Washington State Department of Health

Socioeconomic Risk of Chronic Disease in Washington State

a multilevel modeling approach

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Paula Braveman: Thoughts on Health Inequities

Systematic differences in health or health determinants that are plausibly influenced by social policy are health inequities if they…

a) Occur between groups with different social position - place in the hierarchy according to power, wealth, prestige.

b) Place groups already at social disadvantage at even greater disadvantage due to poor health.

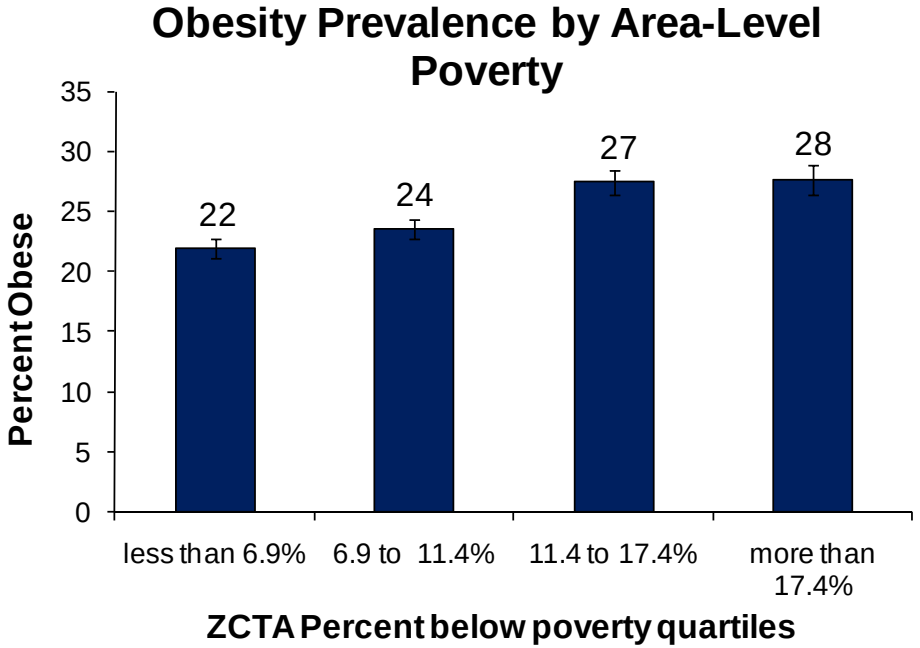
You do not need to attribute causation or prove that the disparity is avoidable if social policies were changed, as long as the impact is plausible.

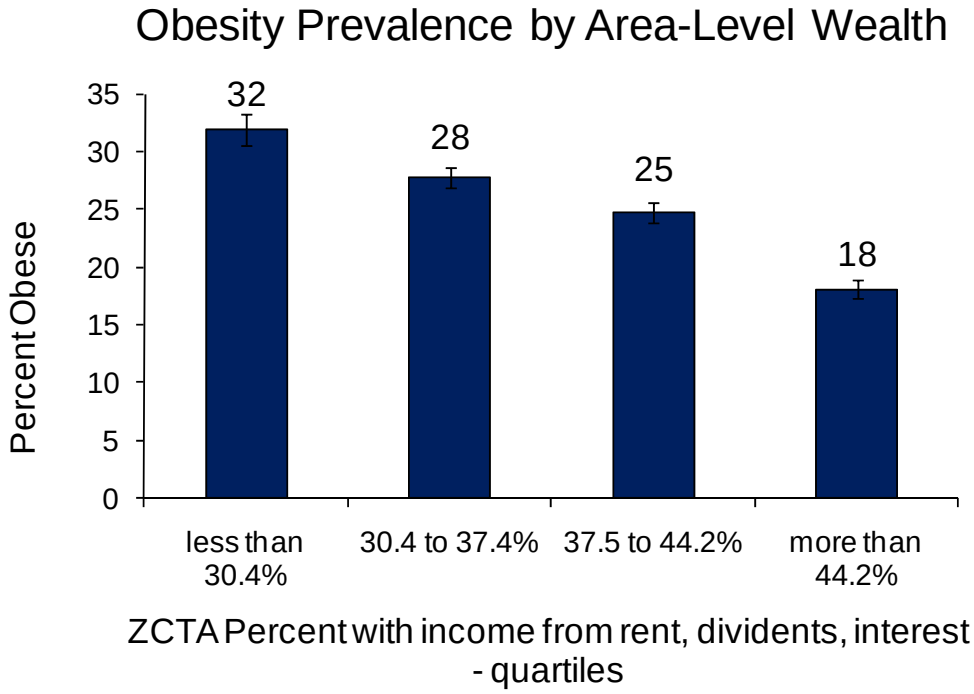
Braveman, 2004, Health Policy and Development 2(3) 180-185

Data Sources

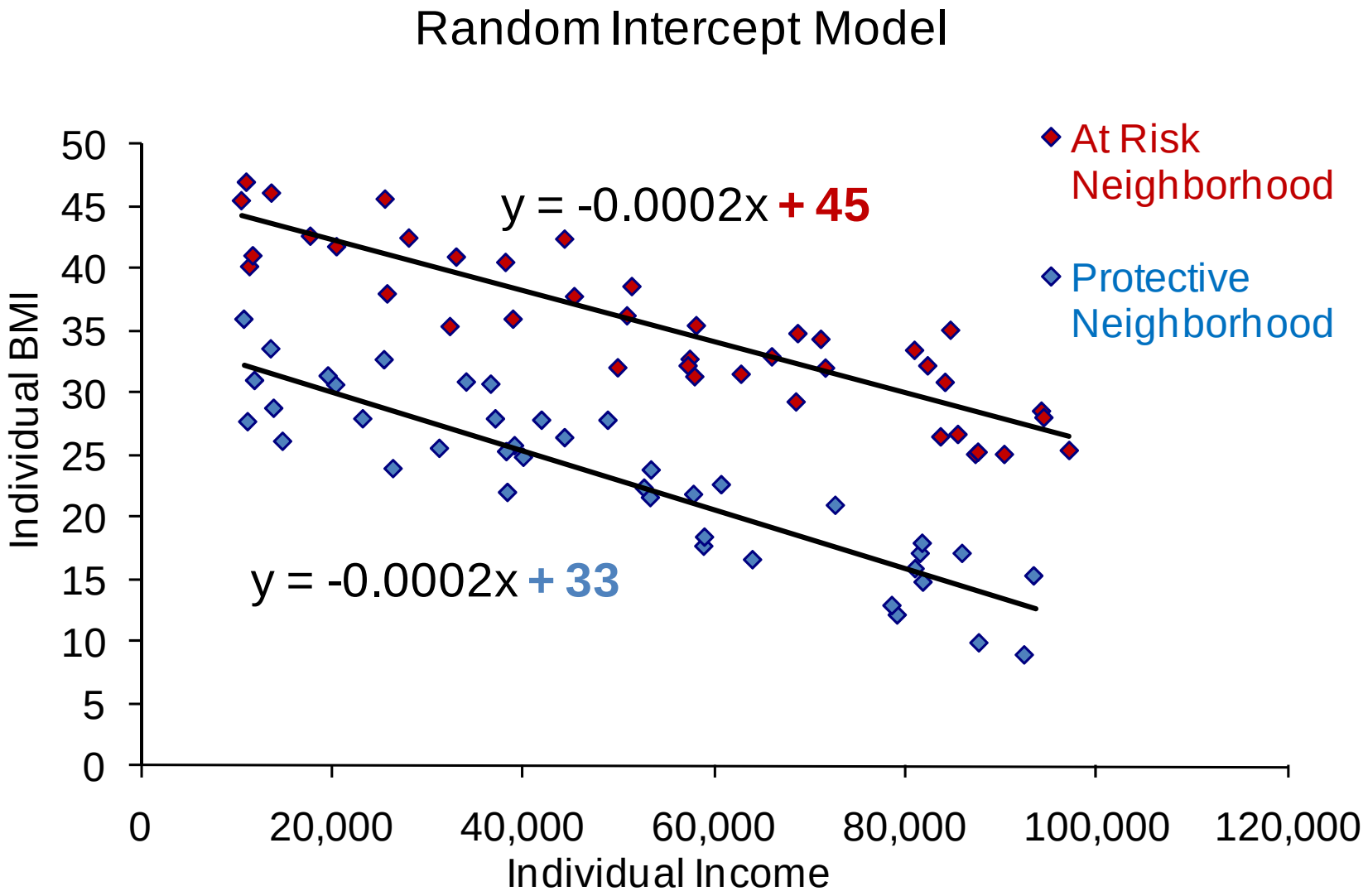
- Behavioral Risk Factor Surveillance System (BRFSS) years 2005-2007
  - Self-reported health conditions and risk factors
  - Includes respondents' postal zip-code
- US Census Bureau Decennial Census year 2000
  - Socio-economic and demographic data by ZIP Code Tabulation Area (ZCTA)
  - American Community Survey provides more current information, but not by ZCTA
  - Note: ZCTA not quite the same as ZIP code

