

Differences in TBI Prevalence, Outcomes, and Symptoms in Colorado

CB Eagye



TBI Prevalence Research Studies



Initial Research Project

- Colorado Study of TBI Prevalence and Associated Outcomes - 2007
- Funded by the CDC
- Statewide population-based survey to gather the lifetime history of TBI using a random-digit-dial method
- 2,701 adults aged 18 and over interviewed using a modified CATI version of the OSU-TBI-ID
- Plus standardized current assessments of 11 post-concussive symptoms and 10 negative outcomes



Initial Research Project

- **Three Sections of Survey Questions:**
 - Random selection of survey participants following CDC BRFSS methodology
 - Modified CATI version of the Ohio State TBI Identification Method (OSU TBI-ID) gathering the lifetime history of traumatic injuries focusing on TBI, gathering enough information to characterize their severity and care paths (hospitalized, ED visit, physician office, or no medical care)
 - Assess current demographics, post-concussive symptoms, and outcomes



Initial Research Project

- **Primary Objective:**
 - To estimate the number of adults with a lifetime history of traumatic brain injury (TBI) and current negative symptoms and outcomes in the state of Colorado



Secondary Analysis Research Project

- **Using the same dataset:**
 - Respondents from the sample were weighted to the 2016 population characteristics of 14 administrative Planning Regions in Colorado using iterative proportional fitting, to estimate the prevalence of TBI and negative outcomes and symptoms in those Regions
 - Plotted prevalence results on a series of Planning Region-specific bar charts
 - Funded by MINDSOURCE



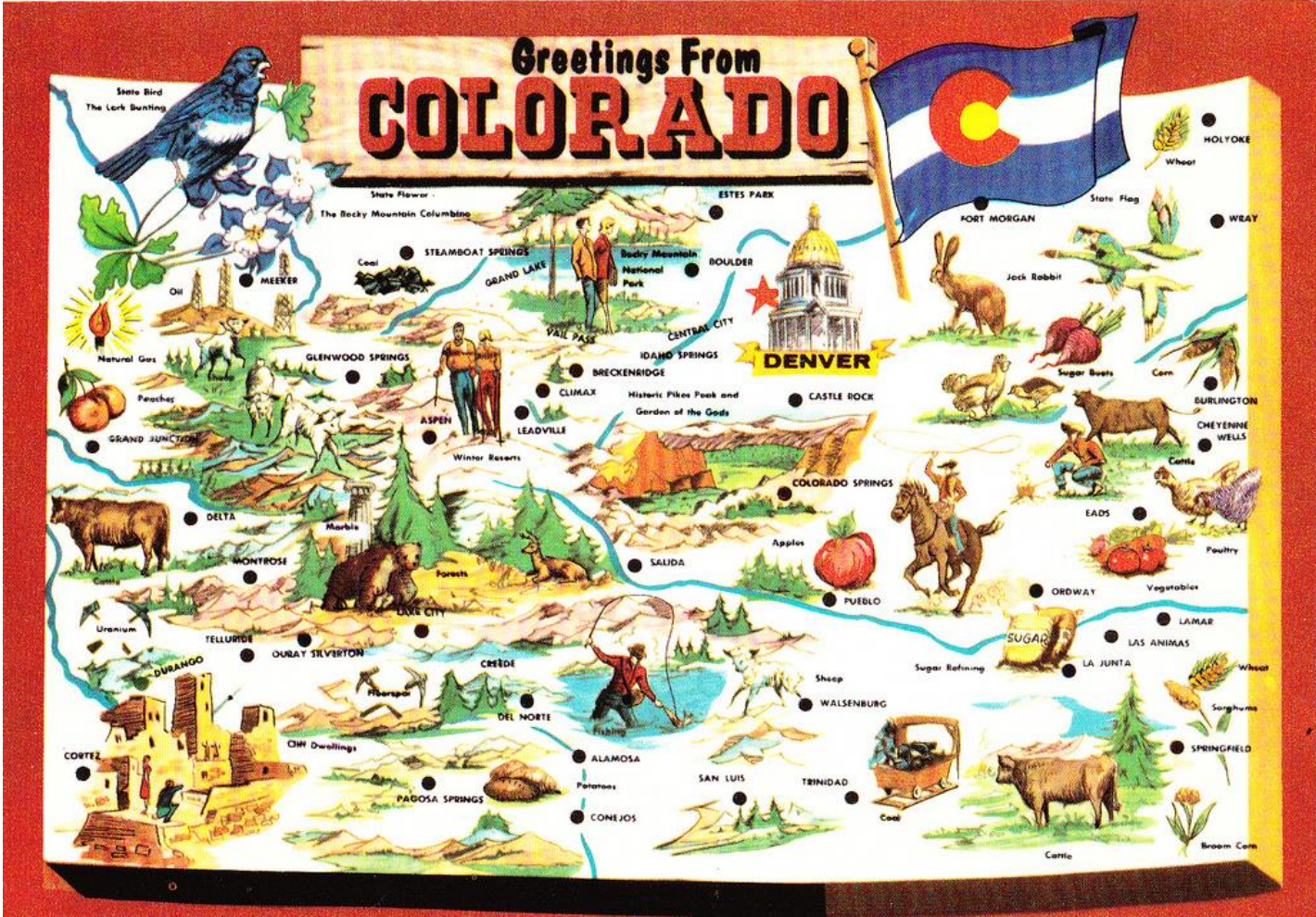
Tertiary Analysis Research Project

- **Using the same dataset:**
 - Respondents from the sample were weighted to the 2016 population characteristics of urban, rural, and frontier areas using iterative proportional fitting, to estimate the prevalence of TBI and negative outcomes and symptoms
 - Plotted prevalence results on a map
 - Investigated sample data in terms of race/ethnicity
 - Funded by MINDSOURCE



Maps of Colorado

Our Fair State





Colorado Statewide Statistics



Injury and TBI Rates in Colorado

- N = 2,701
- 19.8% Report no traumatic injury in their lifetime
- 37.7% Report one or more traumatic injuries, but none involving TBI
- **42.5% Report one or more mild to severe TBI**



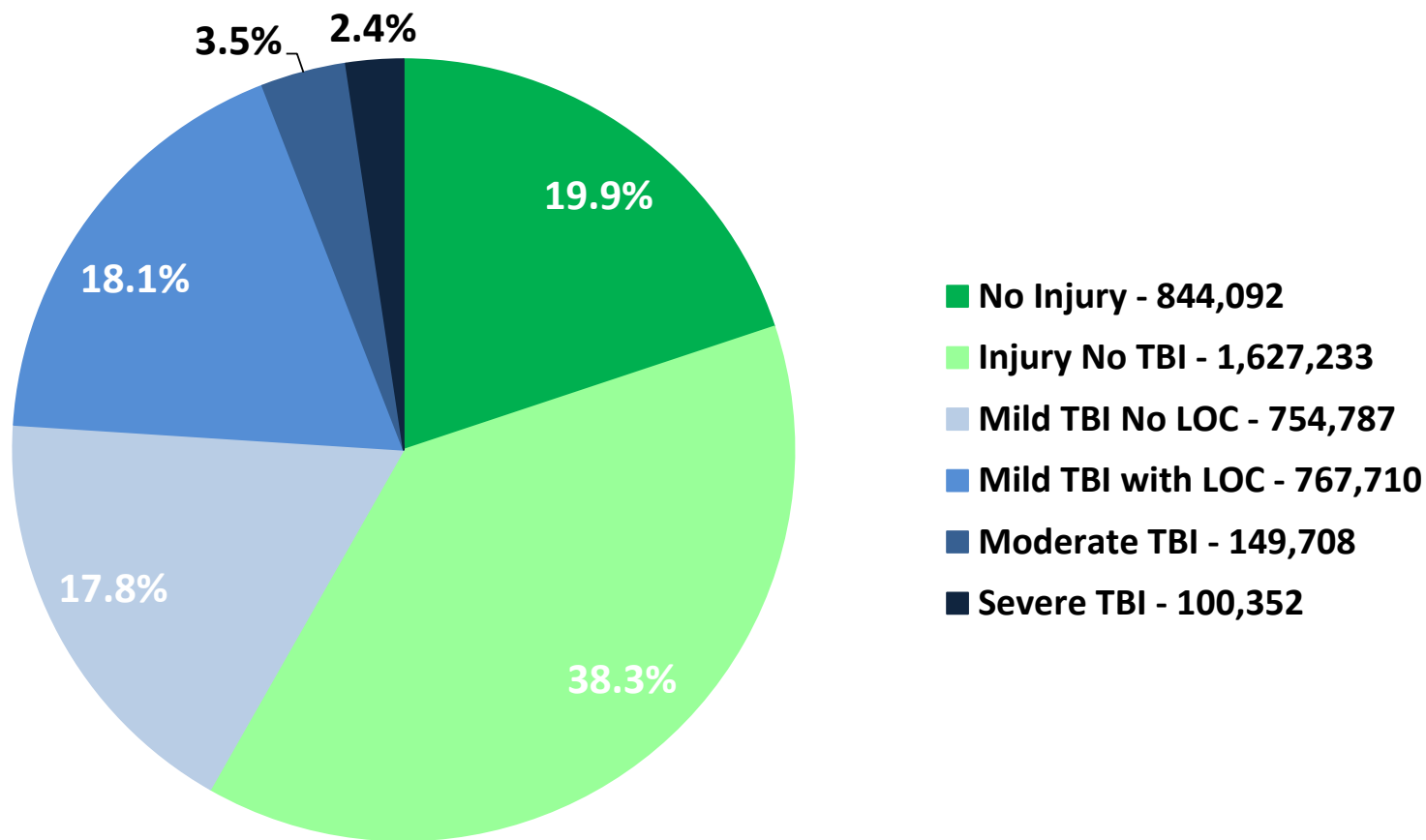
Rates by Most Severe TBI Reported

- **42.5% Report 1 or more mild to severe TBI**
 - 18.1% Report mild TBI without LOC
 - 18.4% Report mild TBI with LOC < 30 min
 - 3.6% Report moderate TBI (LOC > 30 min)
 - 2.4% Report severe TBI (LOC > 24 hours)
- **24.4% Report 1 or more TBI with LOC**

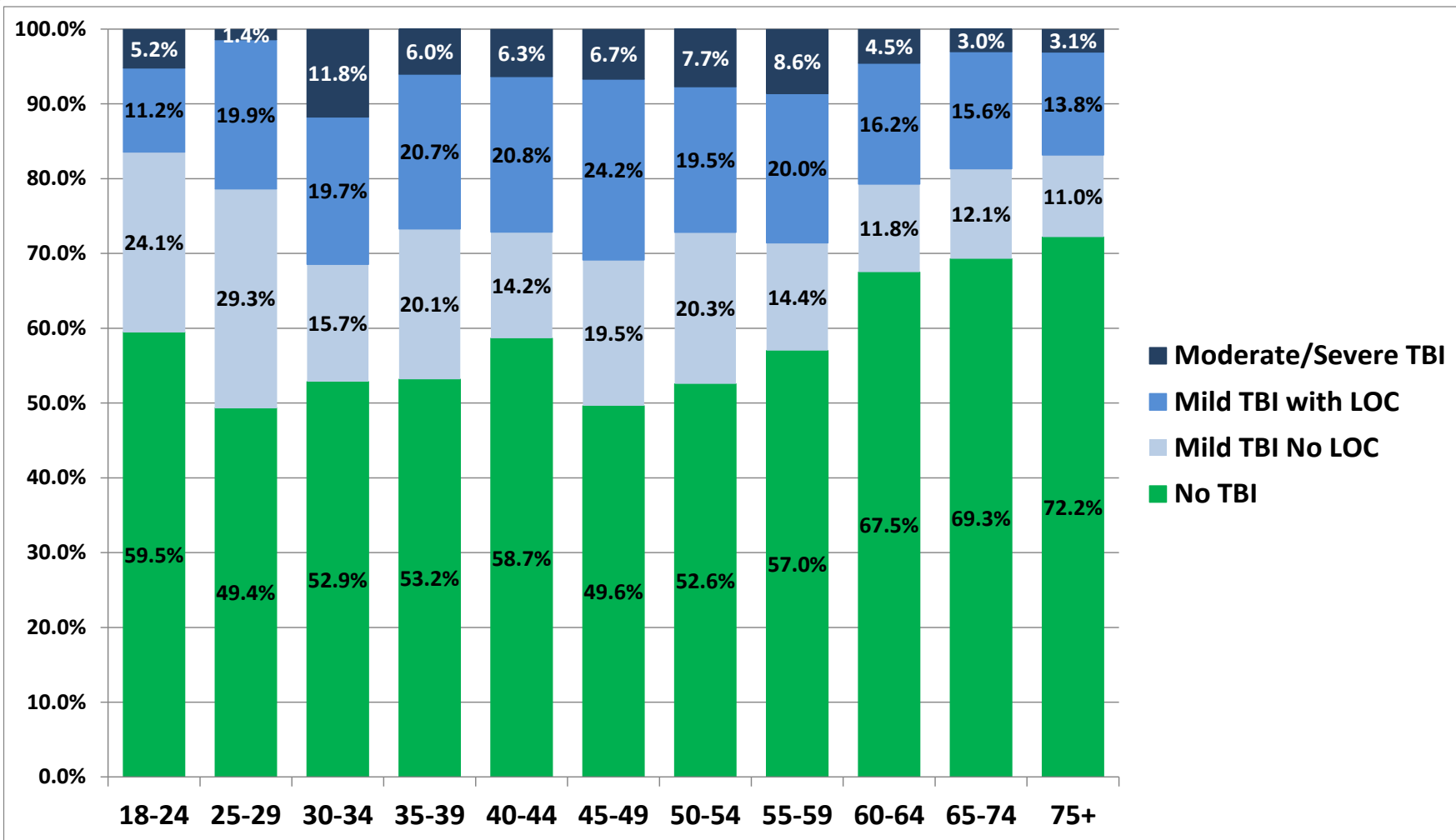
TBI Severity by Treatment Location

	No TBI	Mild TBI No LOC	Mild TBI with LOC	Moderate/ Severe TBI
Admitted to Hospital	10.5%	13.9%	18.4%	66.6%
Emergency Room	29.3%	41.2%	40.2%	24.9%
Physicians Office	16.3%	12.5%	9.6%	3.1%
No Treatment	43.8%	32.4%	31.7%	5.4%
Total	100.0%	100.0%	100.0%	100.0%

