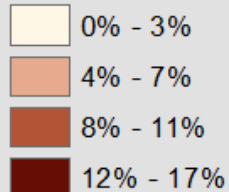
Each dot
represents the
approximate
location of 10
addresses



Diabetes and grocery access

Benton County
2014-2015

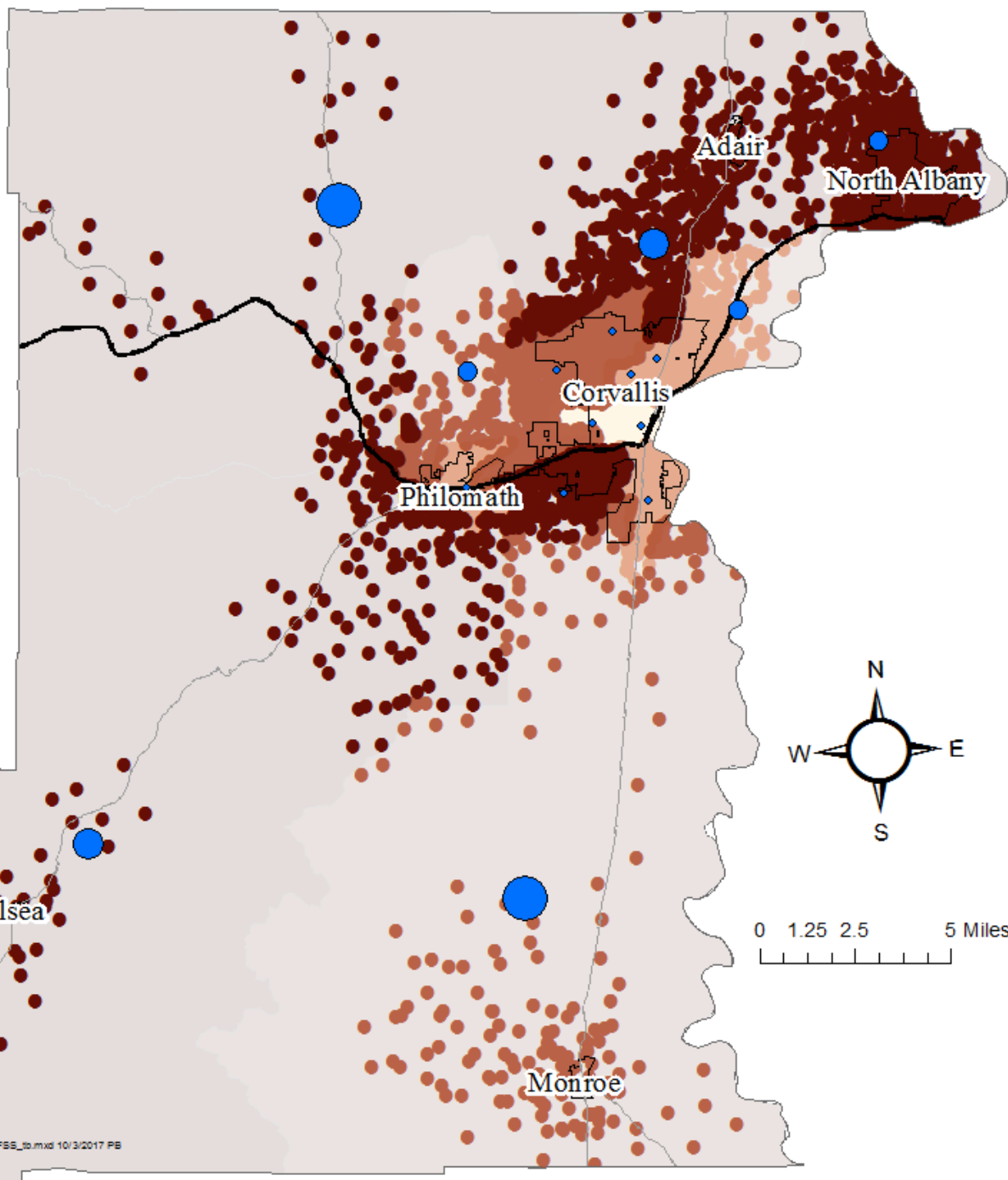
Estimated diabetes prevalence



Distance in miles to a grocery



Each dot represents the approximate location of 10 addresses





Contact information

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541-766-6364

Data sources:

Oregon Behavioral Factors Surveillance System 2014, 2015

U.S. Census Bureau ACS 2011-2015 5-year estimates

Corvallis Tobacco Retail Licensing program

Oregon Environmental Public Health Tracking Tool, 2012