Simple Cross Tabulation – Obesity prevalence by income and wealth.





Random Intercept Model

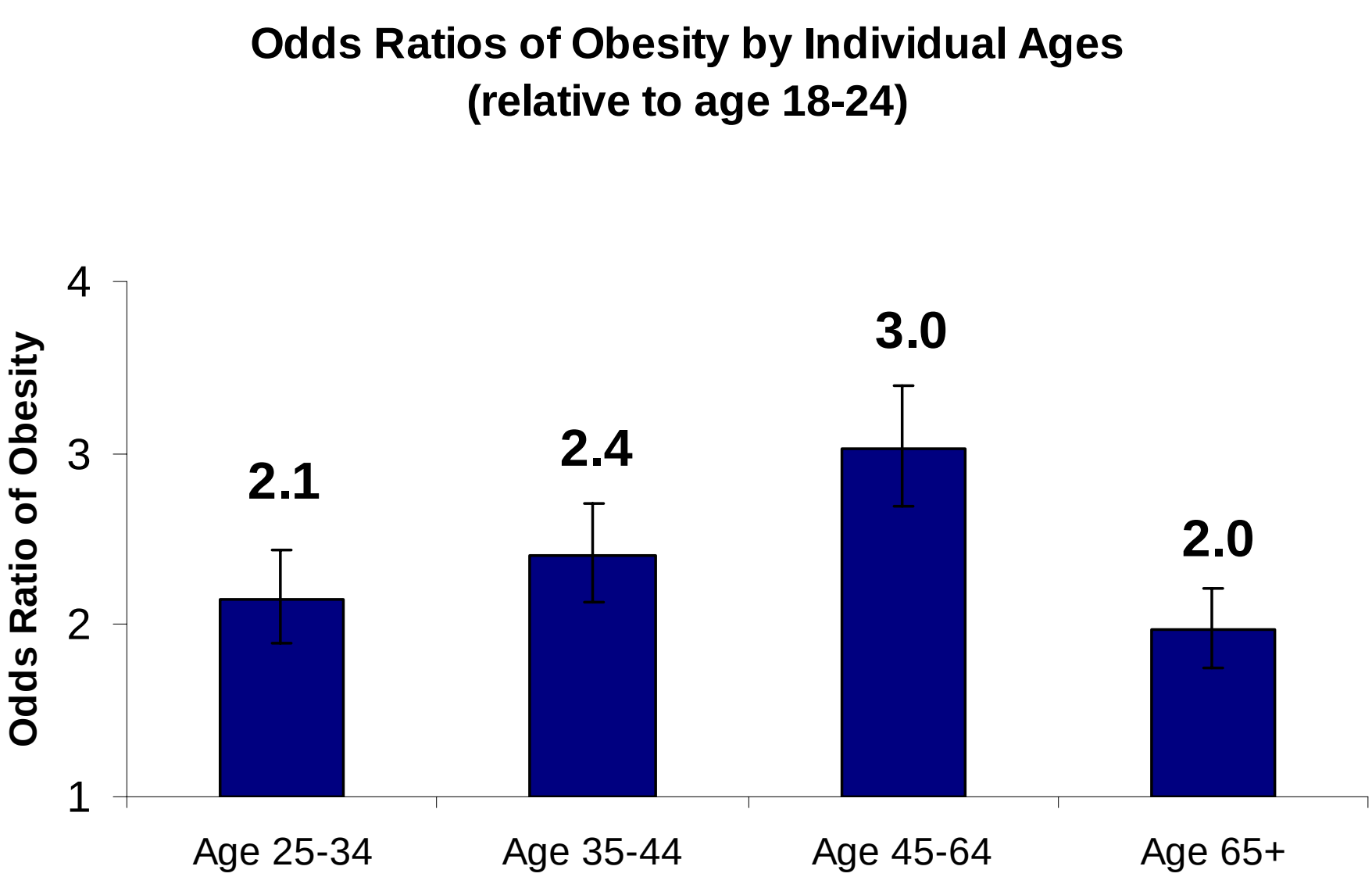


$$logit(y_{i,j}) = (\beta_0 + \zeta_j) + \beta_1 x_{1,j} + \ldots + \beta_k x_{k,i,j} + \cdots + \epsilon_{i,j}$$