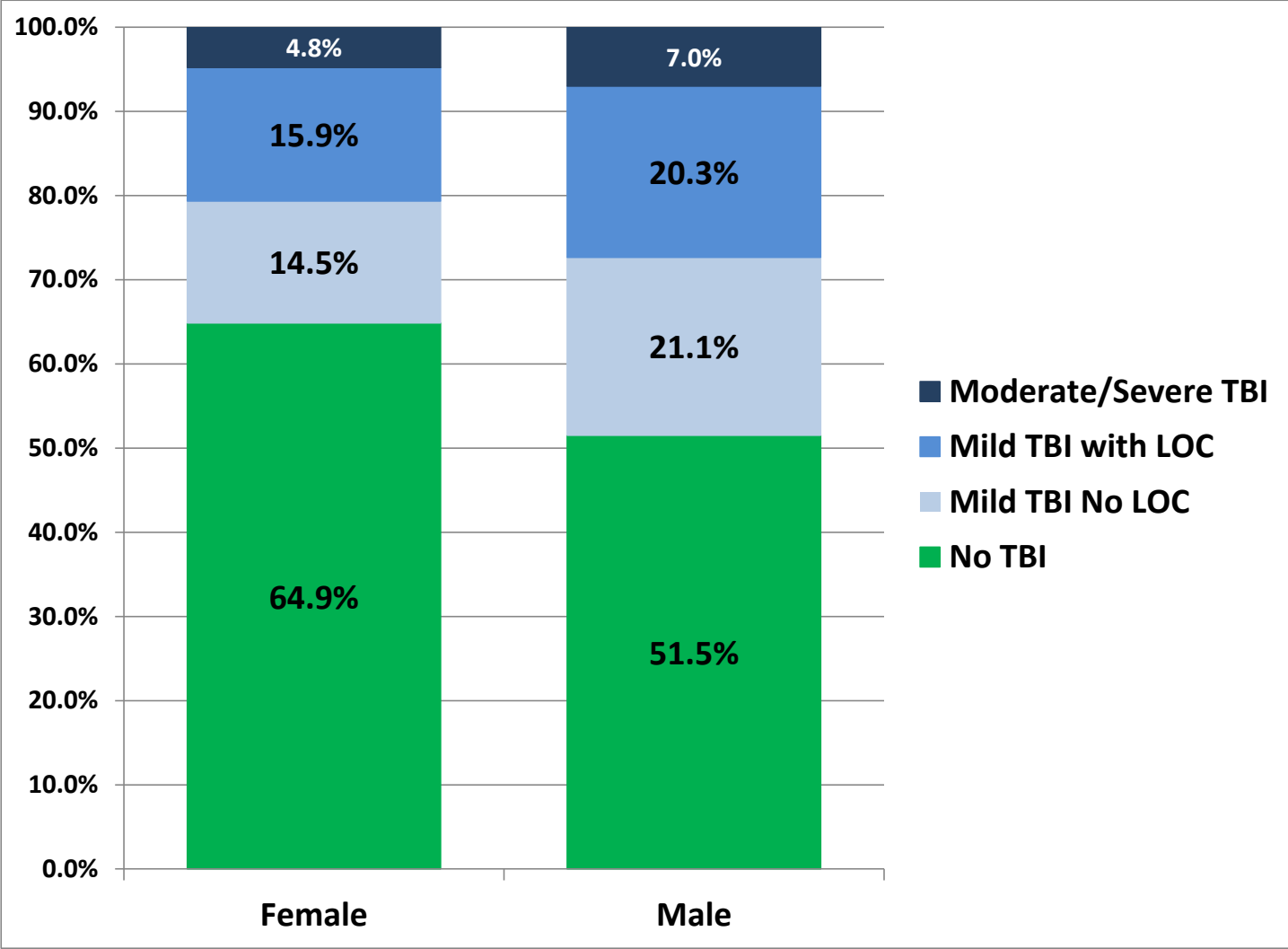
Statewide Age 18+: 6 Injury Groups



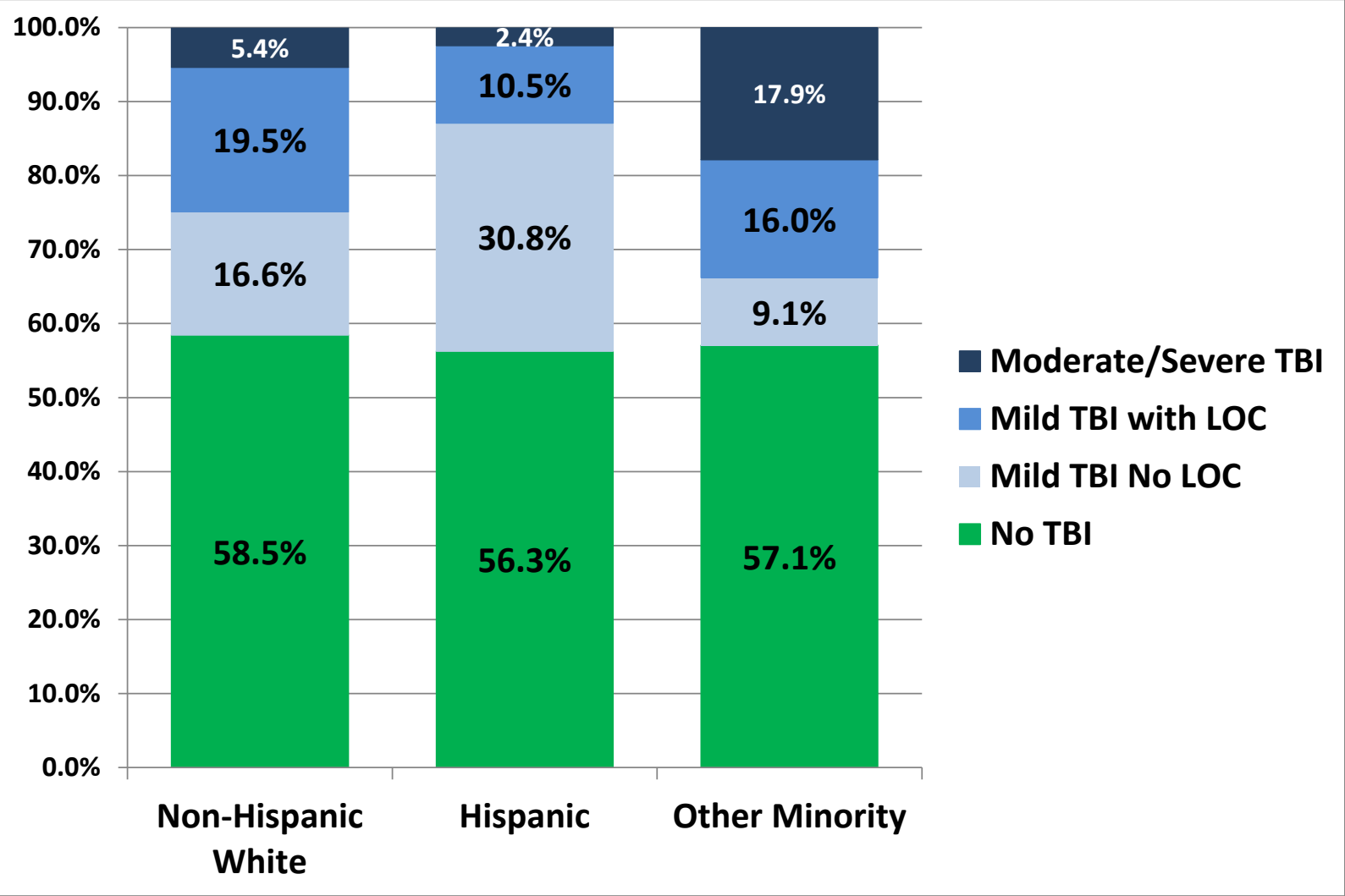
Statewide Injuries by Age Groups



Statewide Injuries by Sex



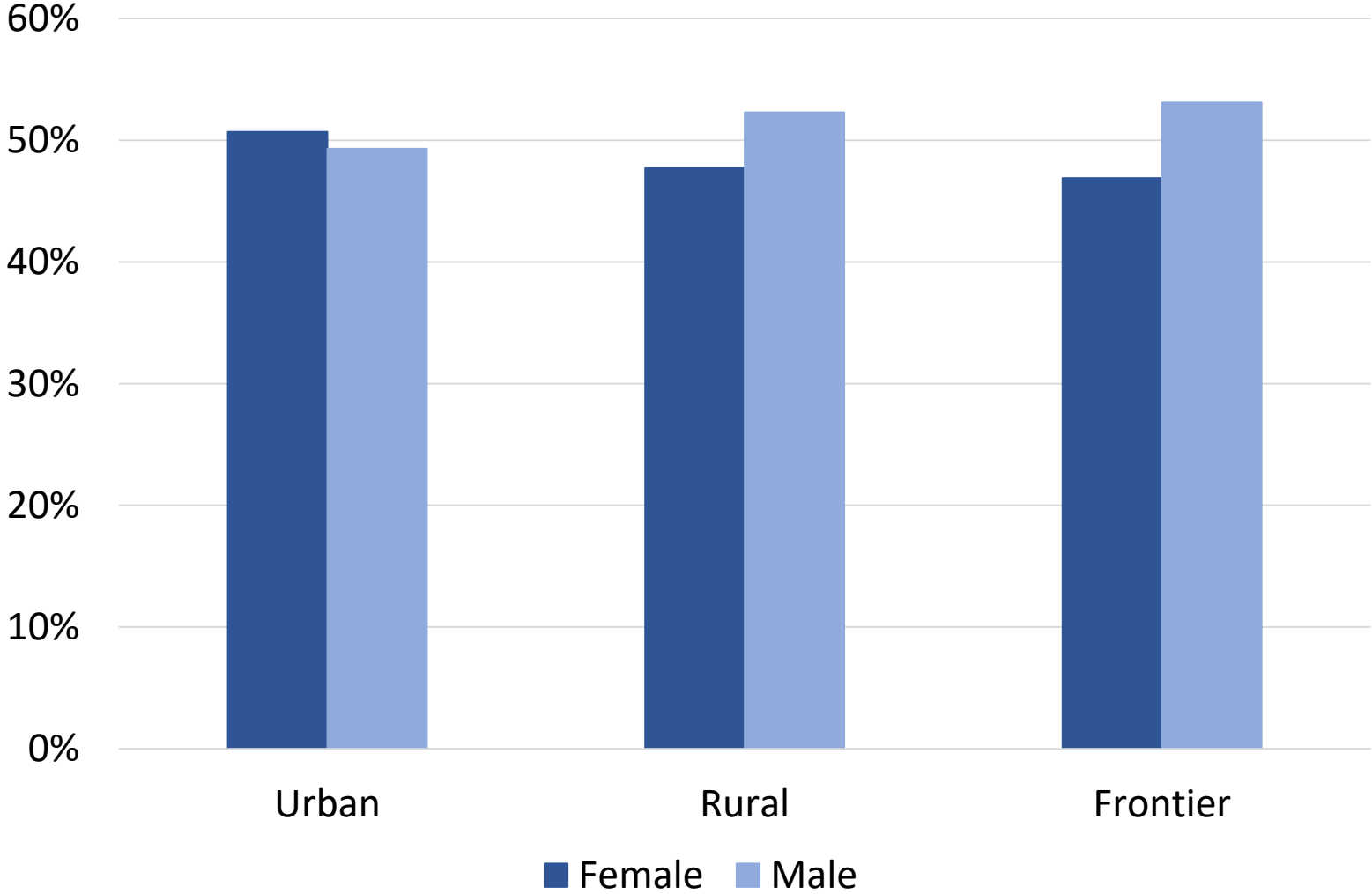
Statewide Injuries by Race



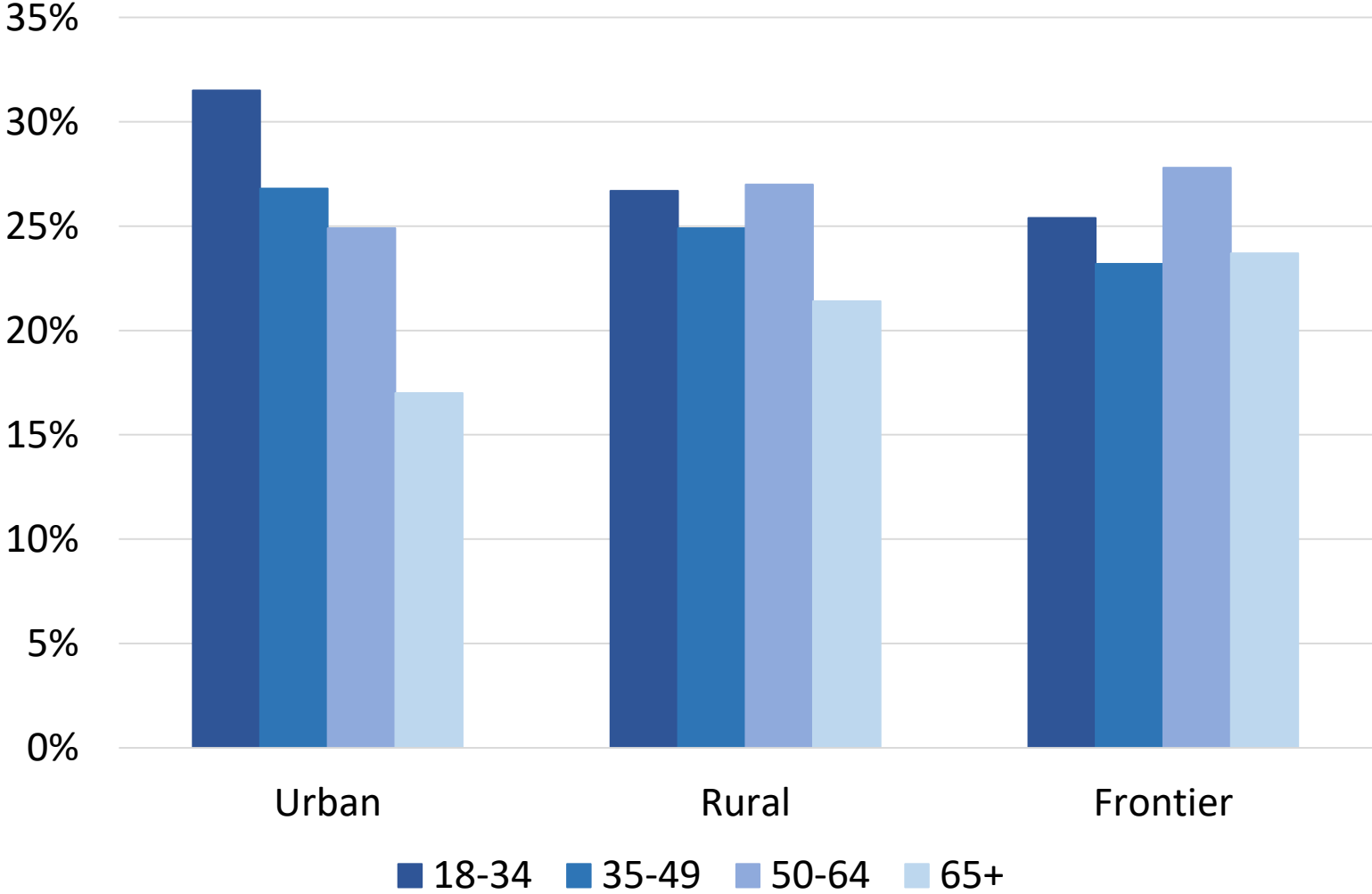


Regional Demographic Differences

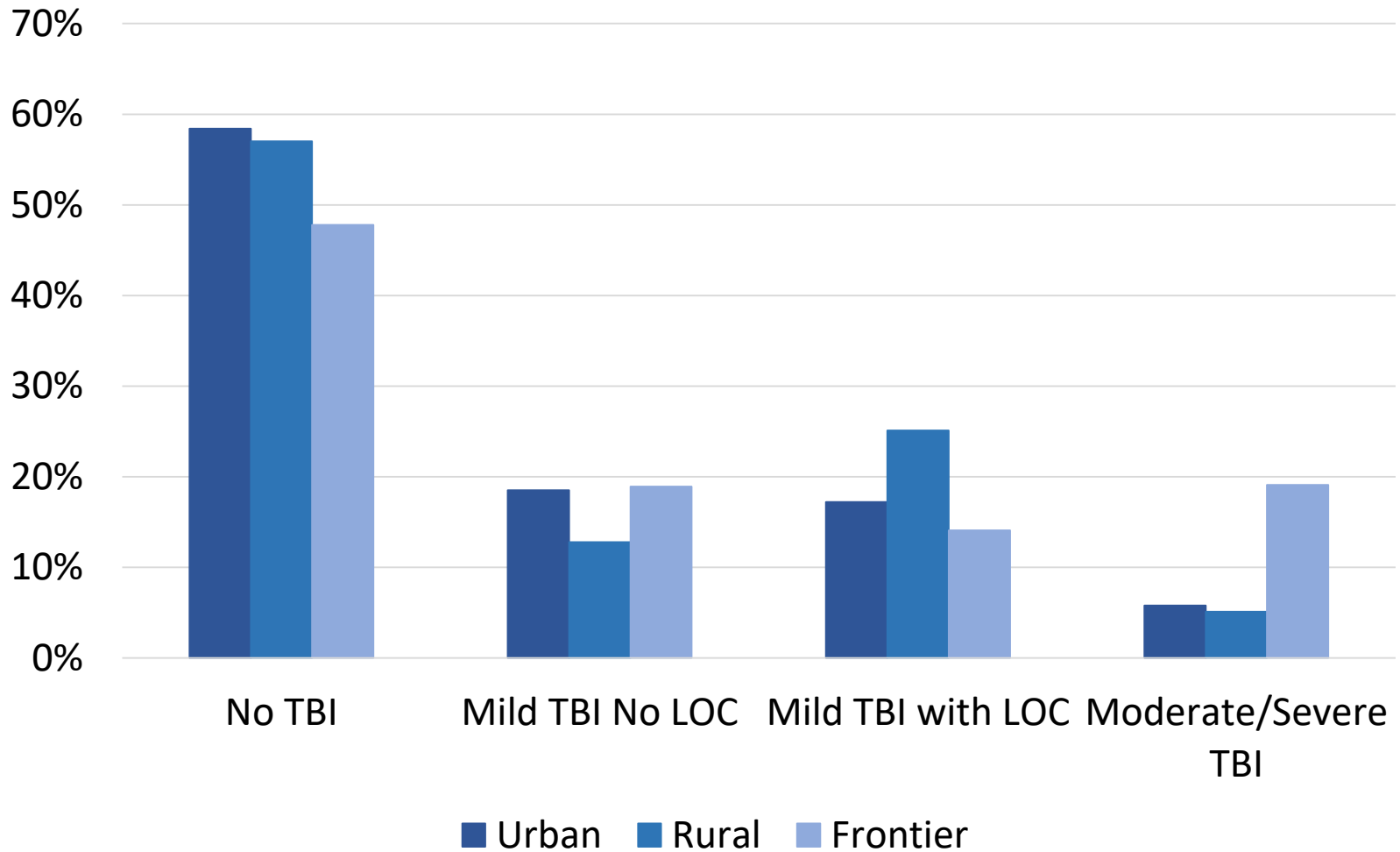
Gender Differences in Colorado



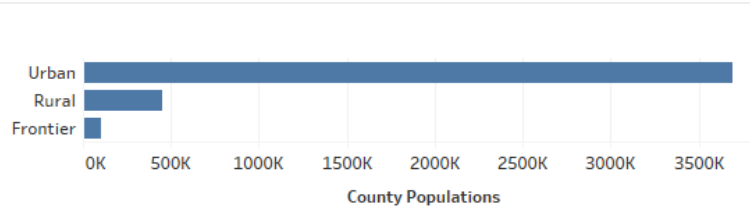
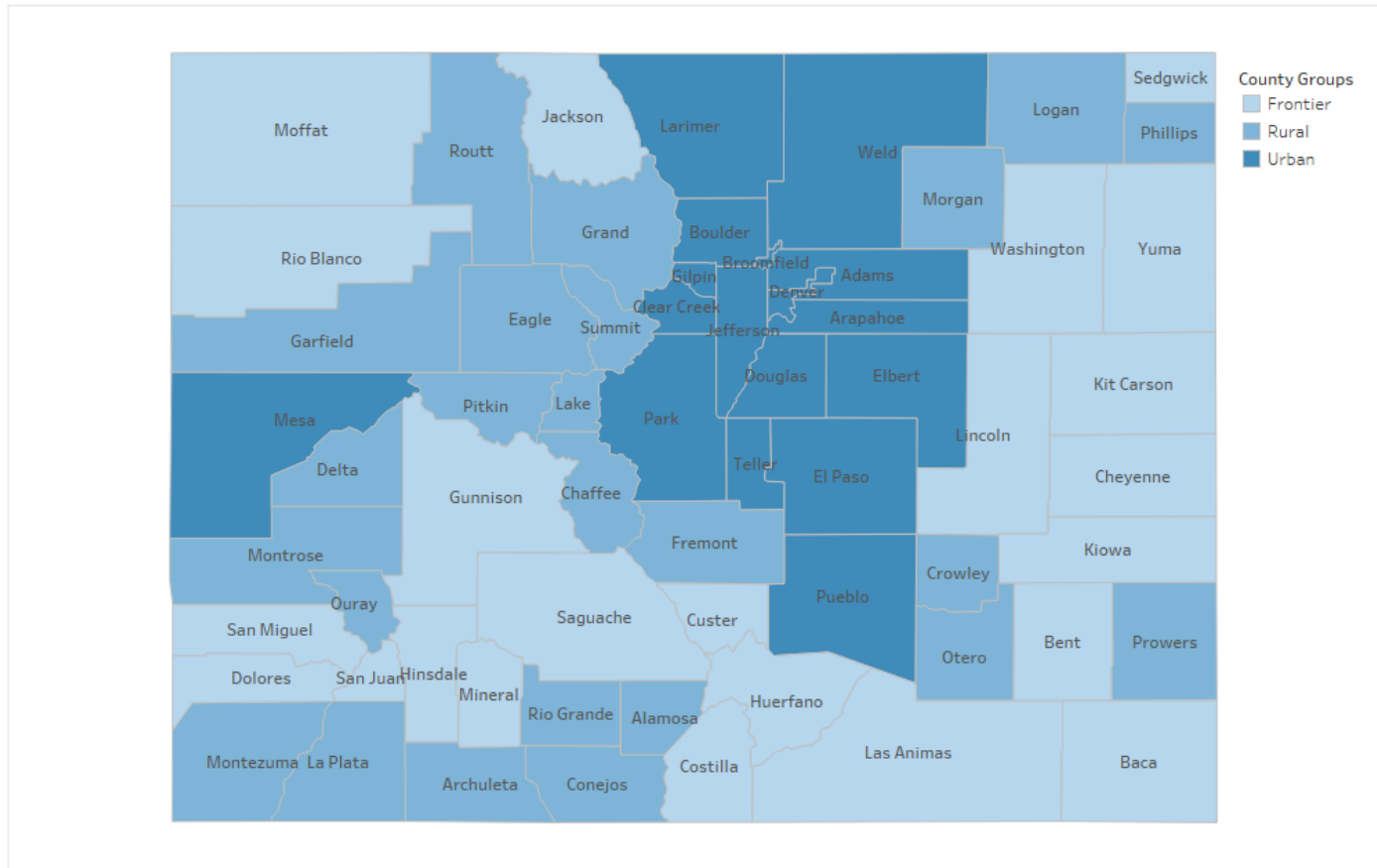
Age Differences in Colorado



TBI Prevalence Differences in Colorado



TBI Prevalence by Urban/Rural/Frontier



	% Mild TBI with LOC	% Moderate/Severe TBI
Frontier	14.1	19.1
Rural	25.1	5.1
Urban	17.2	5.8



Negative Outcomes and Post-Concussive Symptoms

Urban/Rural/Frontier Geographic Designations



Assessing Outcomes Associated with TBI

- Used standardized survey questions from other surveys to ask about current status
- All outcomes were dichotomized to determine the percentage of people reporting good vs negative outcomes
- Can't determine causation, only association
- Can relate the percent of people with negative outcomes to the severity of the TBI reported



Assessing Outcomes Associated with TBI

- **Disability** – yes to either “Are you limited in any way in any activities because of physical, mental, or emotional problems?” or “Do you now have any health problem that requires you to use special equipment?”
- **Work limitation** – yes to “Are you limited in the kind or amount of work you can do because of any impairment or health problem?”
- **General health fair or poor** – “Would you say that in general your health is (excellent, very good, good, fair, poor)?”
- **2+ days/mo poor physical health** – “Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?”
- **2+ days/mo poor mental health** – “Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?”