Individual Level Factors – BRFSS

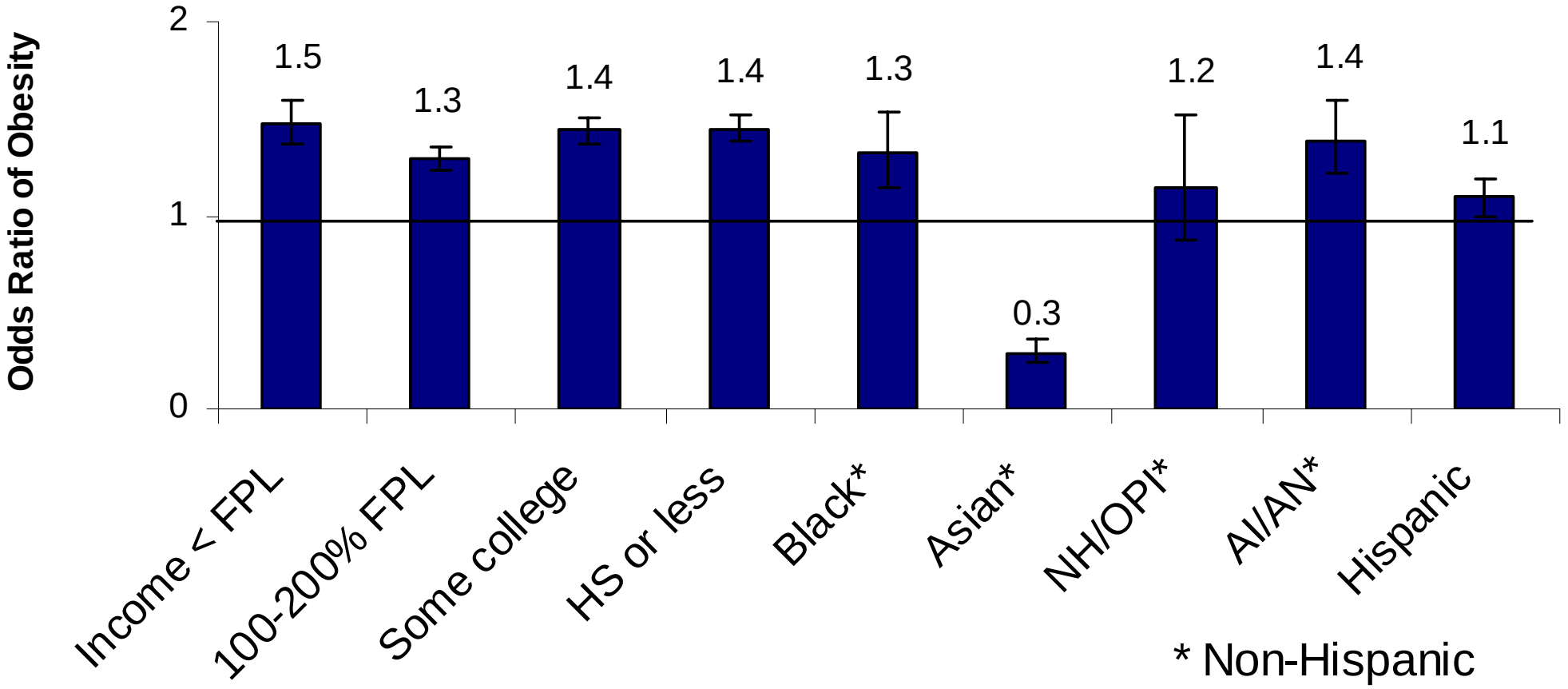
- Age - 5 categories
- Income as percent of federal poverty level
- Education
- Race / Ethnicity - 6 groups

Individual level factors - BRFSS



Individual level factors

Odds Ratios of Obesity for Individual Sociodemographic Factors (relative to college graduate, white, non-Hispaninc, with income > 200% federal poverty level)



Area Based Factors - Census

All factors significant , P<.001

- Percent below federal poverty level
- Median household income
- Percent receiving public assistance
- Percent with supplemental security income

- Percent age 25+ with college degree
- Percent age 25+ with less than HS education

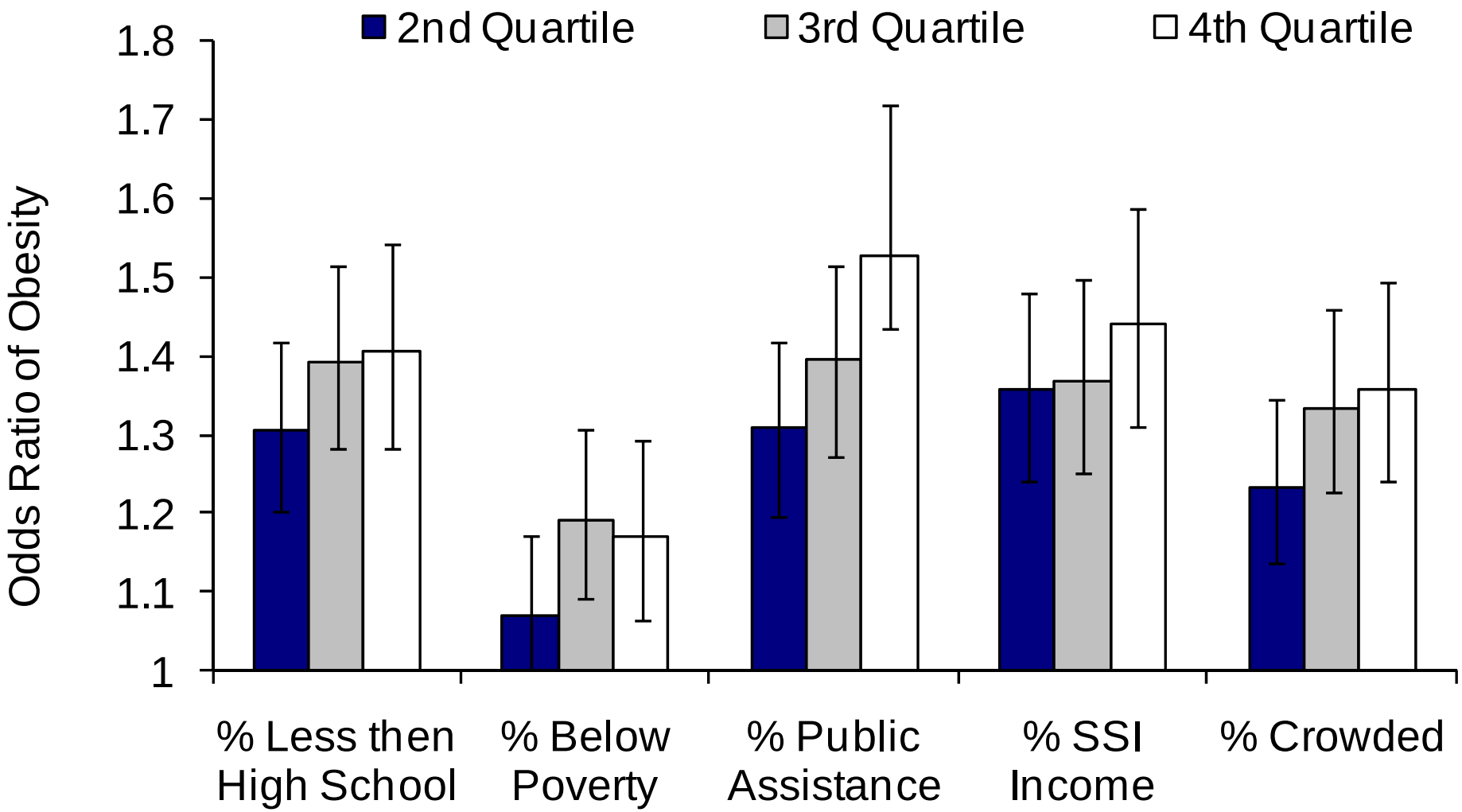
- Percent with assets - income from rent, dividends, or interest
- Median home value
- Percent of K-12 age children in private school

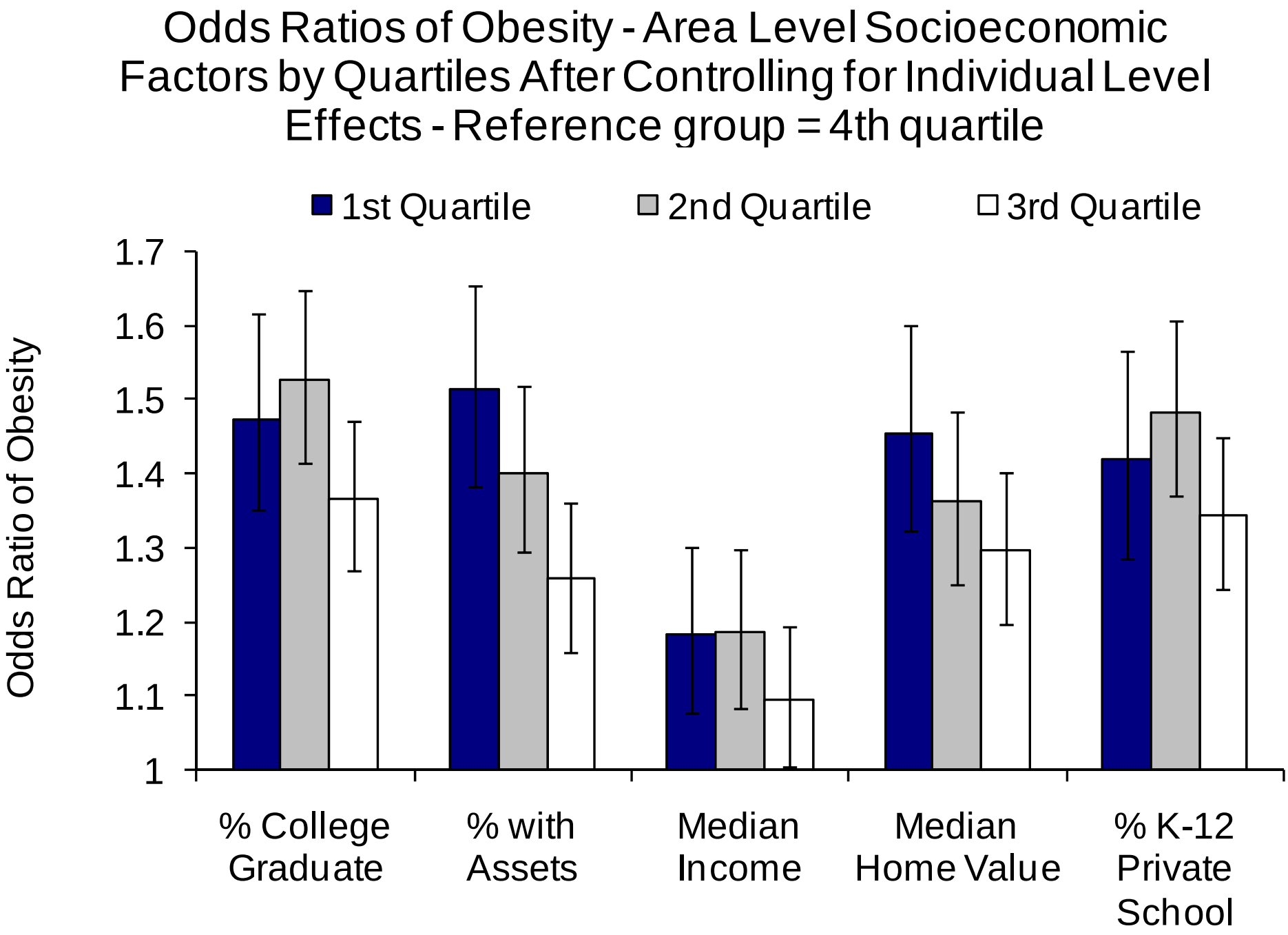
More Area Based Factors

All factors significant , P<.05

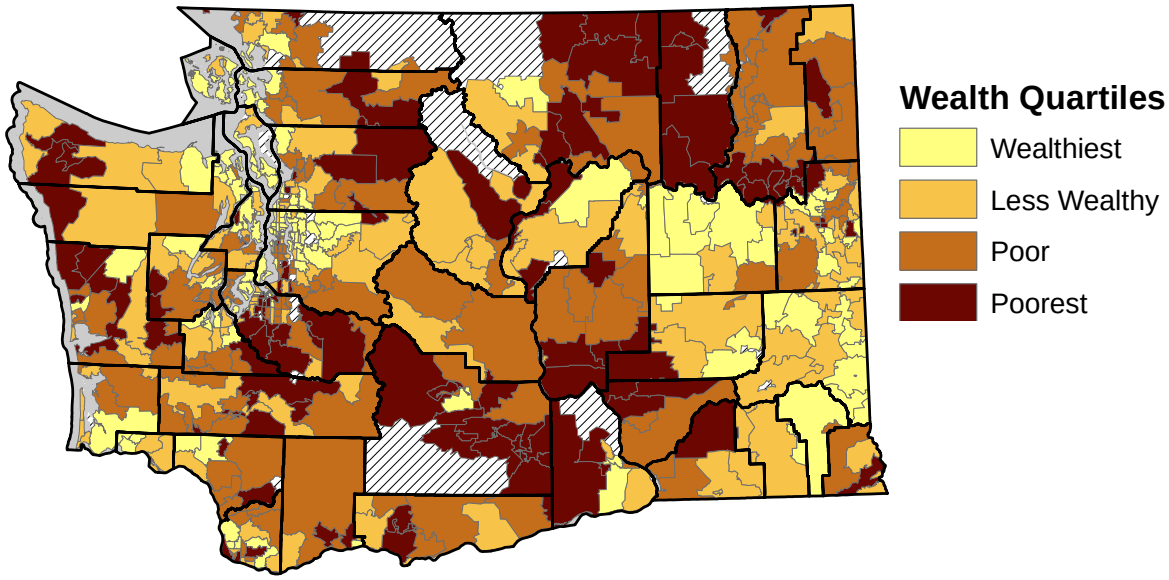
- Percent of households with more than one person per room
- Percent age over 65 years
- Percent in at-risk race/ethnic group: Black, Hispanic, American Indian / Alaska Native; weak effect
- Percent rural; marginal, non-linear effect:

Odds Ratios Obesity - Area Level Socioeconomic Factors by Quartiles, After Controlling for Individual Level Effects - Reference group = 1st quartile

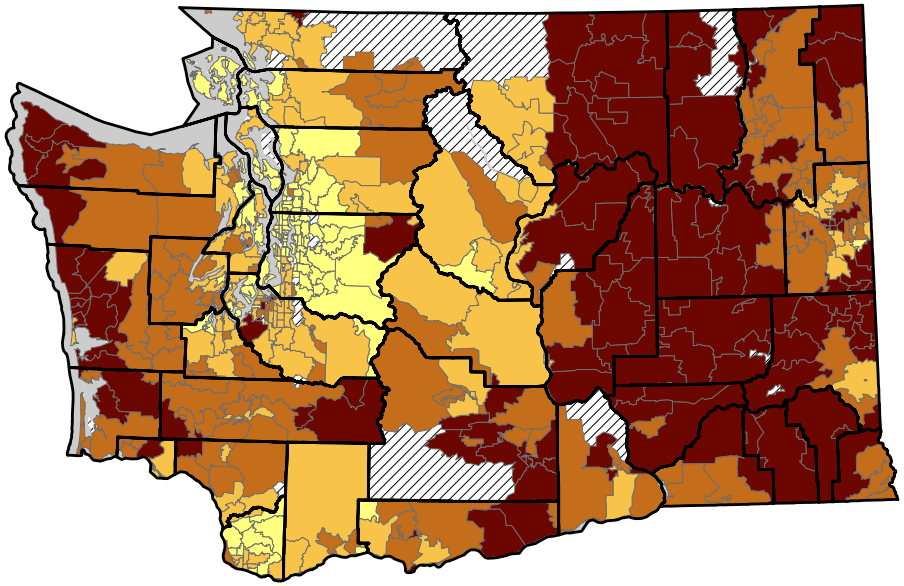



Odds Ratios of Obesity - Area Level Socioeconomic Factors by Quartiles After Controlling for Individual Level Effects - Reference group = 4th quartile
1st Quartile
2nd Quartile
3rd Quartile
Odds Ratio of Obesity
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
% College Graduate
% with Assets
Median Income
Median Home Value
% K-12 Private School