Assessing Outcomes Associated with TBI

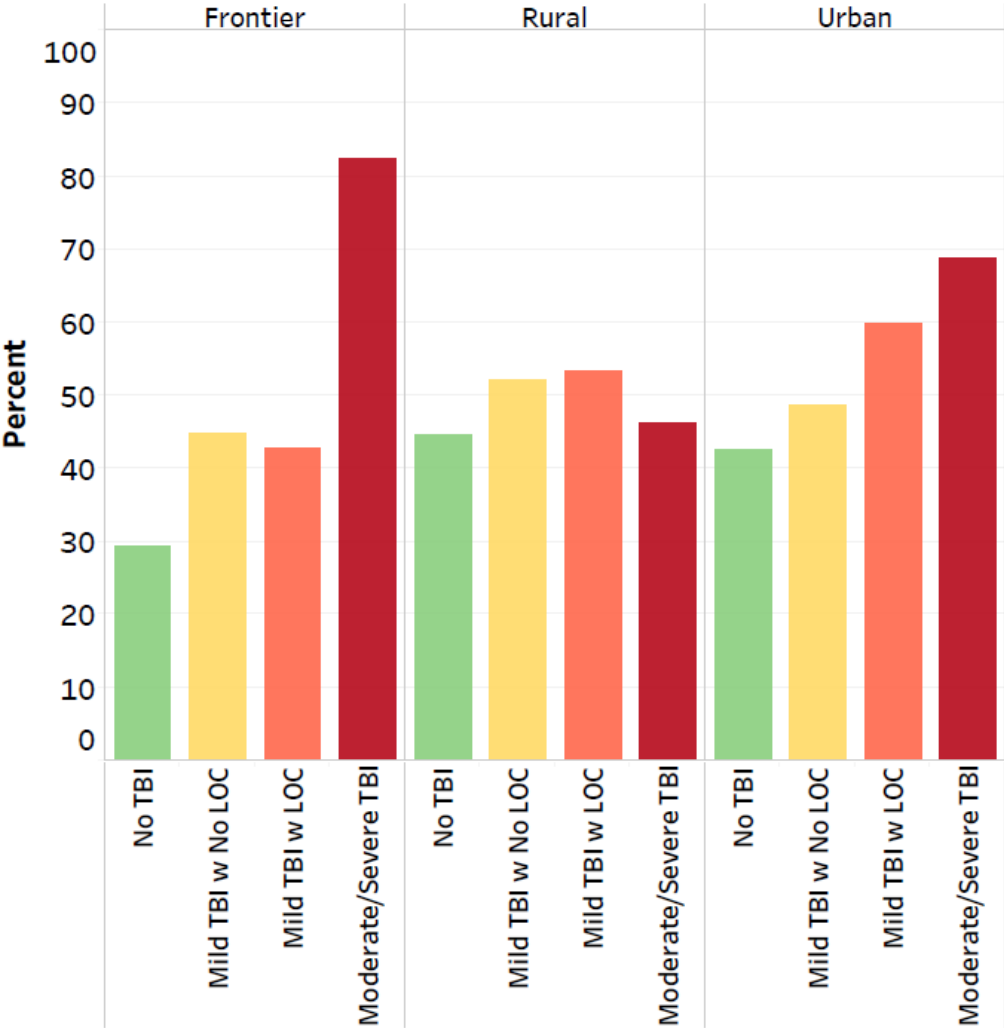
- **Problem alcohol use** – CDC guidelines: greater than 2 drinks per day for men (1 for women) or 5+ drinks in one sitting.
- **Needs help with ADLs** – “Do you receive or need help from another person with bathing, dressing, eating, getting in/out bed or chairs, using the toilet, or getting around inside the home?”
- **Needs supervision for ADLs** – “Do you need to be reminded or do you have someone who stays nearby when bathing, dressing, eating, getting in/out bed or chairs, using the toilet, or getting around inside the home?”
- **Cognitive complaints** – Alertness Behavior Subscale of the Sickness Impact Profile – endorsement of any of 16 items like “I react slowly to things. I do not finish things I start. I have difficulty reasoning and solving problems. I forget a lot. I have difficulty getting along with others.”
- **Low life satisfaction** – below average score on Diener Satisfaction with Life Scale – 5 items like “The conditions in my life are excellent. So far I have gotten the important things I want in life.”



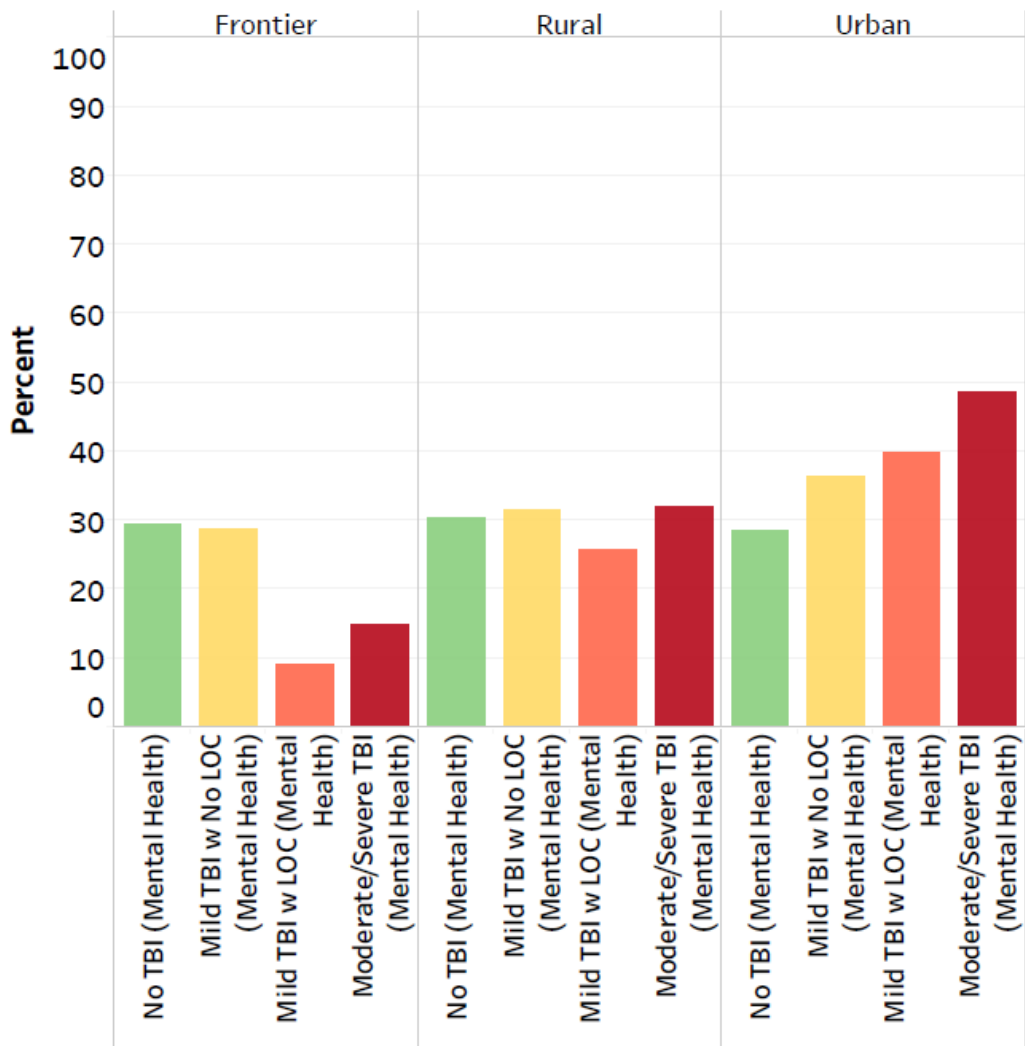
Assessing Symptoms Associated with TBI

- **Symptoms** – Reporting having the following common post-concussive symptoms several days or more per month:
 - Tiredness
 - Sleep disturbance
 - Irritability
 - Headaches
 - Poor concentration
 - Poor memory
 - Noise/light sensitivity
 - Dizziness
 - Tinnitus
 - Poor balance
 - Poor vision

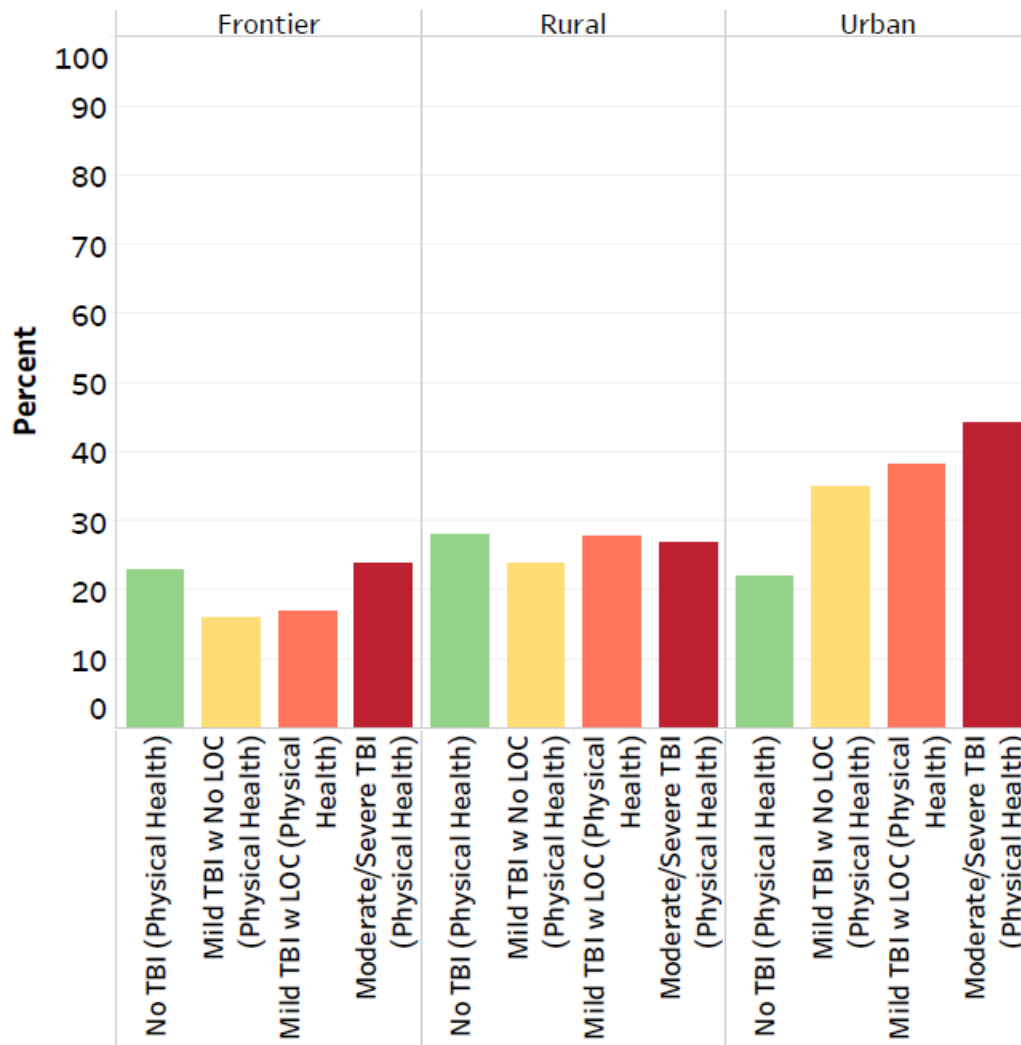
Percent of Cognitive Complaints across Urban/Rural/Frontier Regions, by TBI Severity Level



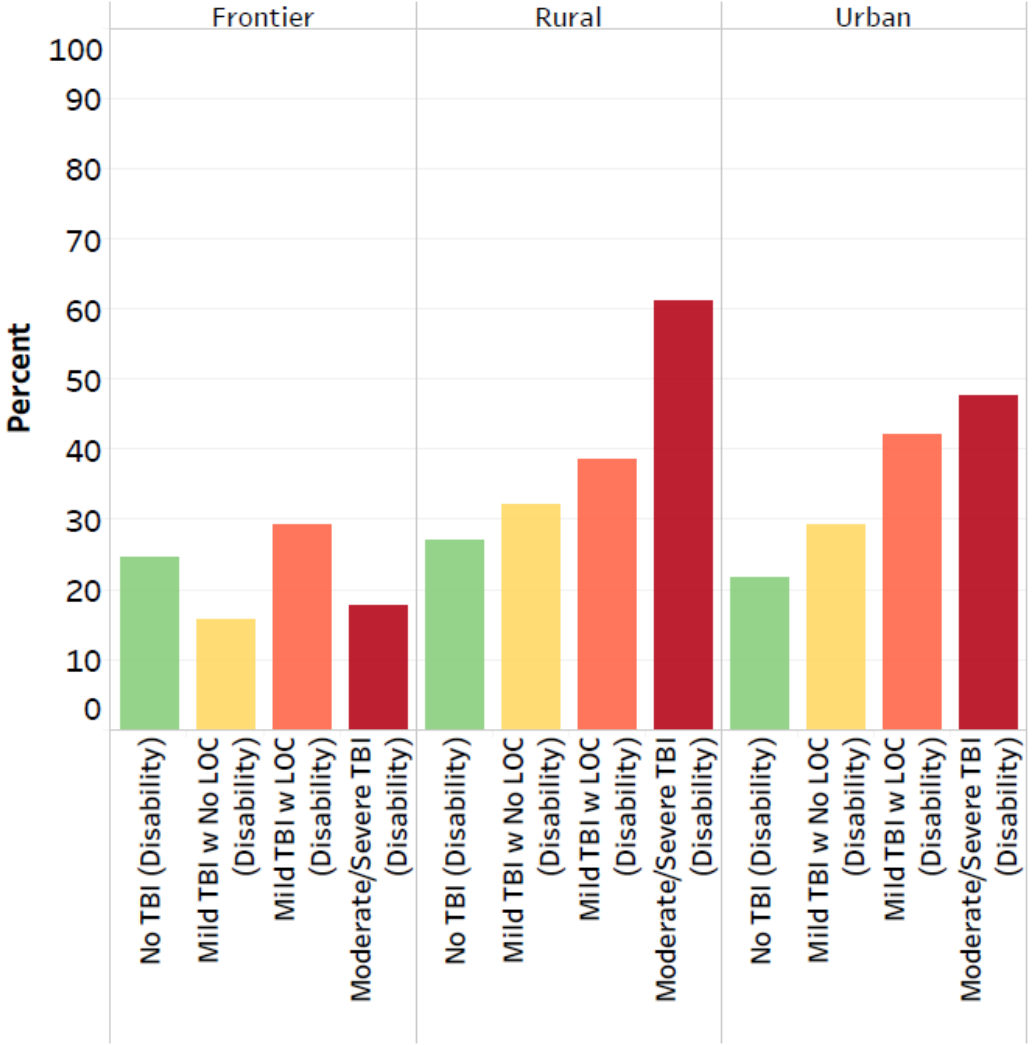
Percent of 2+ Days Poor Mental Health across Urban/Rural/Frontier Regions, by TBI Severity Level



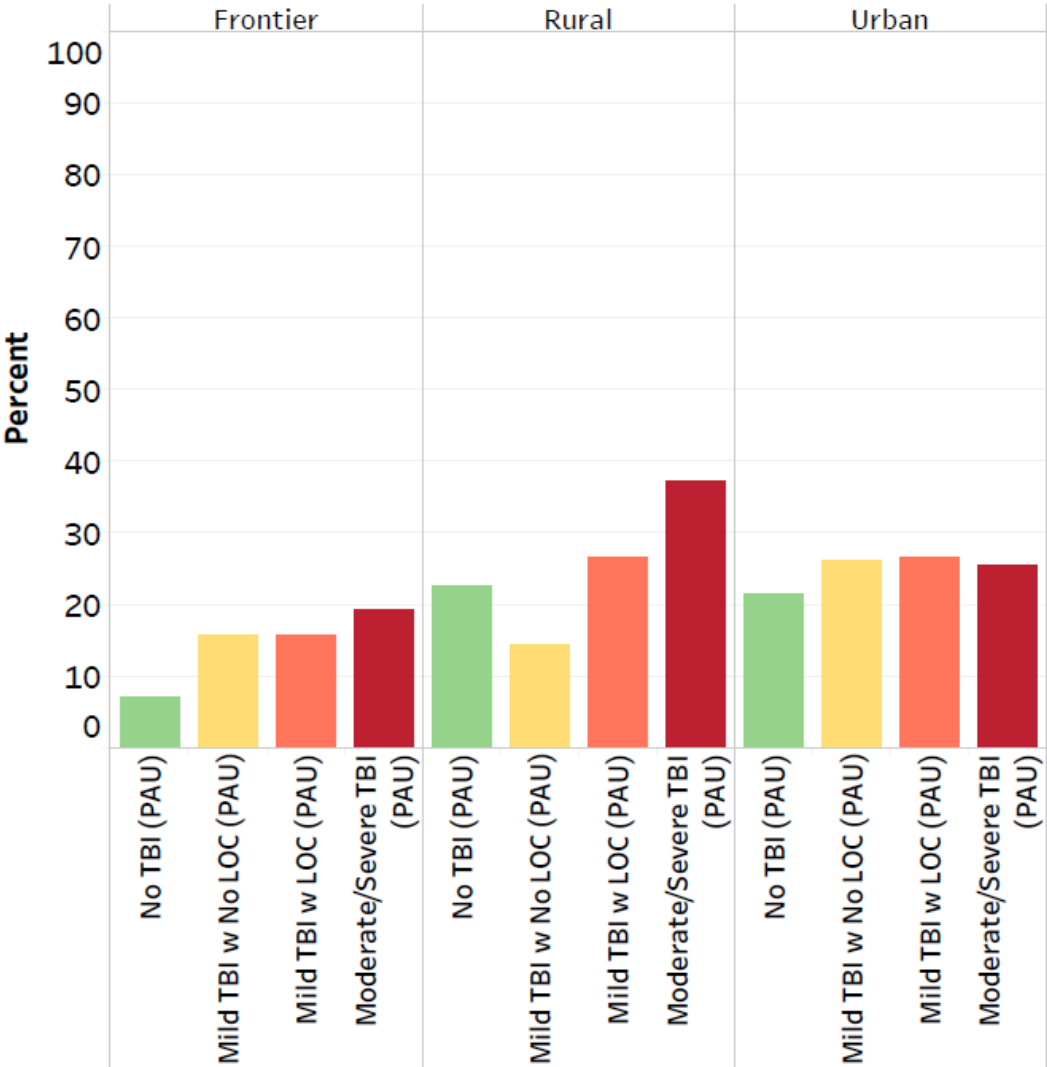
Percent of 2+ Days Poor Physical Health across Urban/Rural/Frontier Regions, by TBI Severity Level



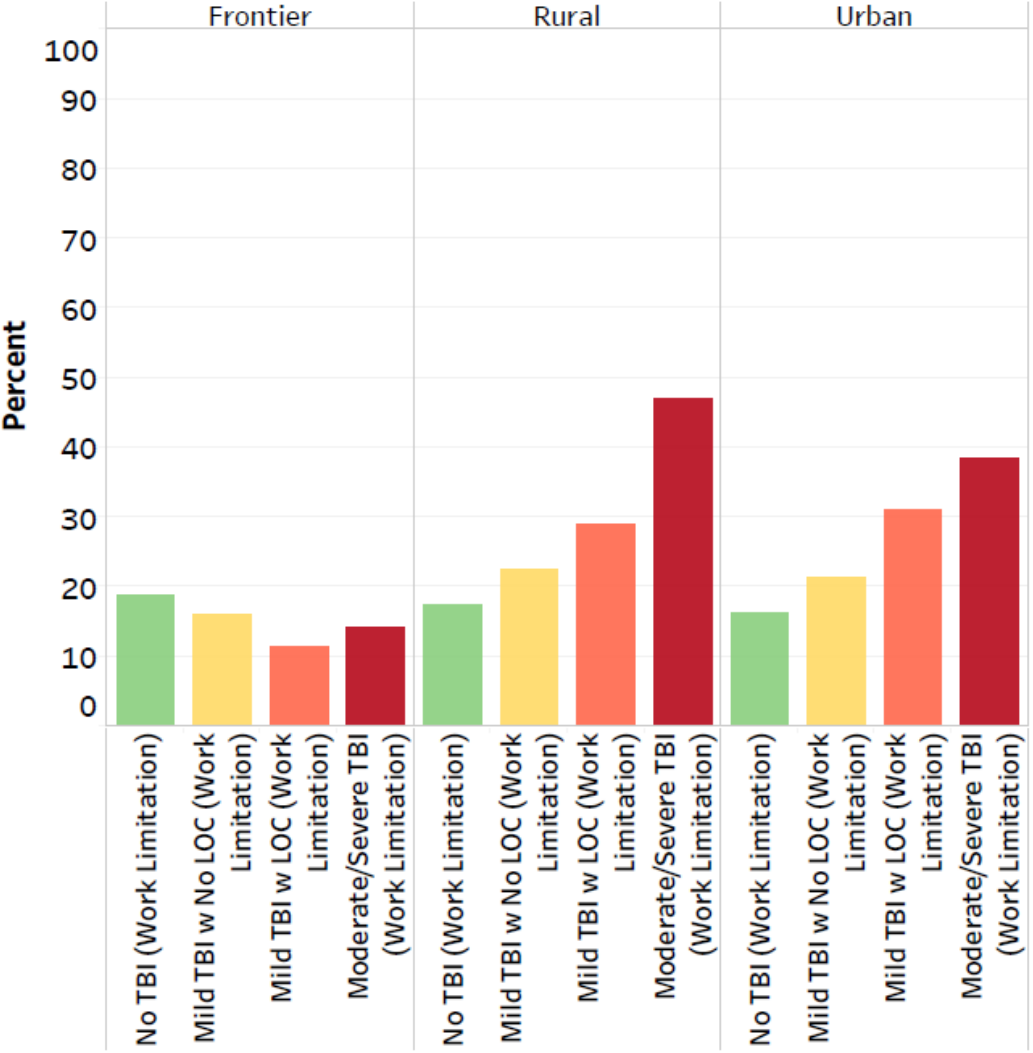
Percent of Disability across Urban/Rural/Frontier Regions, by TBI Severity Level



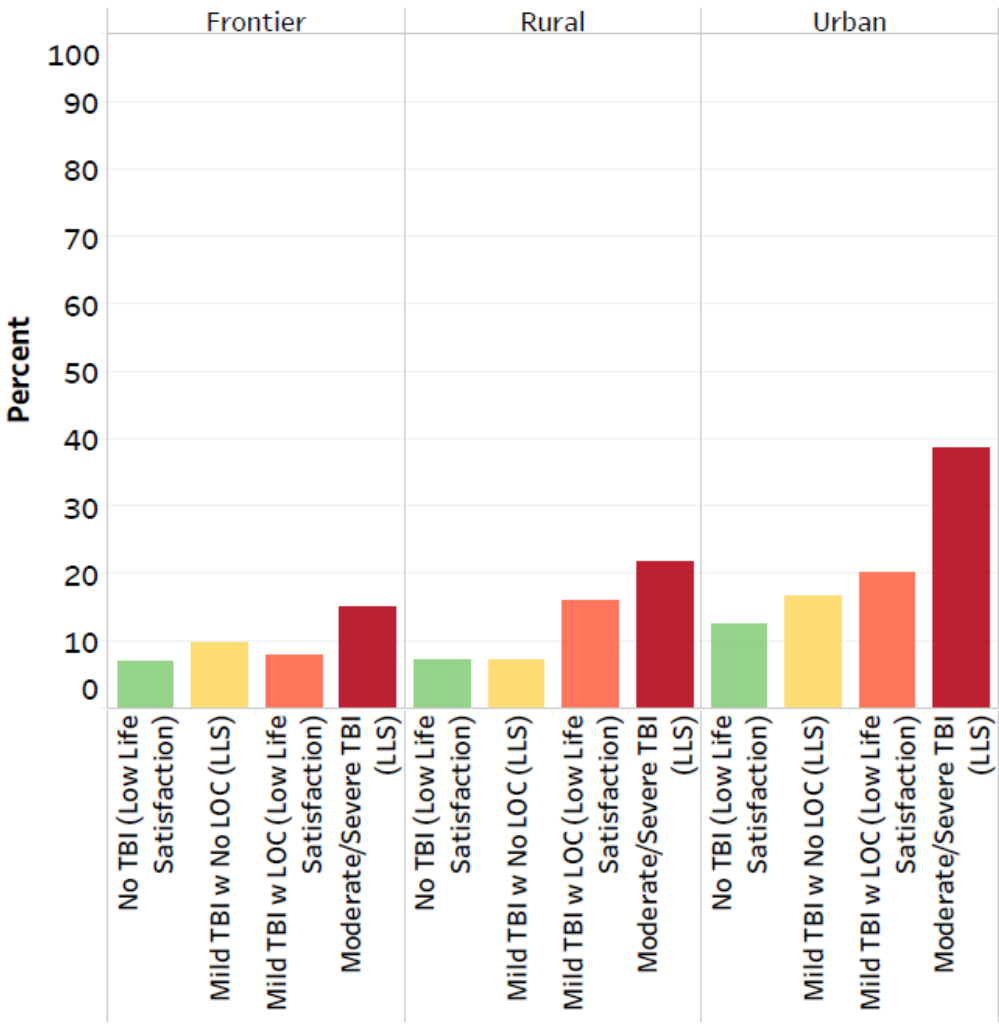
Percent of Problem Alcohol Use across Urban/Rural/Frontier Regions, by TBI Severity Level



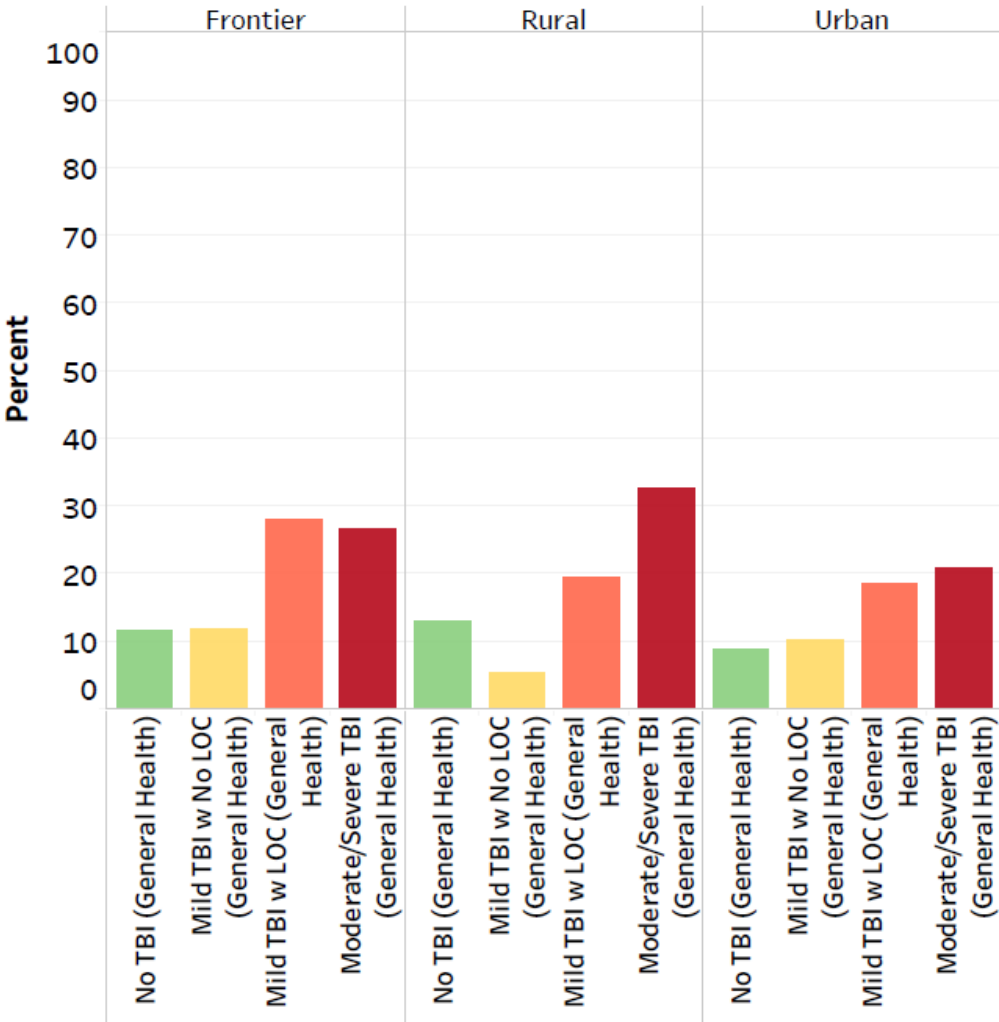
Percent of Work Limitation across Urban/Rural/Frontier Regions, by TBI Severity Level



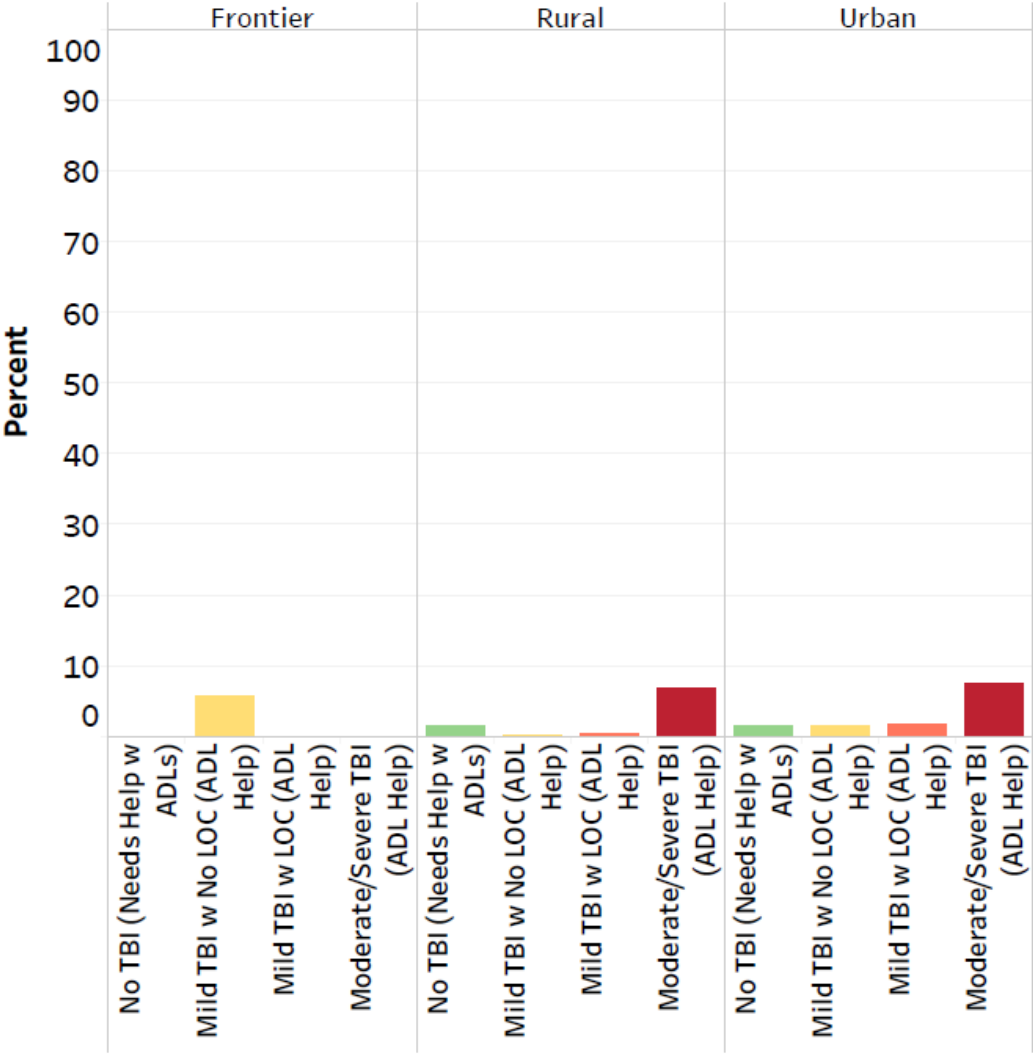
Percent of Low Life Satisfaction across Urban/Rural/Frontier Regions, by TBI Severity Level



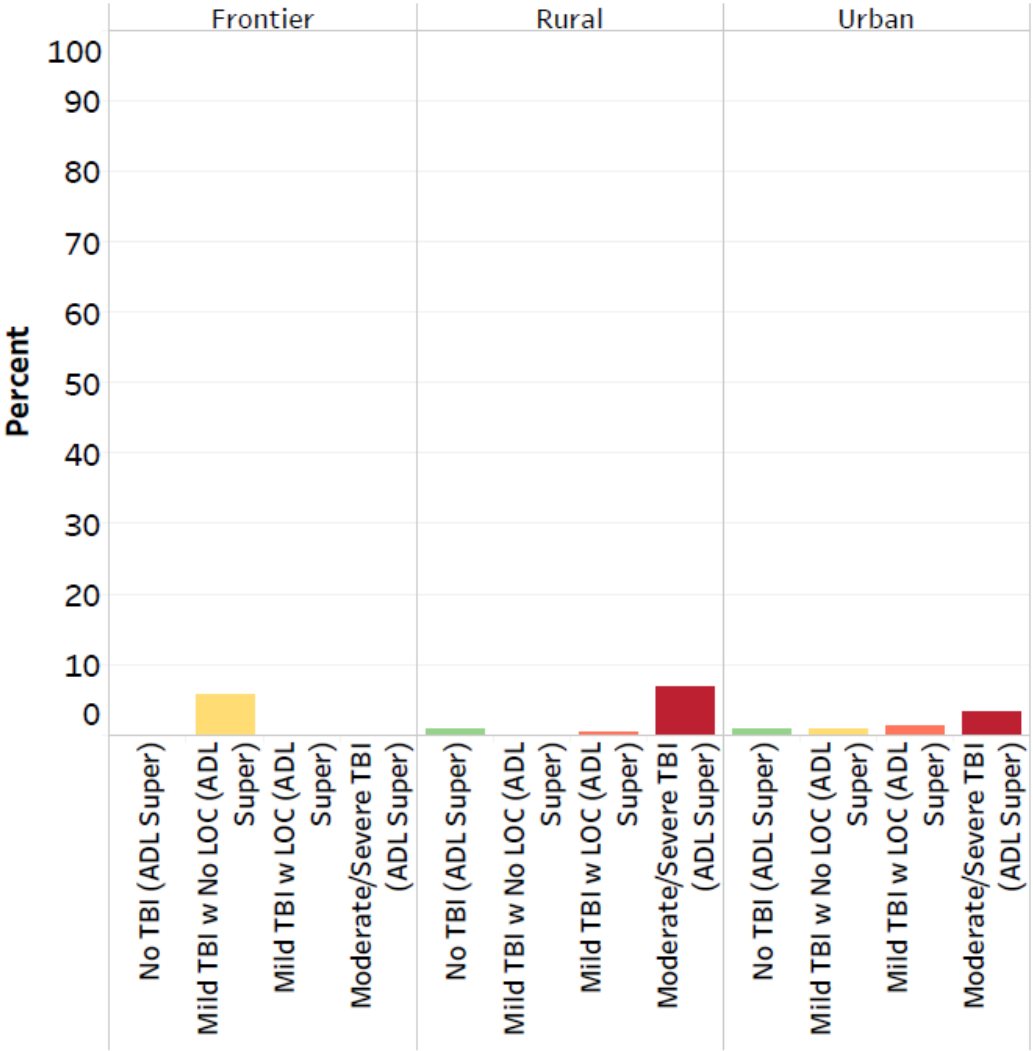
Percent of Poor General Health across Urban/Rural/Frontier Regions, by TBI Severity Level