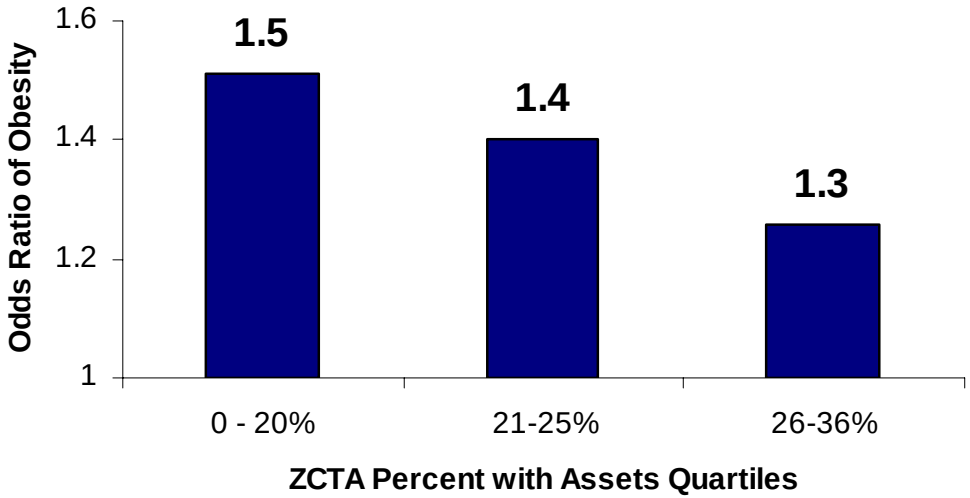
Percent w/ income from interest, rent, or dividends by ZCTA - Quartiles



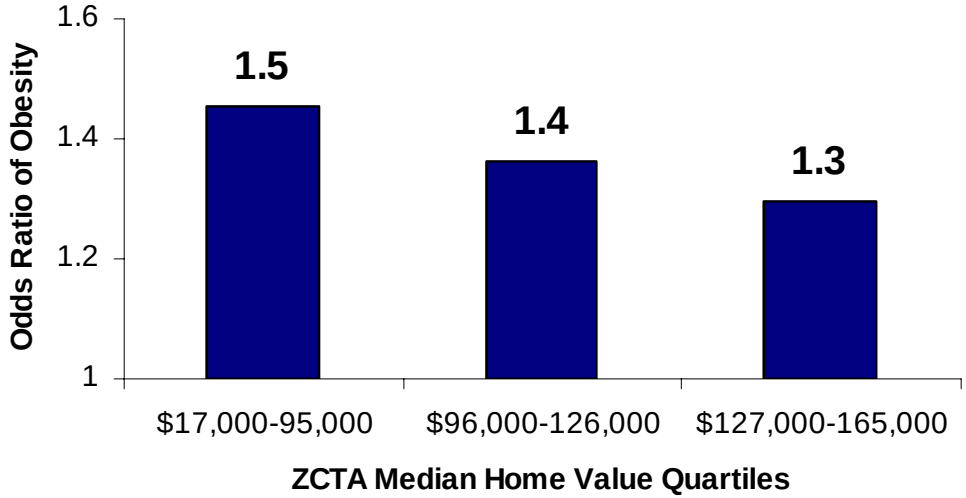
Median Home Value by ZCTA - Quartiles



Odds of Obesity by ZCTA Percent with Assets - Relative to Top Quartile (45-83%)



Odds of Obesity by ZCTA Median Home Value - Relative to Top Quartile ($166,000-227,000)



Area-Level Variable Selection

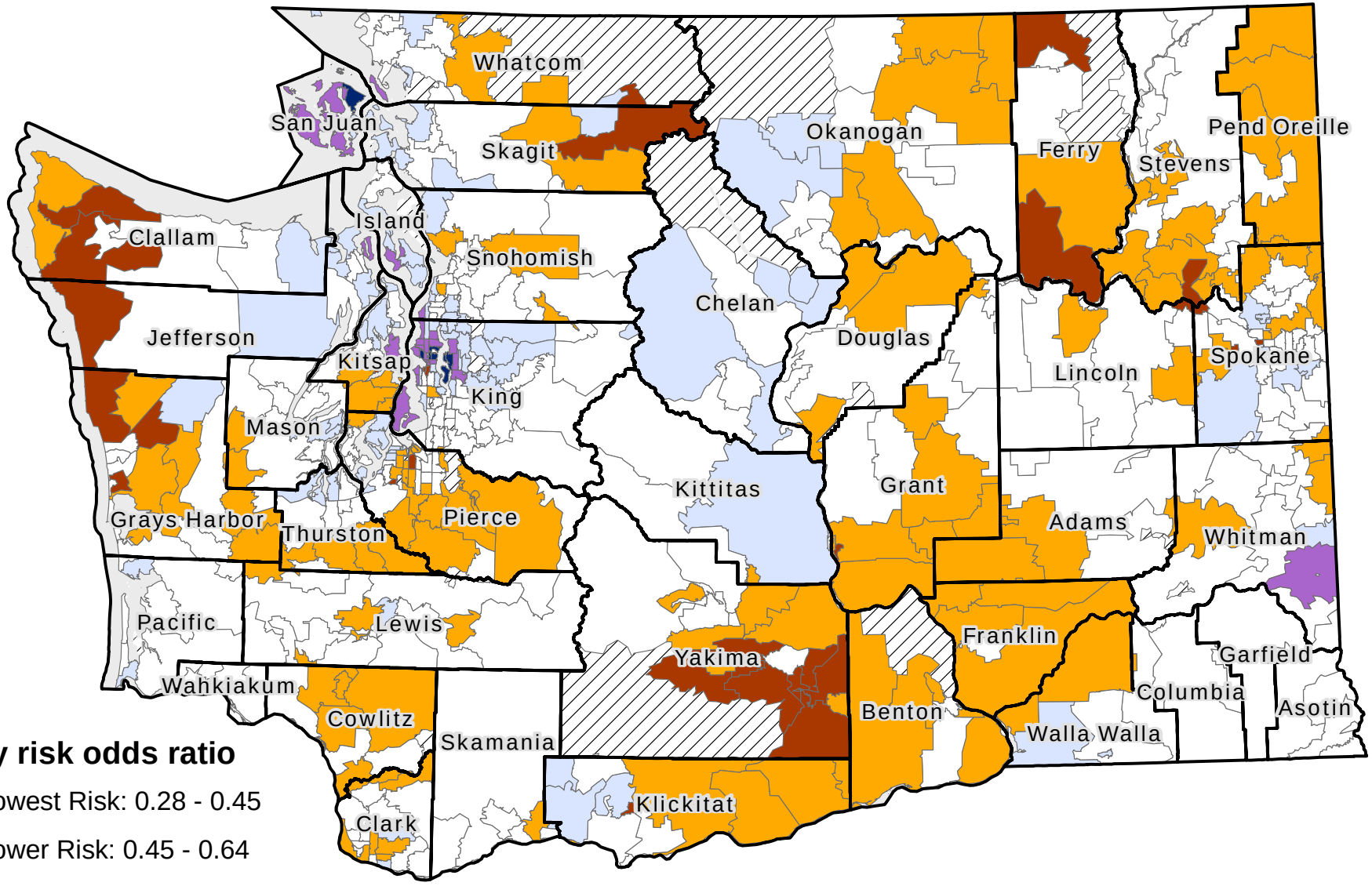
- Include at least one measure each related to income, wealth, and education
- Reduce correlation among factors as much as possible
- Linearity of effect for each factor
- All factors significant
- Best overall model fit based on likelihood ratio