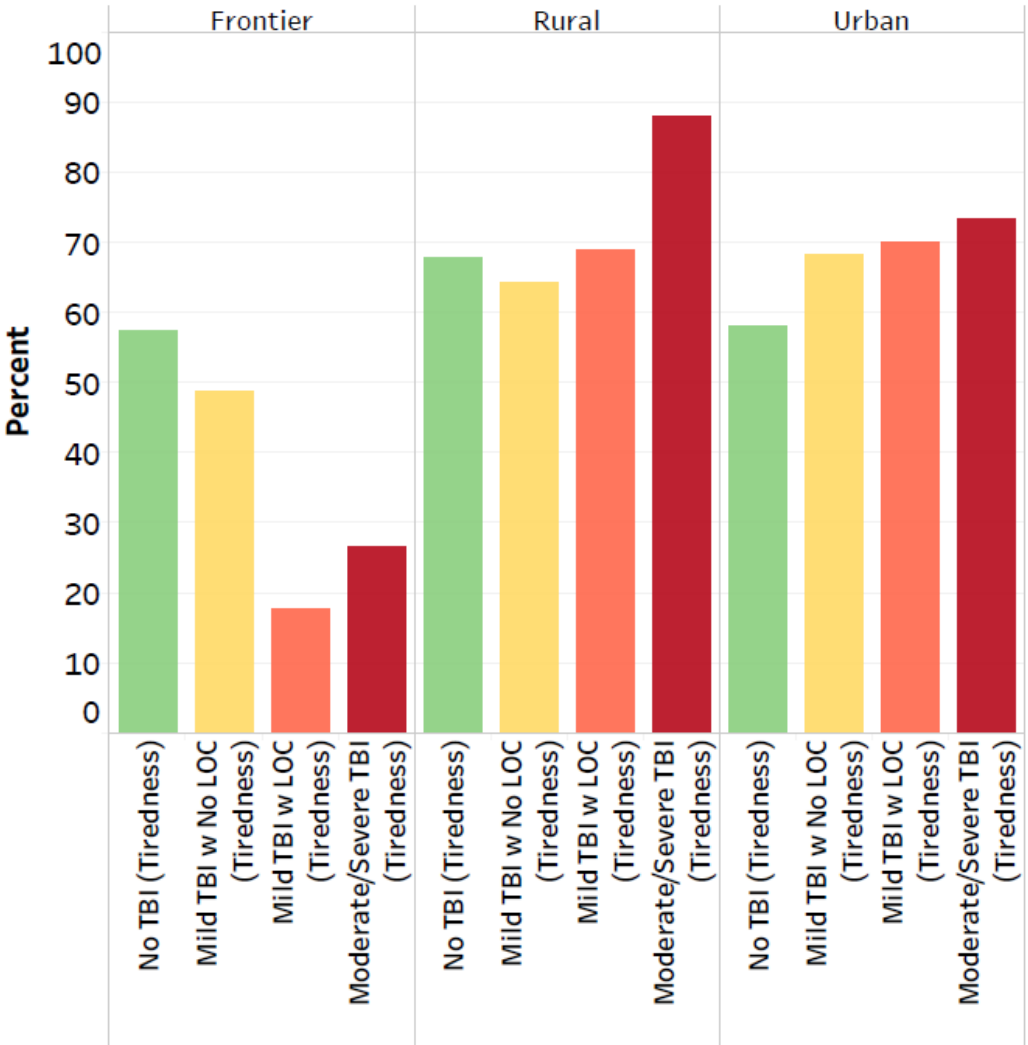
Percent of Needing Help with ADLs across Urban/Rural/Frontier Regions, by TBI Severity Level



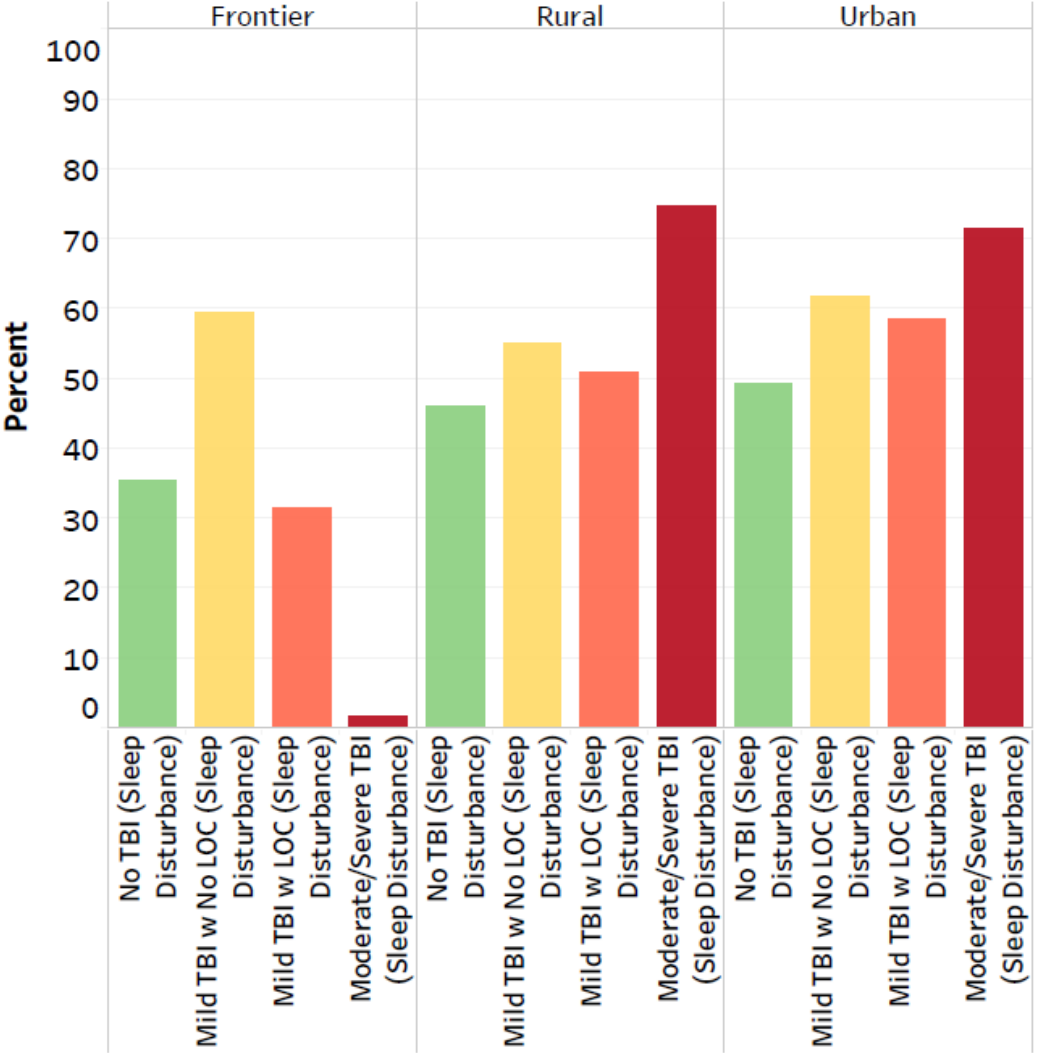
Percent of Needing Supervision with ADLs across Urban/Rural/Frontier Regions, by TBI Severity Level



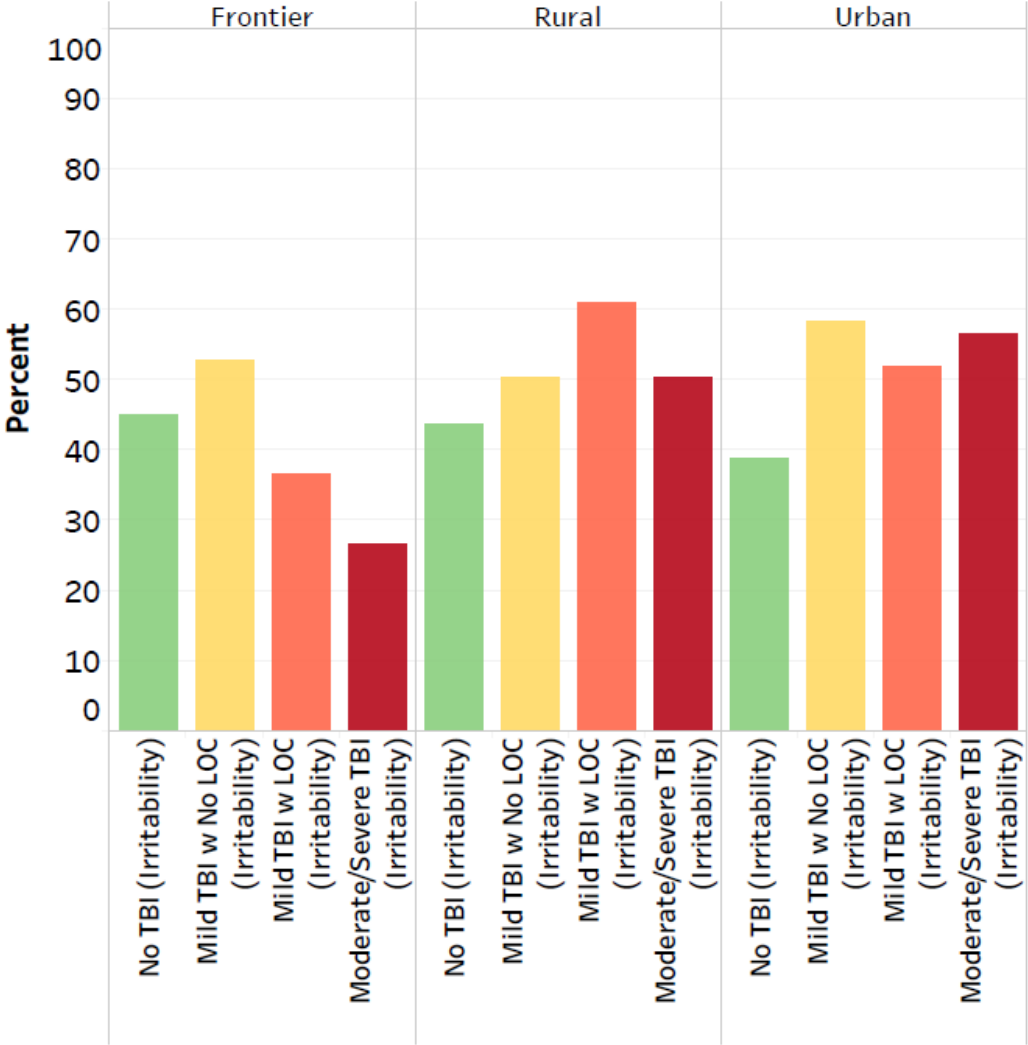
Percent of Tiredness across Urban/Rural/Frontier Regions, by TBI Severity Level



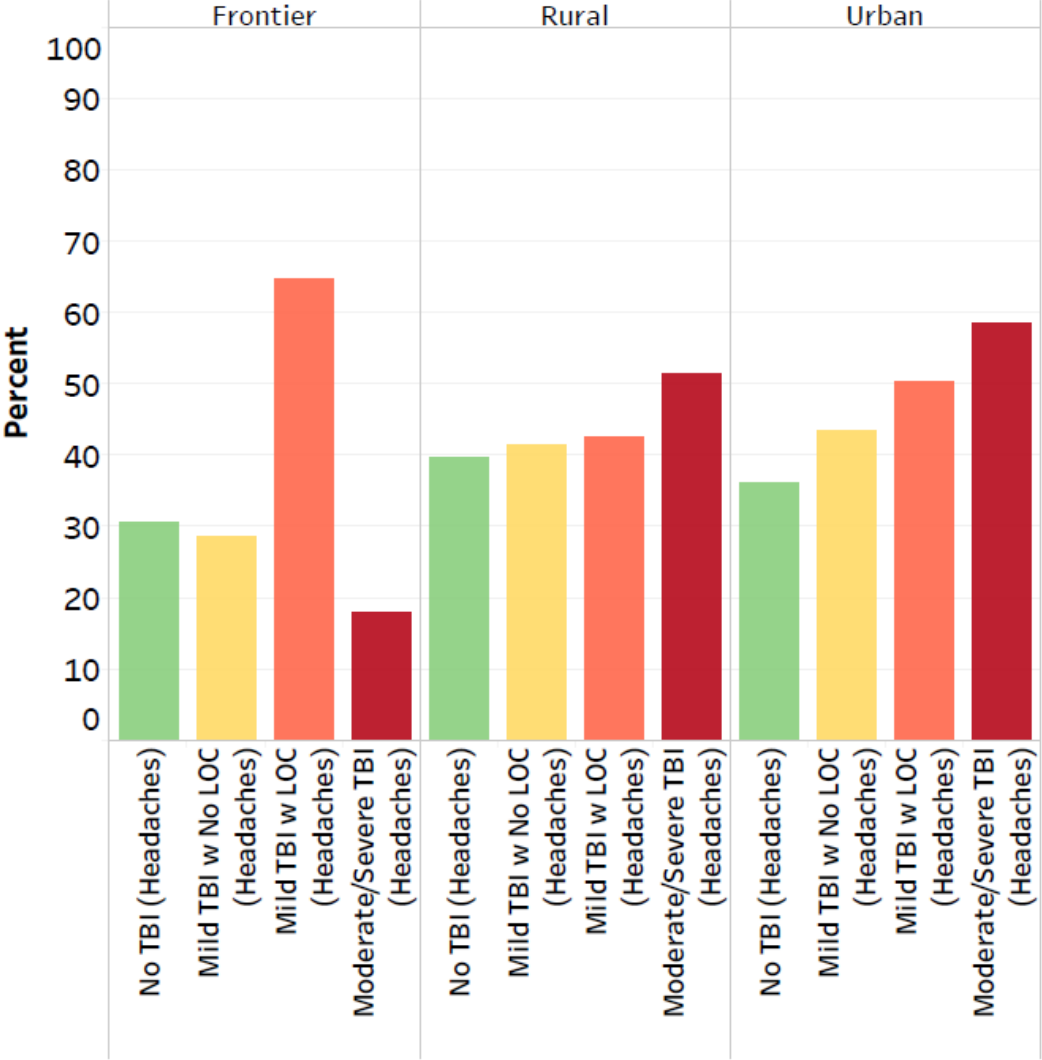
Percent of Sleep Disturbance across Urban/Rural/Frontier Regions, by TBI Severity Level



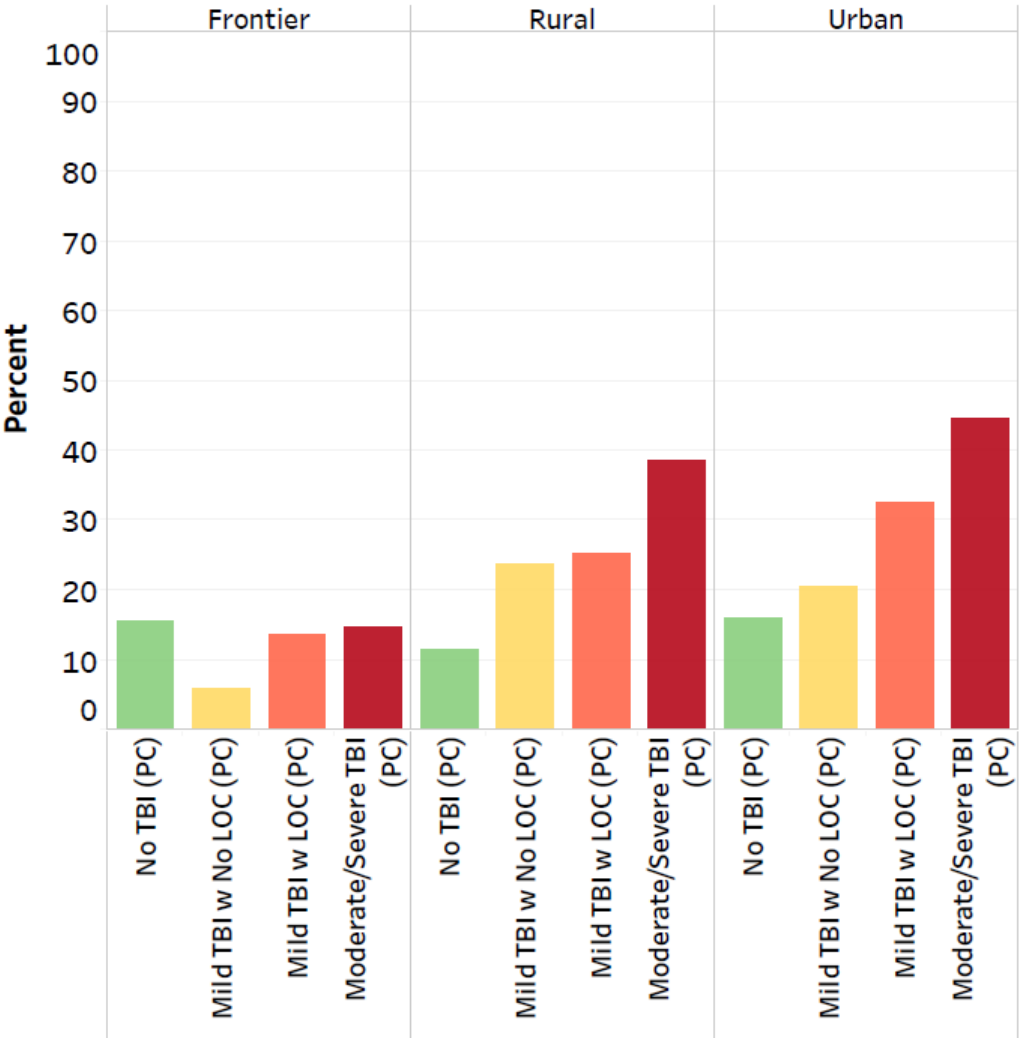
Percent of Irritability across Urban/Rural/Frontier Regions, by TBI Severity Level



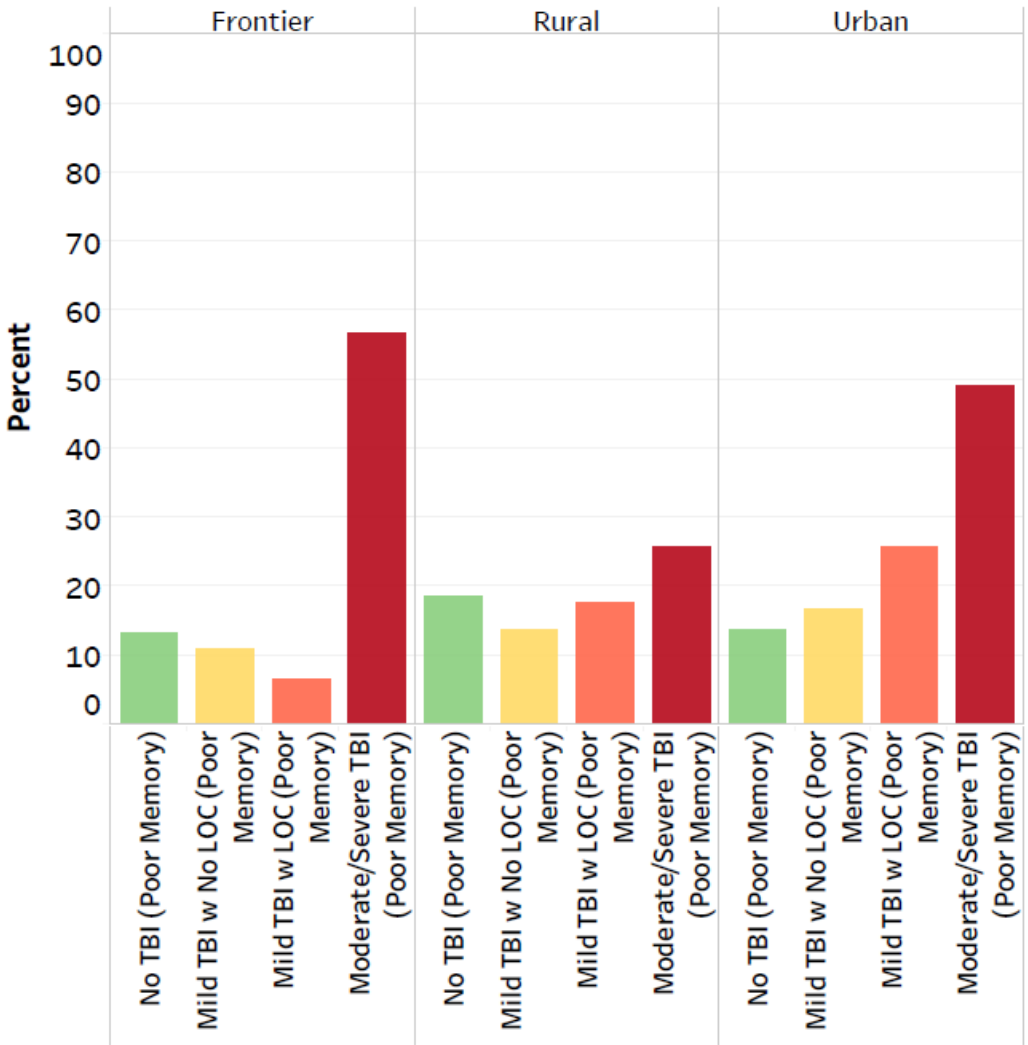
Percent of Headaches across Urban/Rural/Frontier Regions, by TBI Severity Level



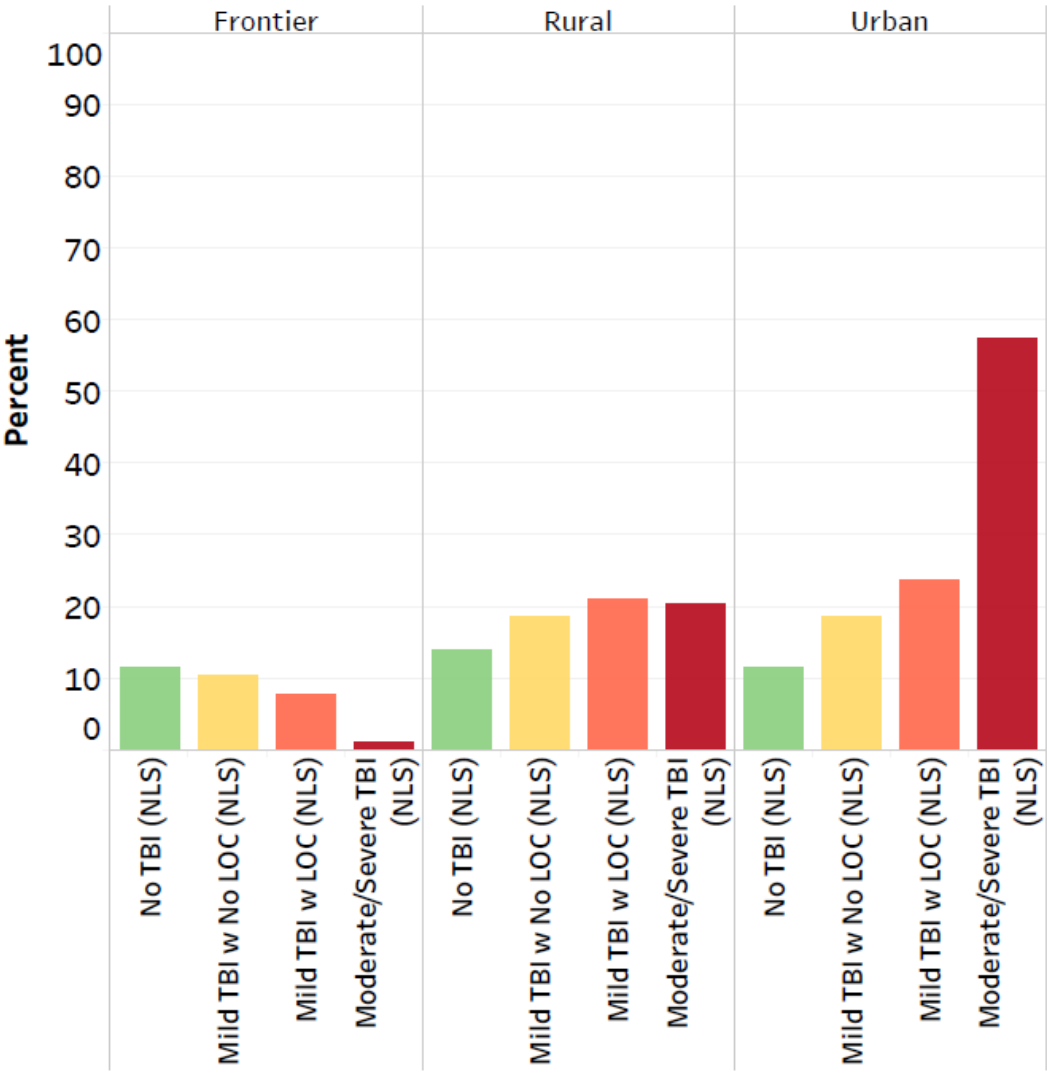
Percent of Poor Concentration across Urban/Rural/Frontier Regions, by TBI Severity Level



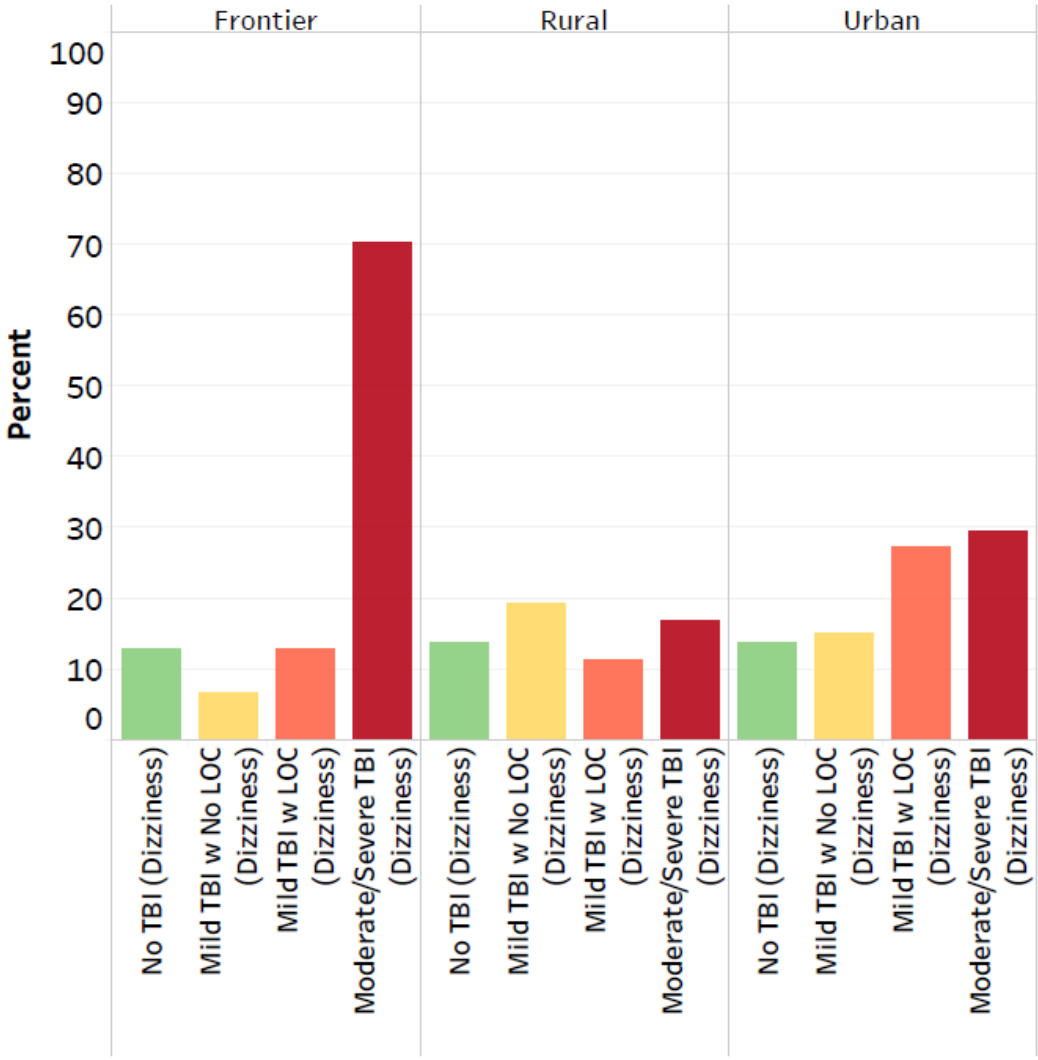
Percent of Poor Memory across Urban/Rural/Frontier Regions, by TBI Severity Level



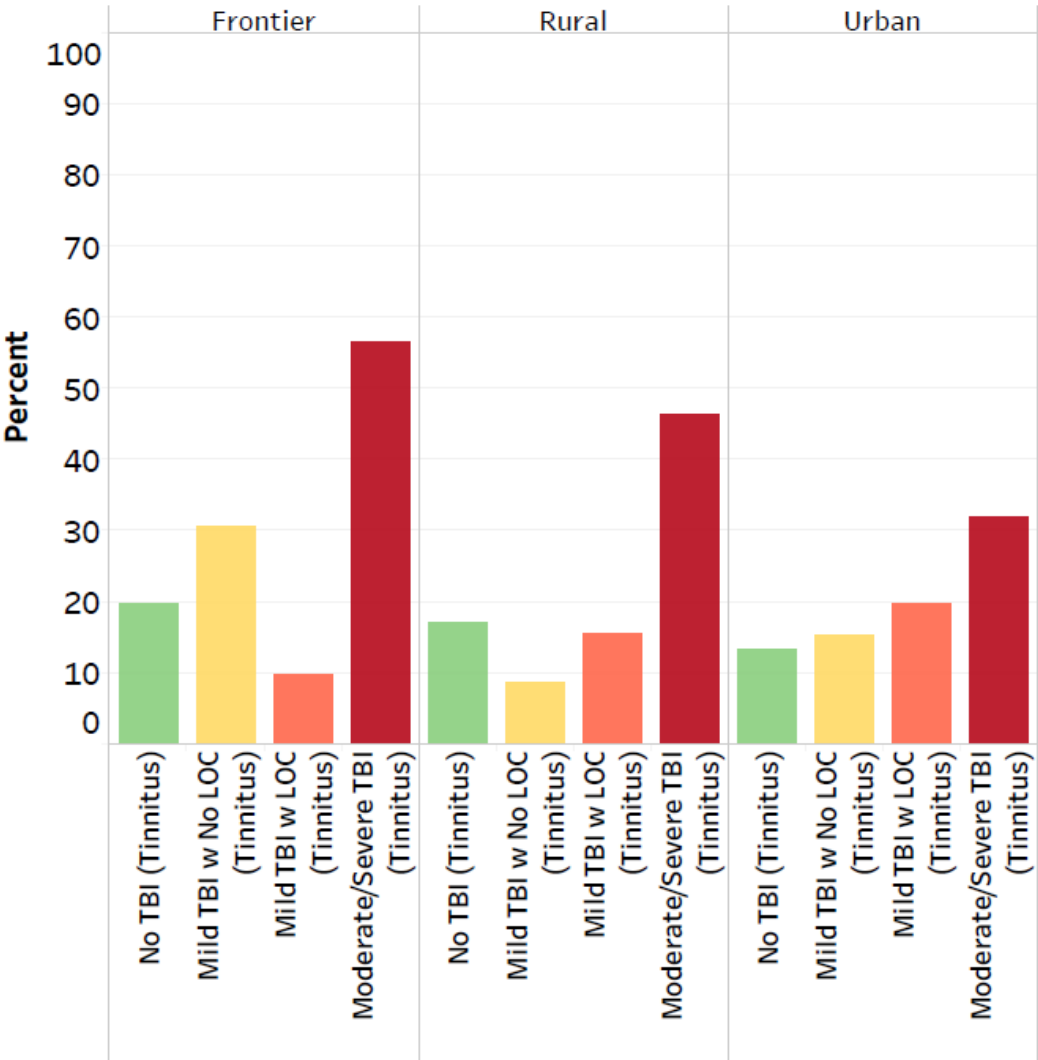
Percent of Noise/Light Sensitivity across Urban/Rural/Frontier Regions, by TBI Severity Level



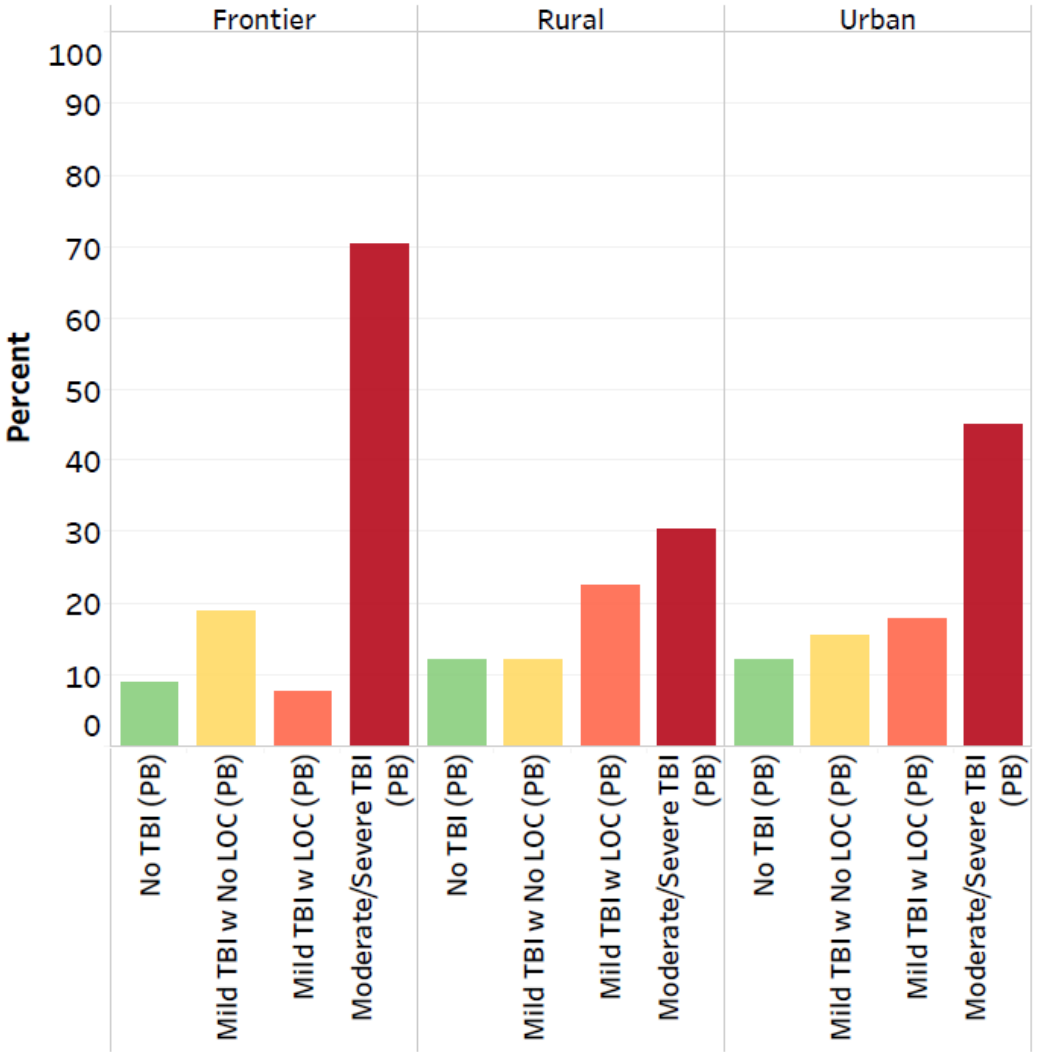
Percent of Dizziness across Urban/Rural/Frontier Regions, by TBI Severity Level