Final Predictive Model

- Includes all individual level factors, plus:

ZIP Code Level Factors	Coefficient (b)	P
% College Education	-0.00721	0.000
Median Household Income	**9.31E-06**	0.000
Median Home Value	-2.40E-06	0.000
% Receiving Public Assistance	0.027226	0.001
% Age 65+ above median value	-0.10541	0.004
Intercept	-1.95176	0.000

Socioeconomic Risk of Obesity in WA State



Obesity risk odds ratio

- Lowest Risk: 0.28 - 0.45
- Lower Risk: 0.45 - 0.64
- Low Risk: 0.65 - 0.84
- Average Risk: 0.85 - 1.04
- High Risk: 1.05 - 1.24
- Higher Risk: 1.25 - 1.90

Insufficient data

Odds Ratios:

Min = 0.26 Avg = 0.96

Max = 1.90 SD = 0.21

Socioeconomic Risk Of Obesity by ZCTA

Obesity risk odds ratio

- Lowest Risk: 0.28 - 0.45
- Lower Risk: 0.45 - 0.64
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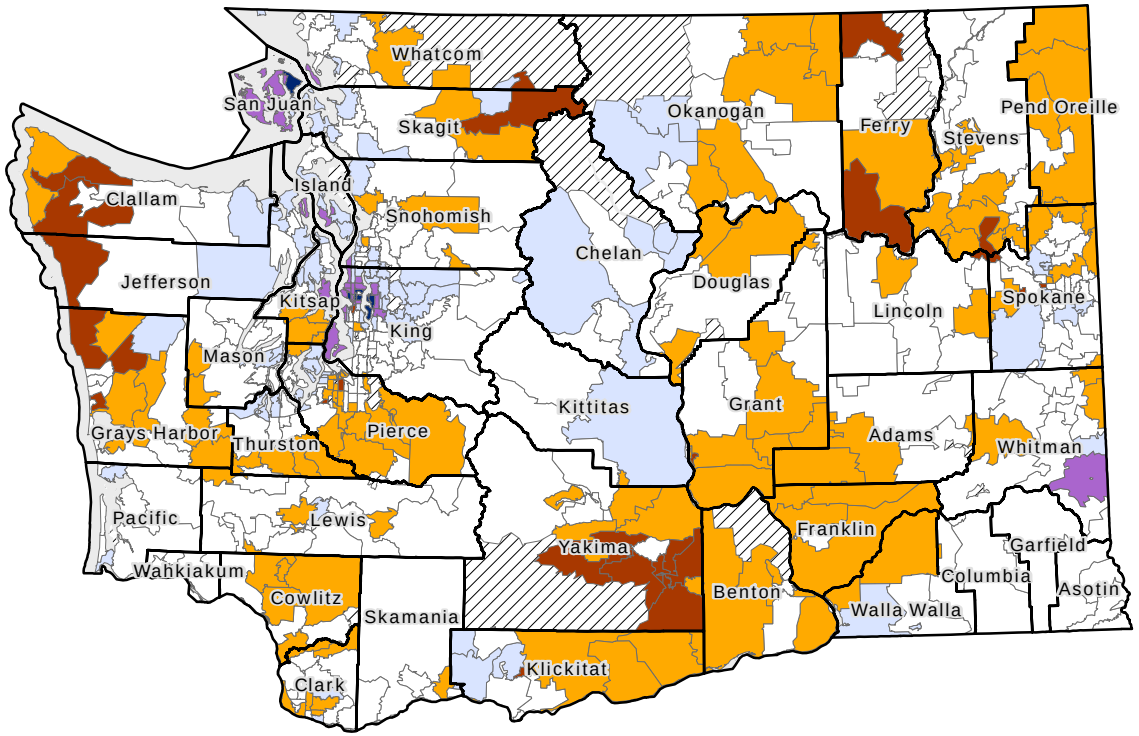

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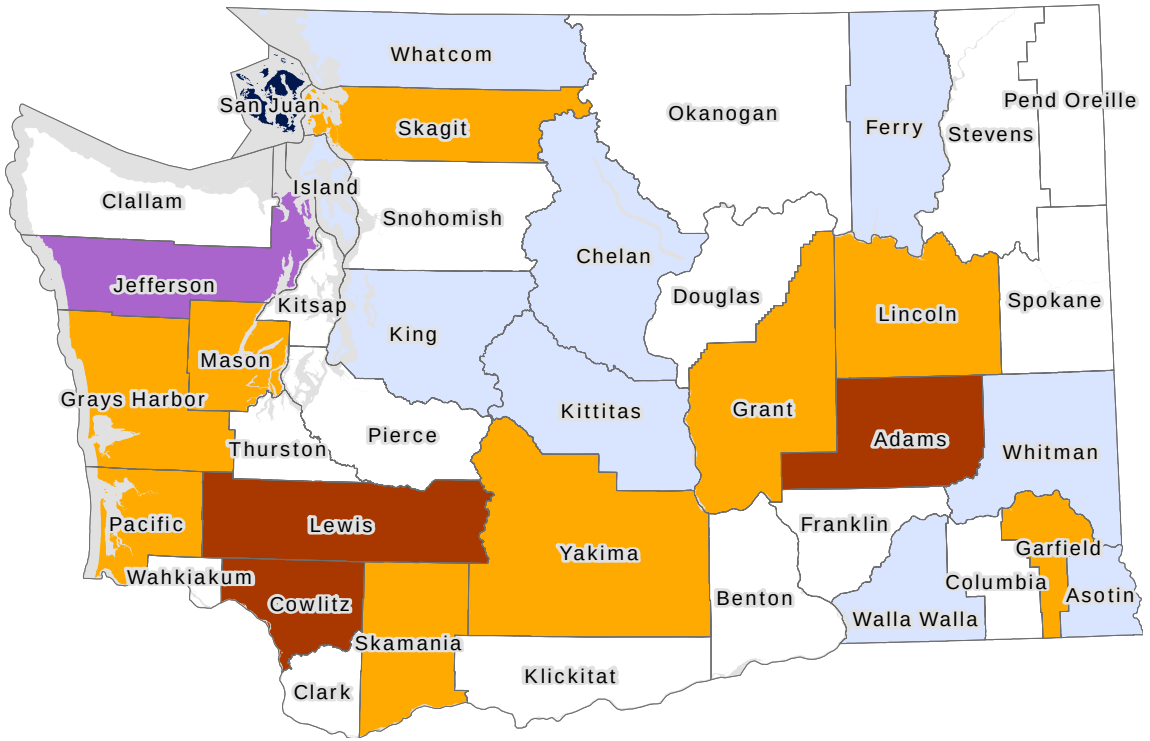
Obesity Prevalence By County

Obesity Prevalence

- 13.7-14.6% (Less then -2.5 SD)
- 14.7 - 19.6% (-2.5 to -1.5 SD)
- 19.7 - 24.7% (-1.5 to -0.5 SD
- 24.7 - 29.8 % (Average)
- 29.9 - 34.8% (+0.5 to +1.5 SD)
- 34.9 - 38.1% (over +1.5 SD)



Diabetes and Smoking Models

(ZIP-Code Level Factors)

Diabetes	Coefficient (b)	P
% College Education	-0.00552	0.011
Median Home Value	-1.40E-06	0.001
% Receiving Public Assistance	0.02942	0.000
Intercept	-2.701	0.000

Odds Ratios by ZIP Code:

Min = 0.28 Avg = 1.01

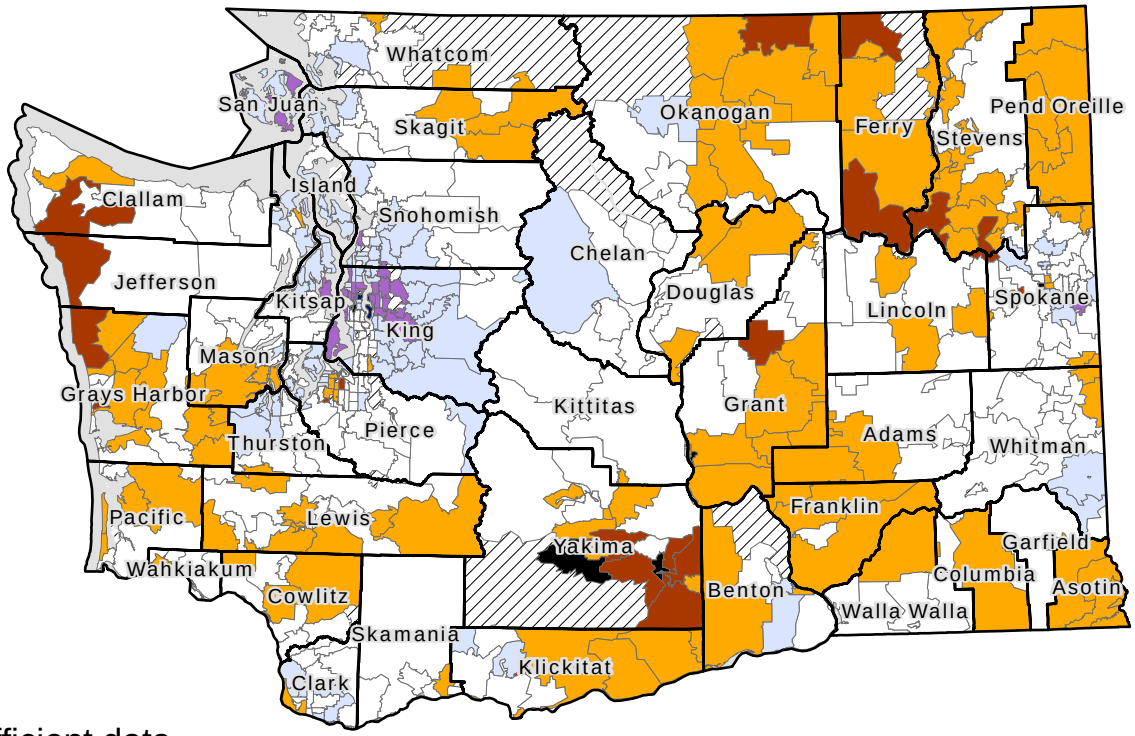
Max = 2.16 SD = 0.22

- Note: For the diabetes model, individual age is treated as a continuous covariate.

Socioeconomic Risk of Diabetes by ZCTA

Diabetes Risk Odds Ratio

- Lowest Risk: 0.27 - 0.47
- Lower Risk: 0.48 - 0.68
- Low Risk: 0.68 - 0.89
- Average Risk: 0.90 - 1.10
- High Risk: 1.11 - 1.30
- Higher Risk: 1.31 - 1.51
- Highest Risk: 1.52 - 2.16

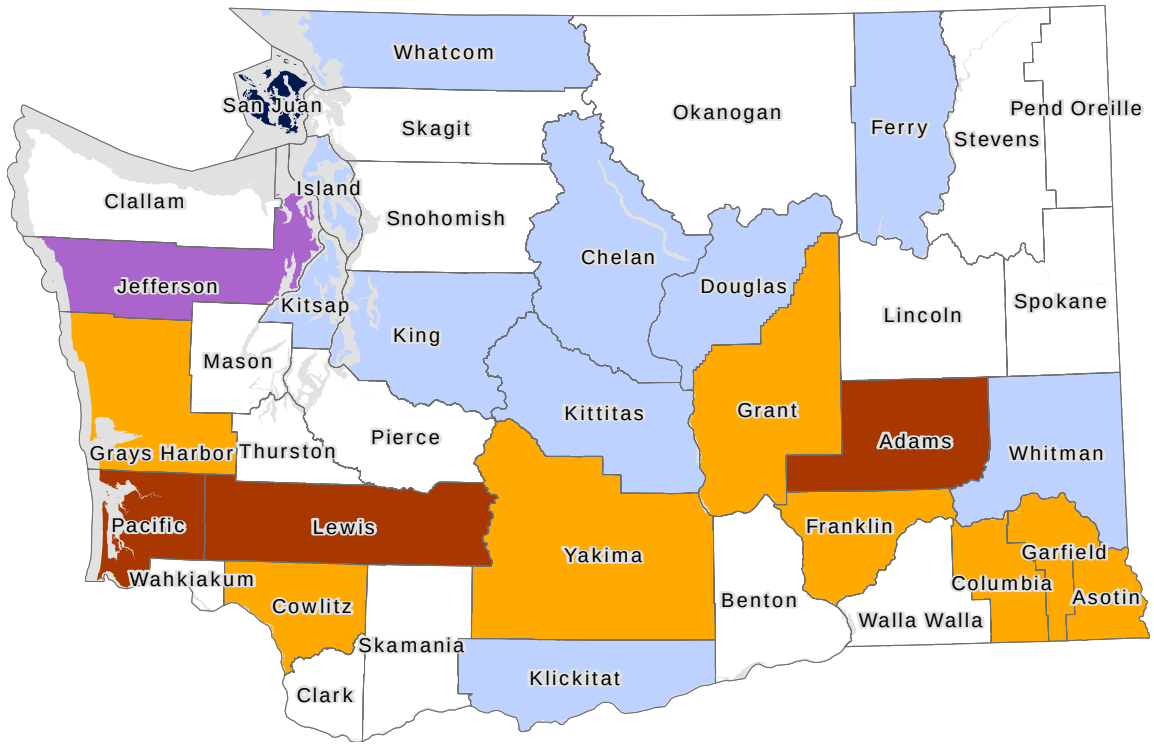


Insufficient data

Diabetes Prevalence By County

Diabetes Prevalence

- 2.9 - 3.0% (less than -2.5 SD)
- 3.0 - 4.7 % (-2.5 to -1.5 SD)
- 4.8 - 6.5 % (-1.5 to -0.5 SD)
- 6.5 - 8.2% (Average)
- 8.3 - 10.0 % (+0.5 to +1.5 SD)
- 10.1 - 12.3 % (More than +1.5 SD)



Diabetes and Smoking Models

(ZIP-Code Level Factors)

Smoking	Coefficient (b)	P
% Less than HS Education	**-0.01881**	0.000
% With Assets	-0.02319	0.000
% Receiving Supplemental Security Income	0.02825	0.001
% Age 65+ (continuous)	0.01543	0.000
Intercept	-1.53127	0.000

Odds ratios by ZIP code:

Min = 0.21 Avg = 1.03

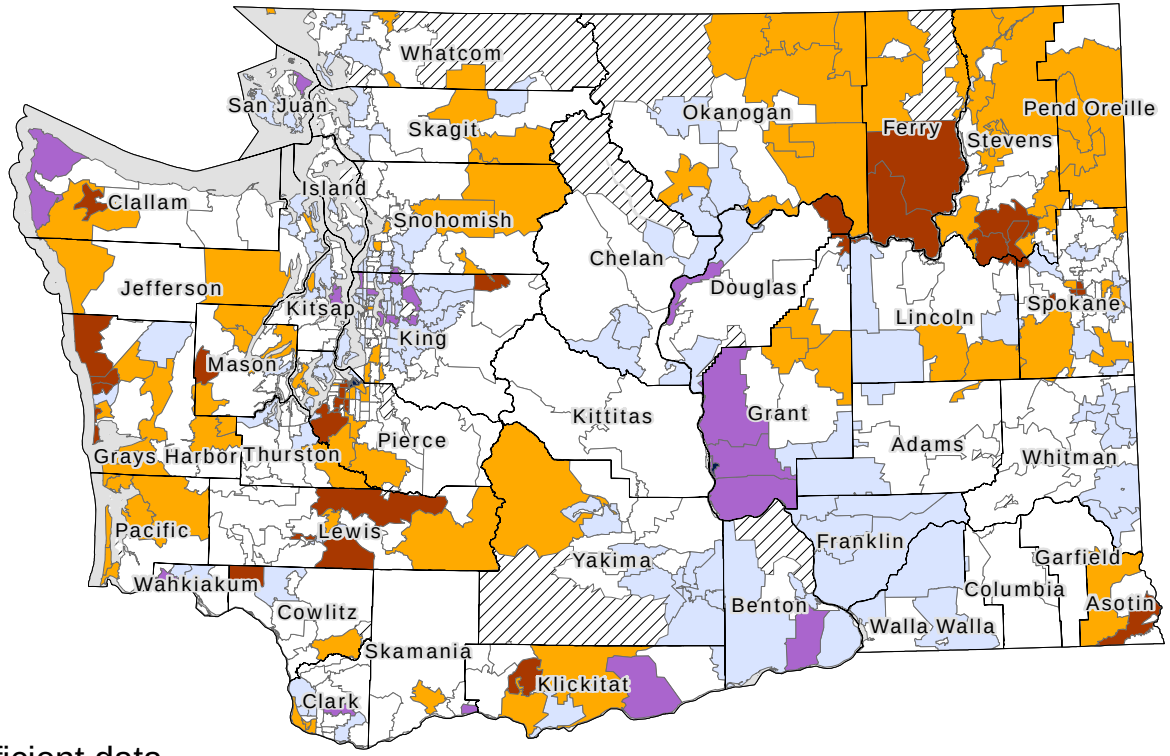
Max = 2.34 SD = 0.25

- Note: Co-linearity reverses the sign of education effect for smoking.

Socioeconomic Risk of Smoking by ZCTA

Smoking Risk Odds Ratio

- Lowest Risk: 0.20 - 0.44
- Lower Risk: 0.45 - 0.67
- Low Risk: 0.67 - 0.89
- Average: 0.90 - 1.27
- High Risk: 1.28 - 1.35
- Higher RisK: 1.36 - 2.35



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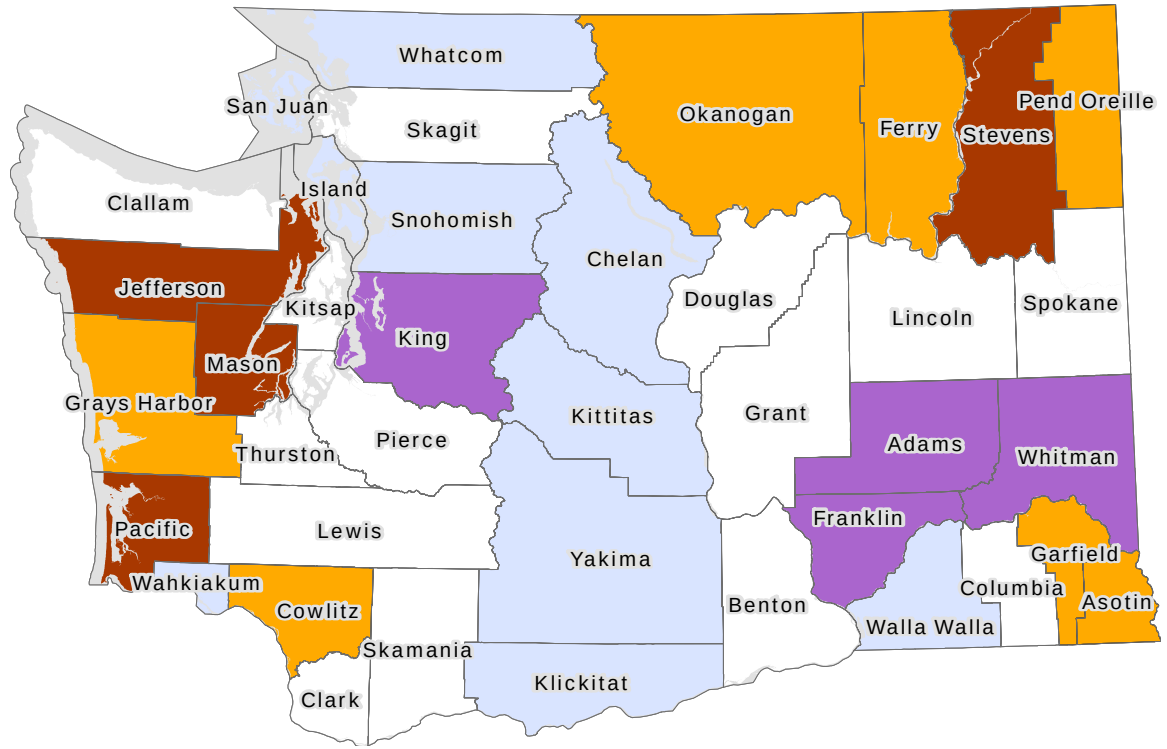
Smoking Prevalence By County

Smoking Prevalence

- 11.0 - 12.0 % (below -1.5 SD)
- 12.1 - 16.5 % (-1.5 to -.5 SD)
- 16.6 - 21.0 % (Average)
- 21.1 - 25.5 % (+.5 to +1.5 SD)
- 25.5 - 27.7% (More than +1.5 SD)



Correlation among factors

ZIP-Code Level Factors

	College Grad	Less than HS	% Poverty	Median Income	% with Assets	% Private school	% Public Assistance	% SSI	Median Home Value
College Grad	1								
Less than HS	**-0.7224**	1							
% Poverty	-0.3938	0.6111	1						
Median Income	0.5753	-0.5793	**-0.8061**	1					
% with Assets	**0.7757**	-0.6945	-0.5788	0.6084	1				
% Private school	0.6921	-0.4759	-0.288	0.3624	0.5334	1			
% Public Assistance	-0.6142	0.615	0.6789	-0.6502	-0.6851	-0.4061	1		
% SSI	-0.5323	0.5098	0.6232	-0.6439	-0.555	-0.3225	**0.7514**	1	
Median Home Value	**0.7809**	-0.5664	-0.4943	**0.7188**	0.6627	0.675	-0.5769	-0.5189	1

Statistical Model

$$logit(y_{i,j}) = (\beta_0 + \zeta_j) + \beta_1 x_{1,j} + \ldots + \beta_k x_{k,i,j} + \cdots + \epsilon_{i,j}$$

- Where

  $y_{i,j}$ = Obesity status (binary) of individual i in zip code j

  $x_{1,j} \ldots x_{p,i,j}$ = individual and area level factors

  $(\beta_0 + \zeta_j)$ = fixed baseline + random intercept in zip code j

  $\epsilon_{i,j}$ = residual error

References

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