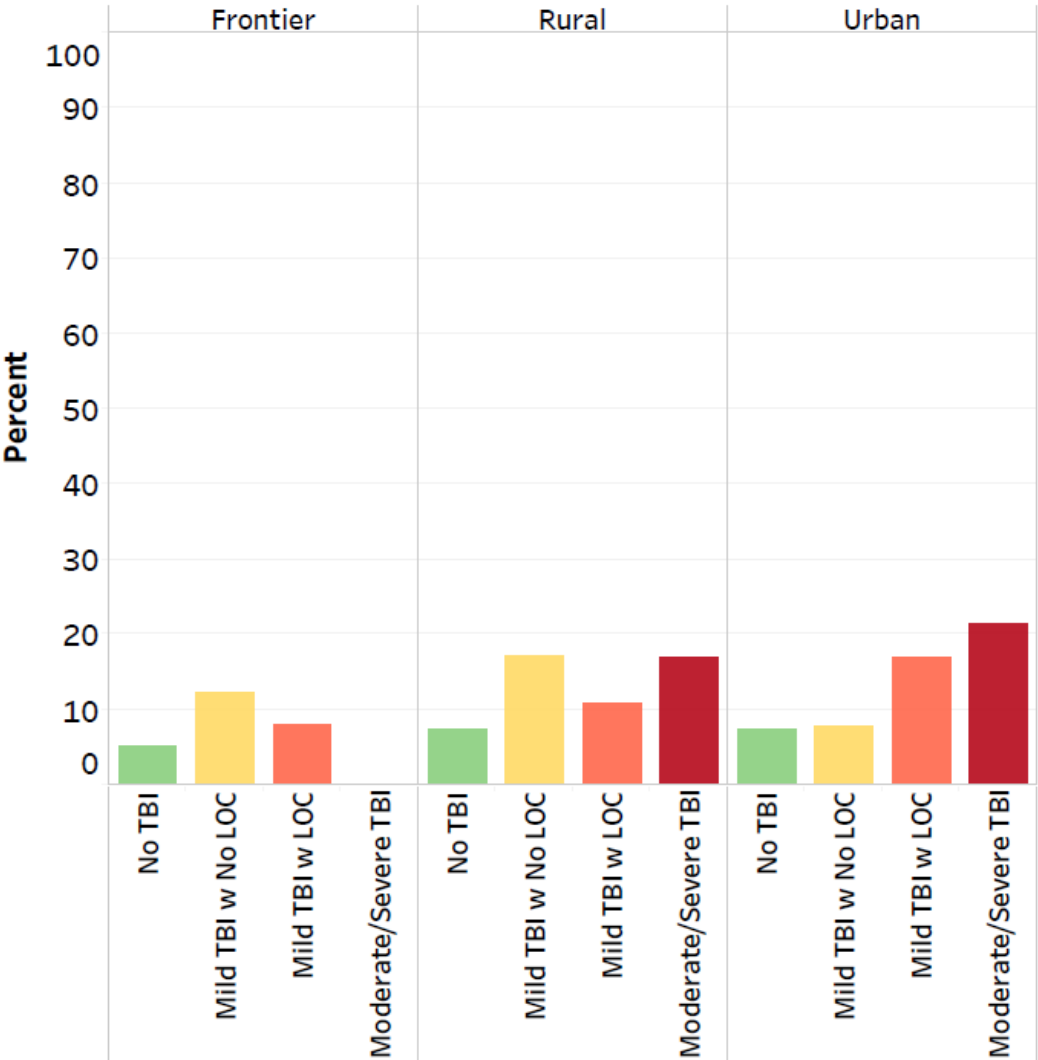
Percent of Tinnitus across Urban/Rural/Frontier Regions, by TBI Severity Level



Percent of Poor Balance across Urban/Rural/Frontier Regions, by TBI Severity Level



Percent of Poor Vision across Urban/Rural/Frontier Regions, by TBI Severity Level





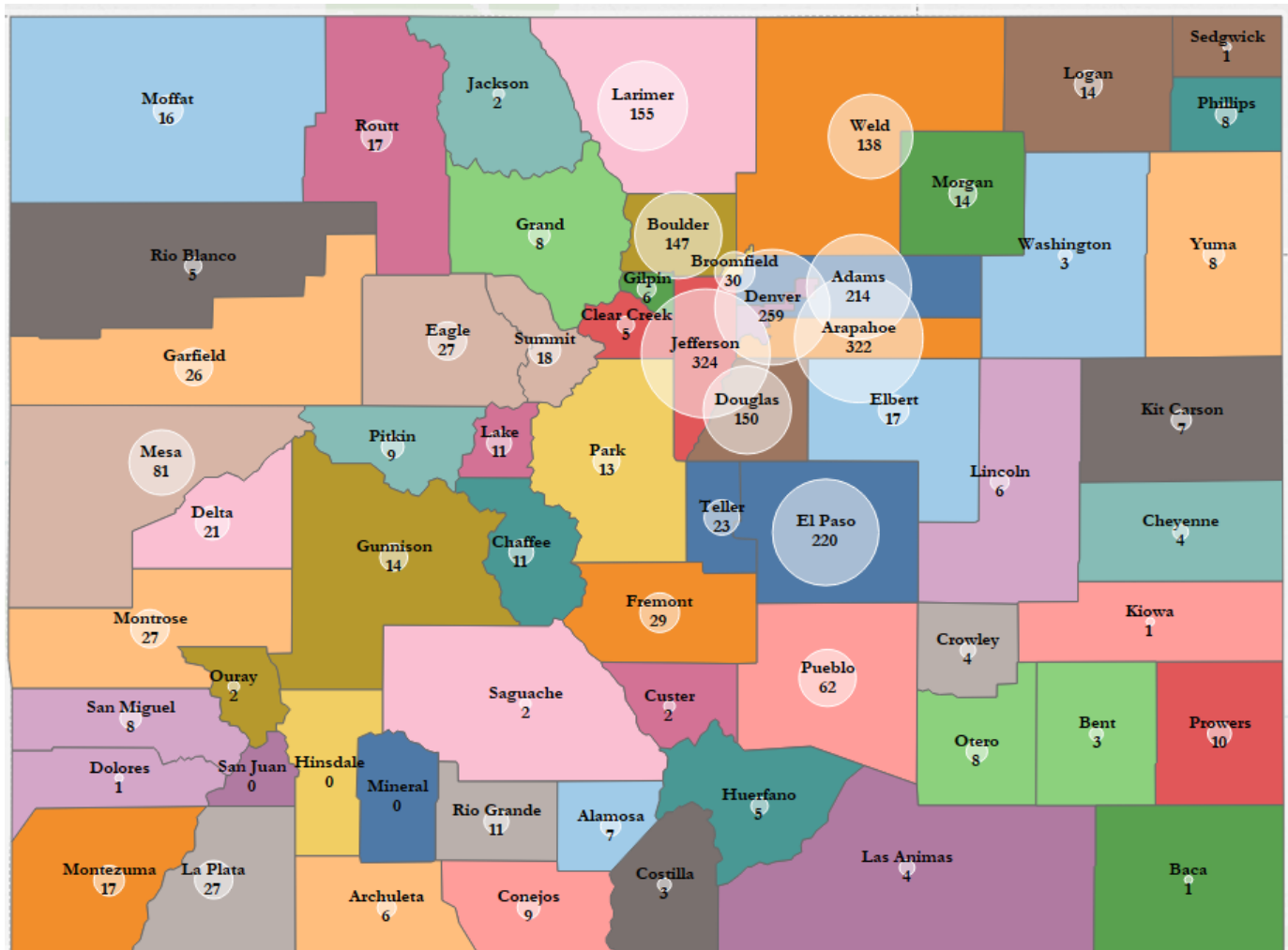
Race Maps and Statistics

Race vs Ethnicity

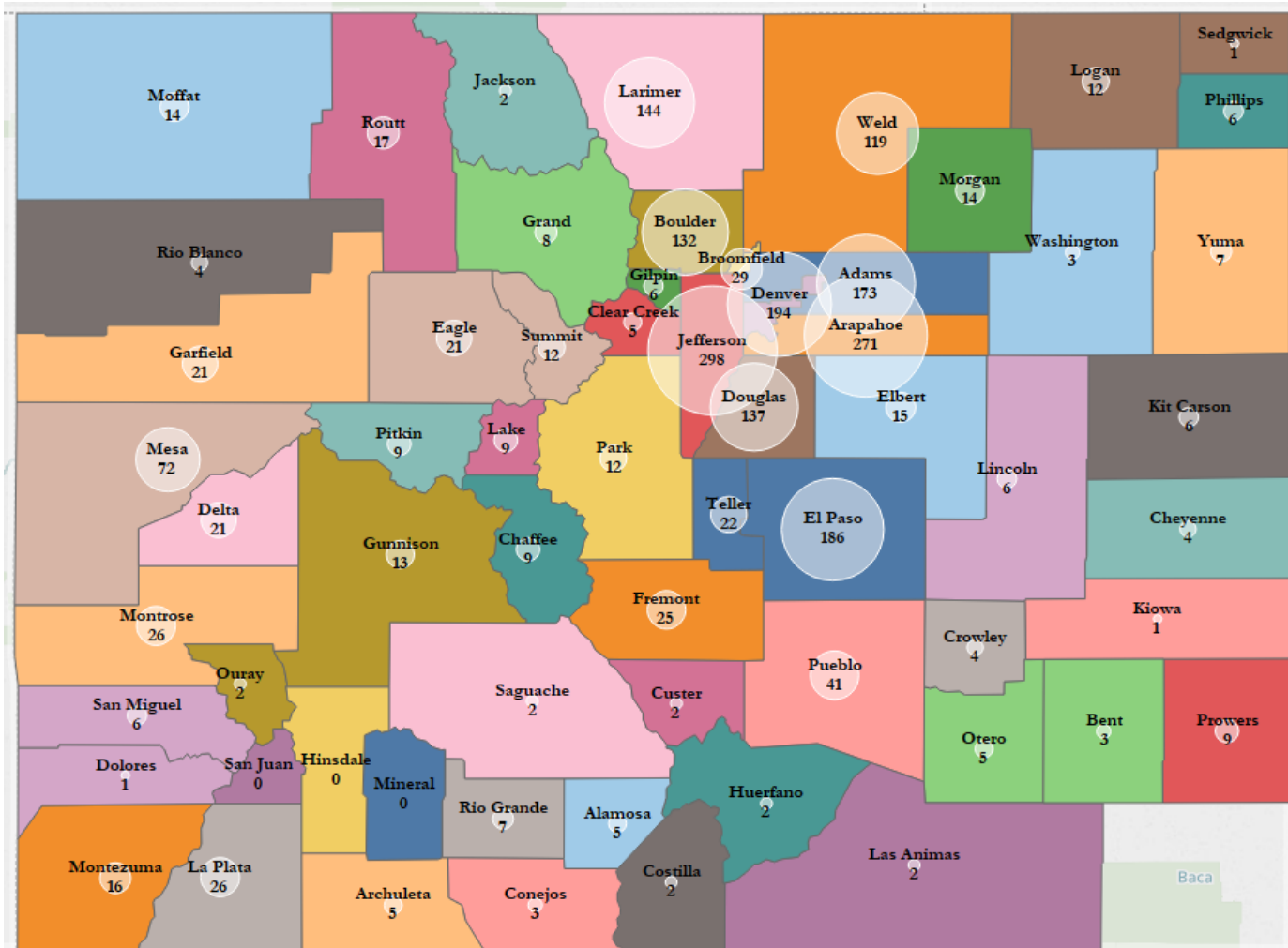
- The U.S. Census Bureau considers race and ethnicity to be two separate and distinct concepts
- The Census Bureau defines race as a person's self-identification with one or more social groups. An individual can report as White, Black or African American, Asian, American Indian and Alaska Native, Native Hawaiian and Other Pacific Islander, or some other race. Survey respondents may report multiple races.
- Ethnicity determines whether a person is of Hispanic origin or not. For this reason, ethnicity is broken out in two categories, Hispanic or Latino and Not Hispanic or Latino. Hispanics may report as any race.

		White	Black	Asian	Native Hawaiian or Other Pacific Islander	American Indian or Alaskan Native	Other	Don't Know	Refused	Total
Are you Hispanic or Latino?	Yes	68	1	0	0	9	230	15	1	324
	No	2212	42	12	2	20	62	3	16	2369
	Total	2280	43	12	2	29	292	18	17	2693

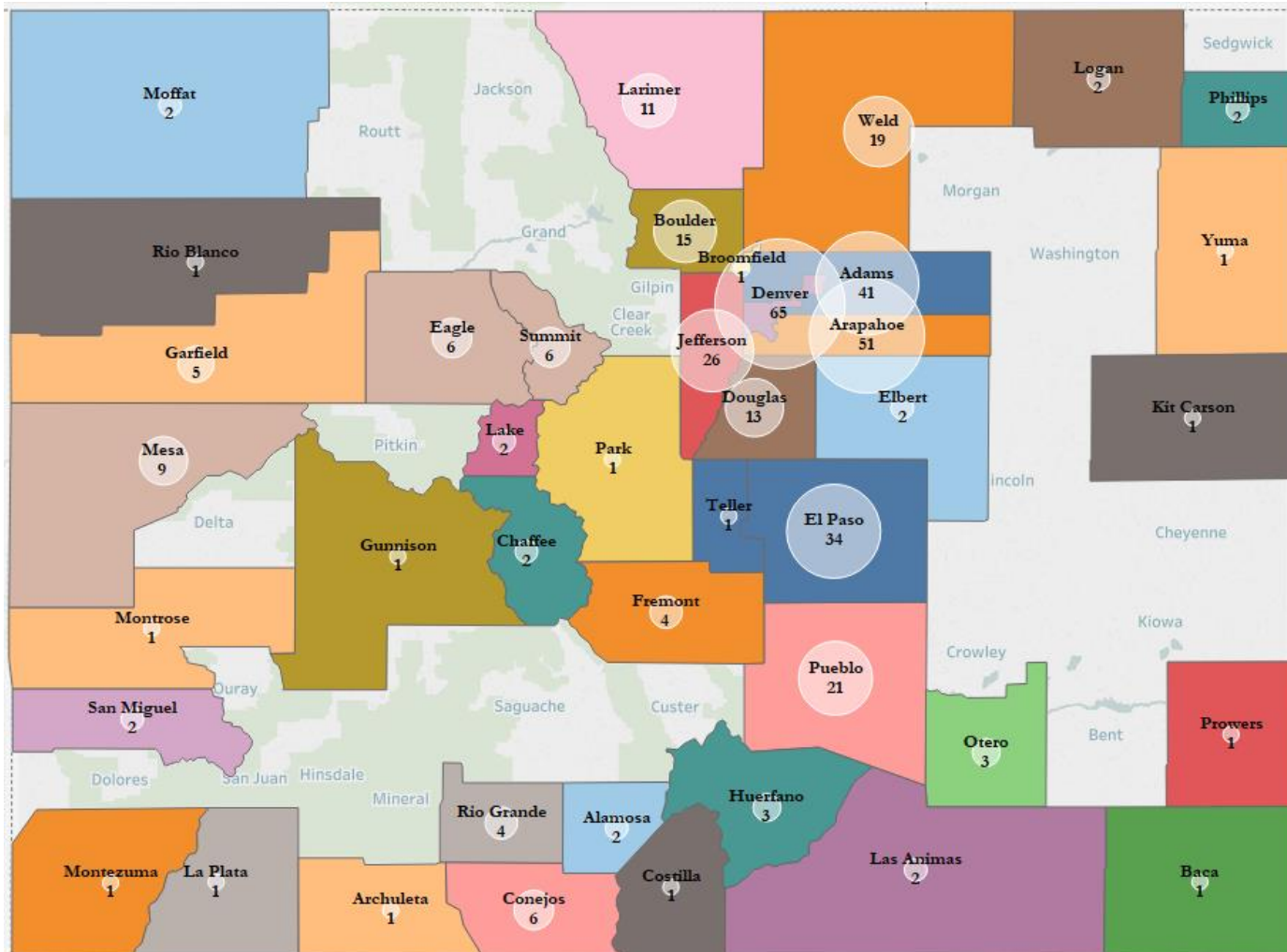
Sample Subject Location by Race – All Races



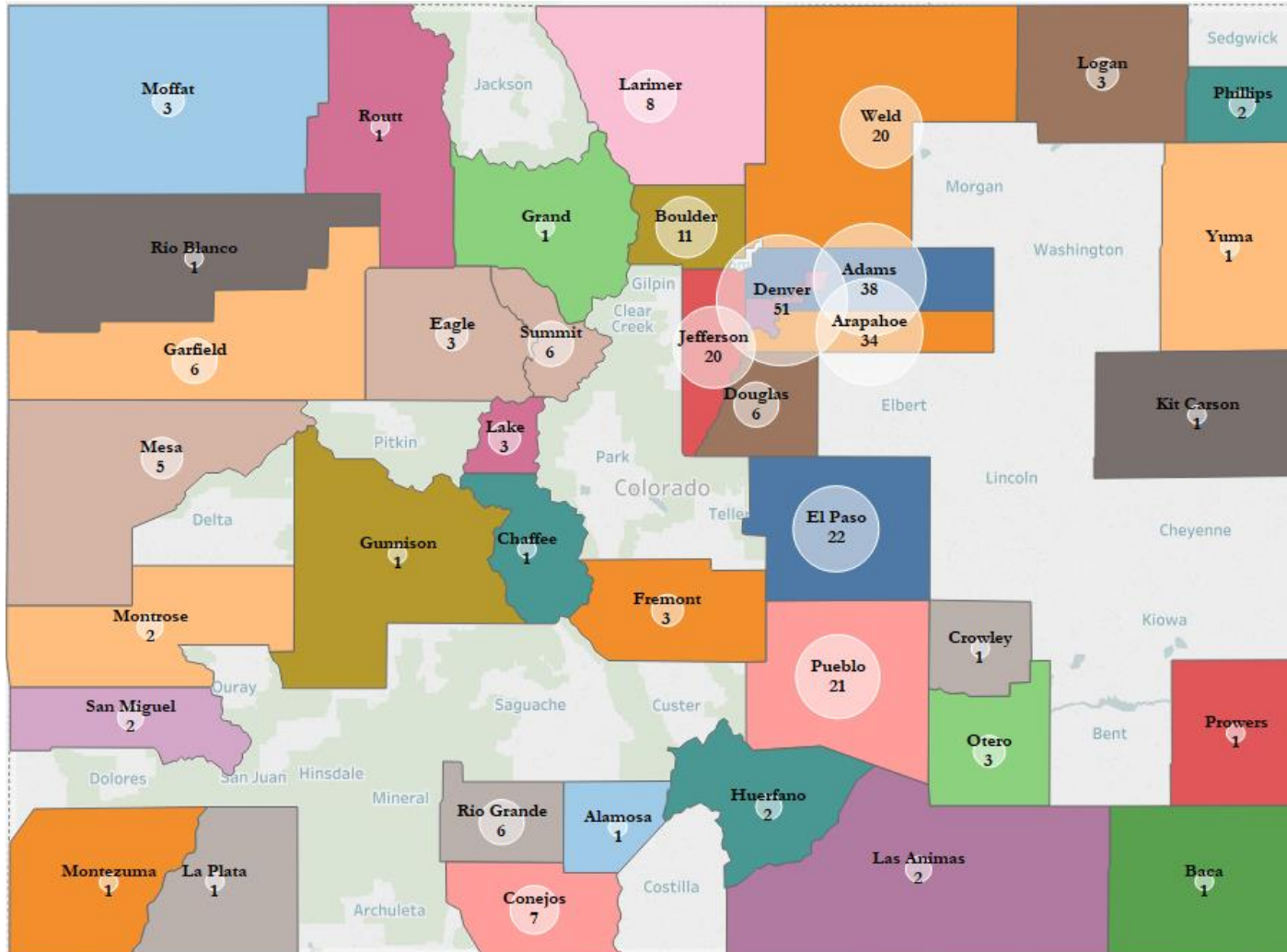
Sample Subject Location by Race – White Only



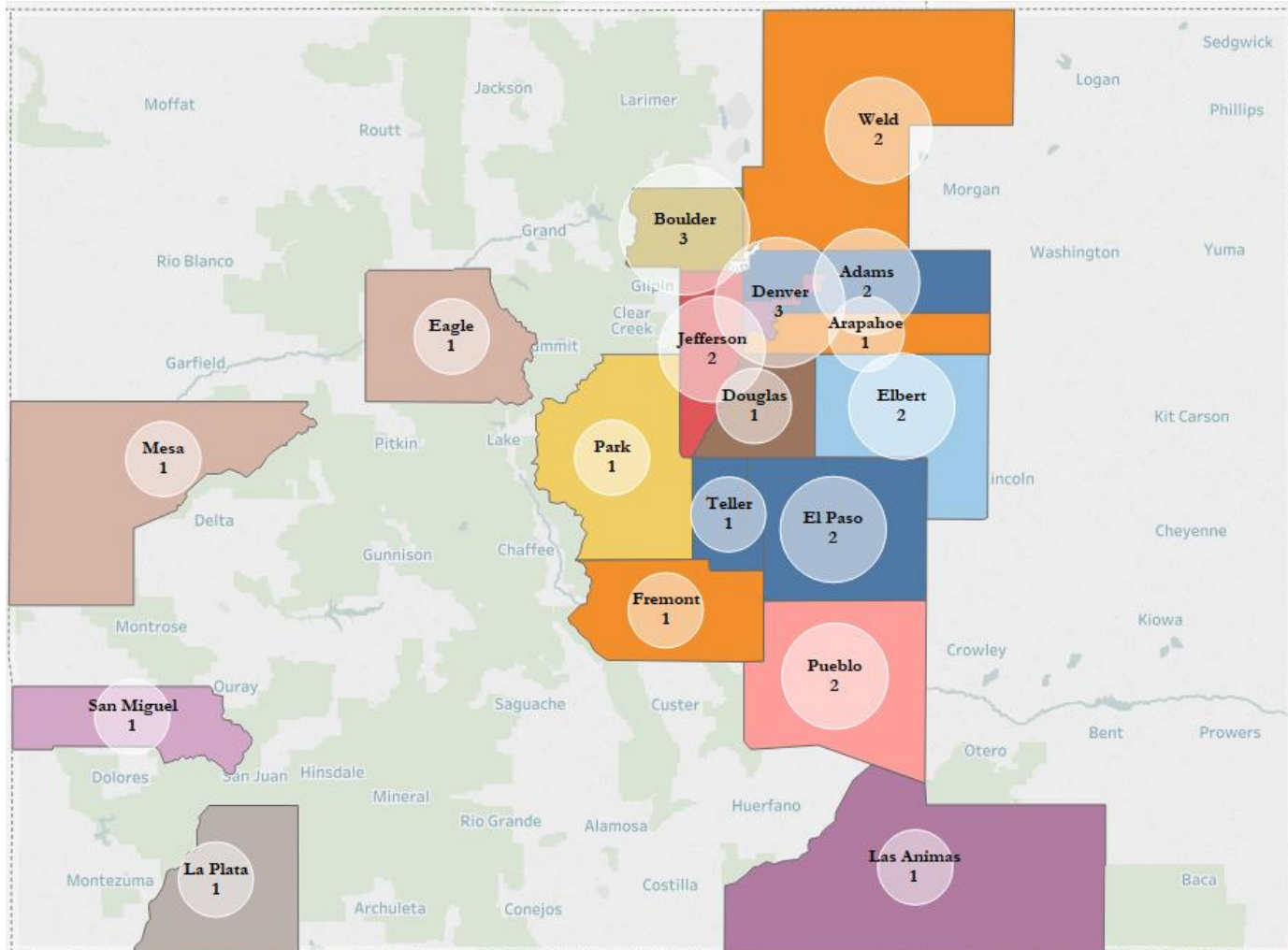
Sample Subject Location by Race – All Non-White



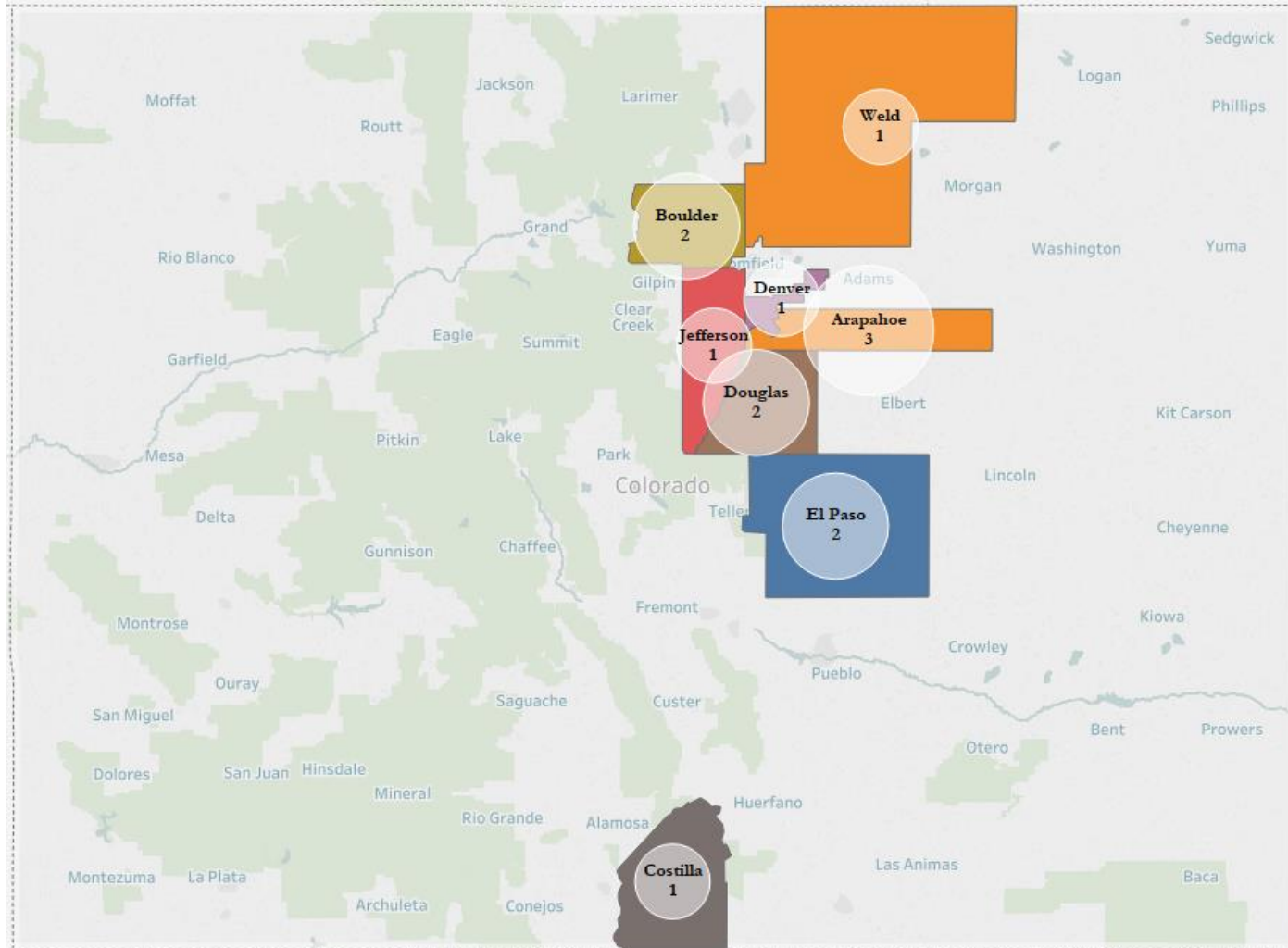
Sample Subject Location by Ethnicity – Hispanic



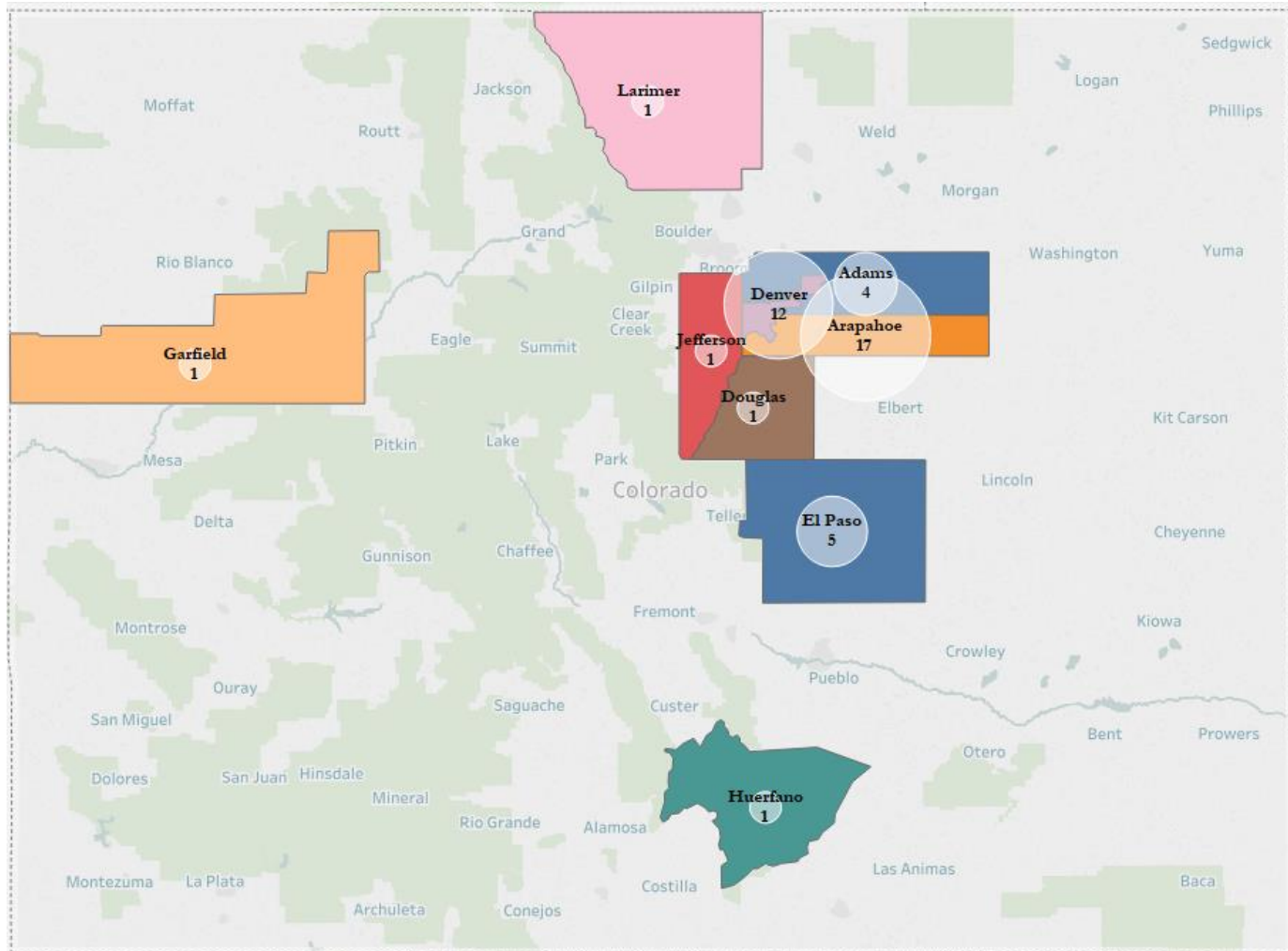
Sample Subject Location by Race – American Indian/Alaska Native



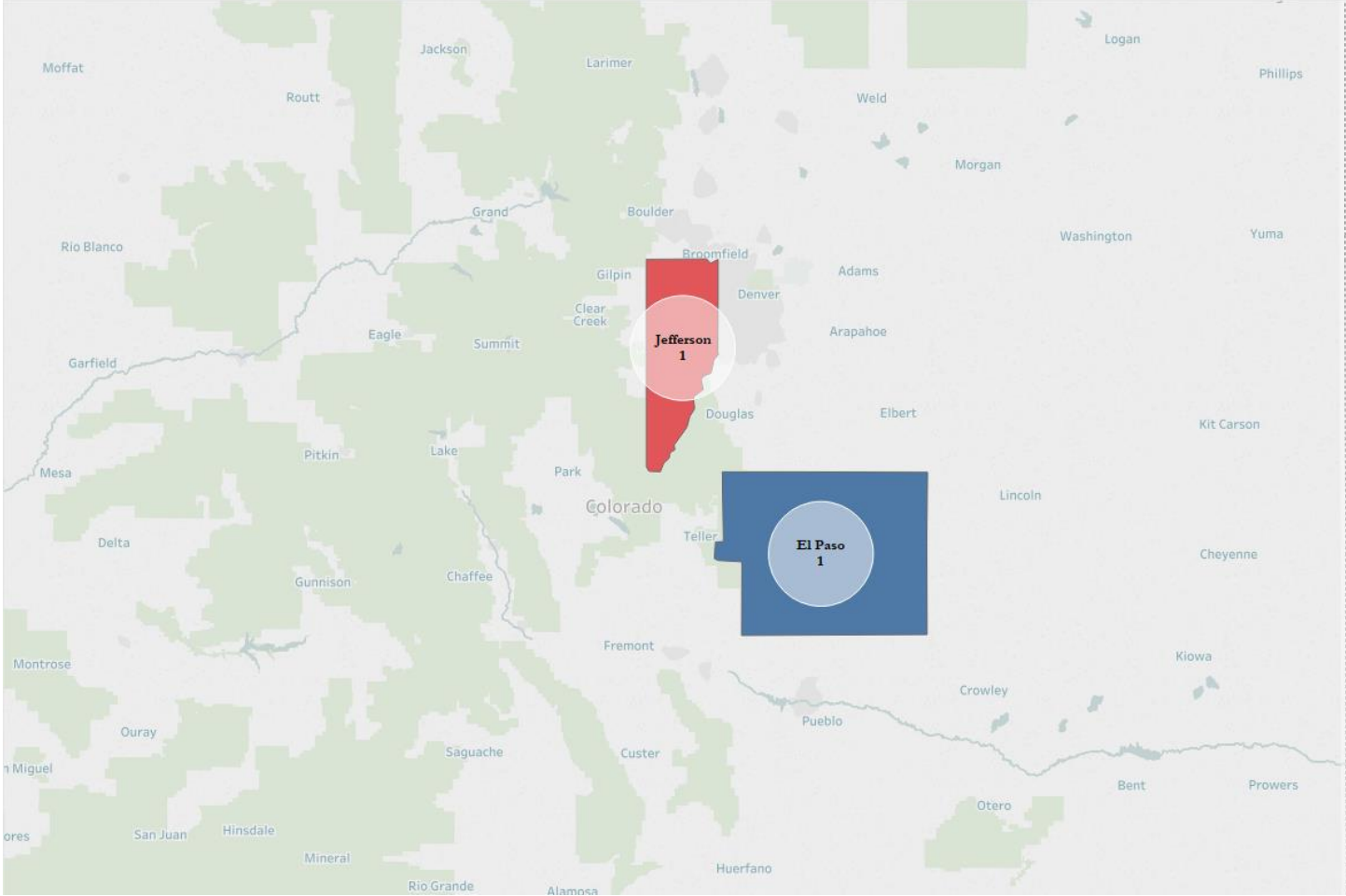
Sample Subject Location by Race – Asian



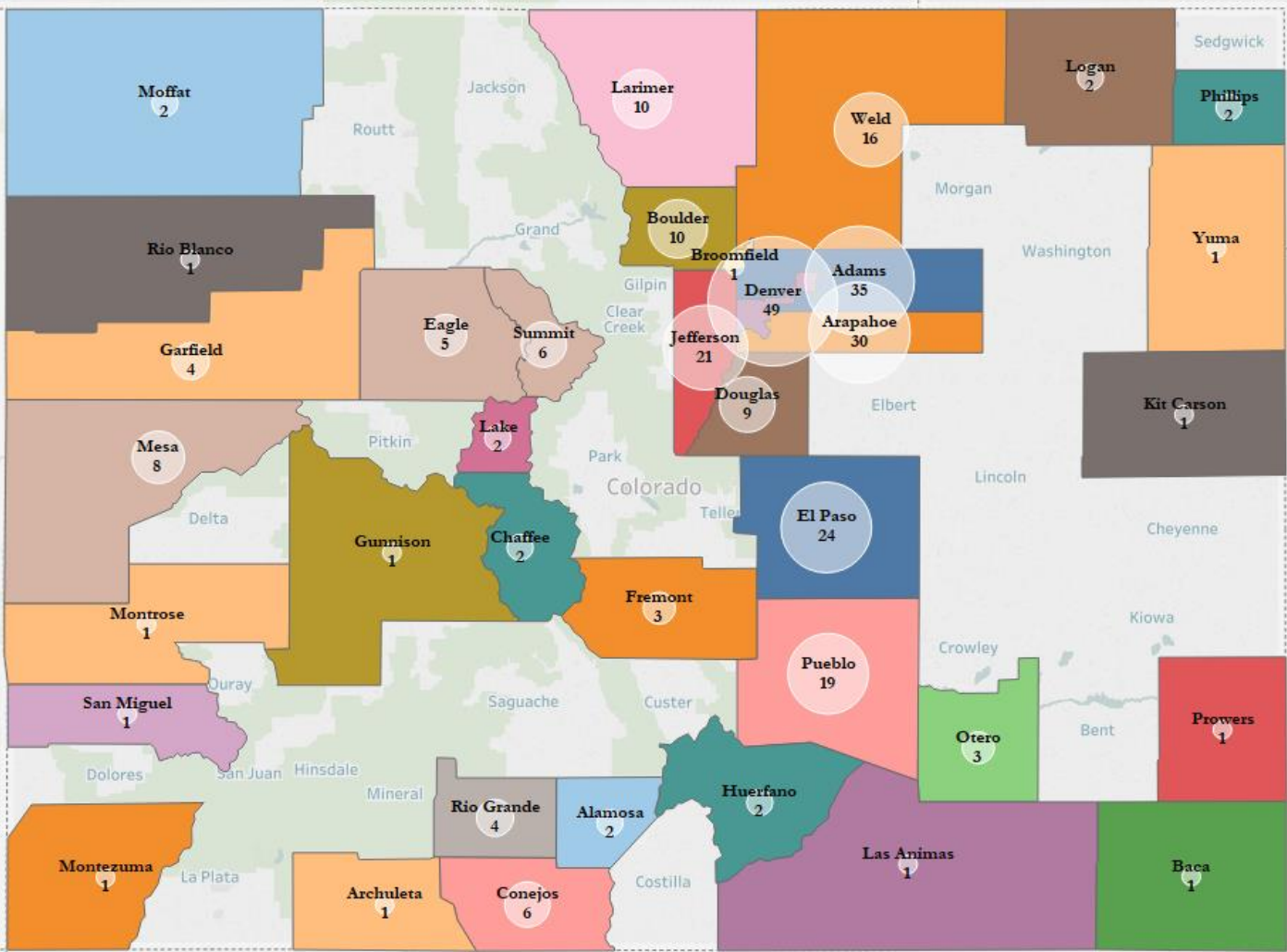
Sample Subject Location by Race – Black



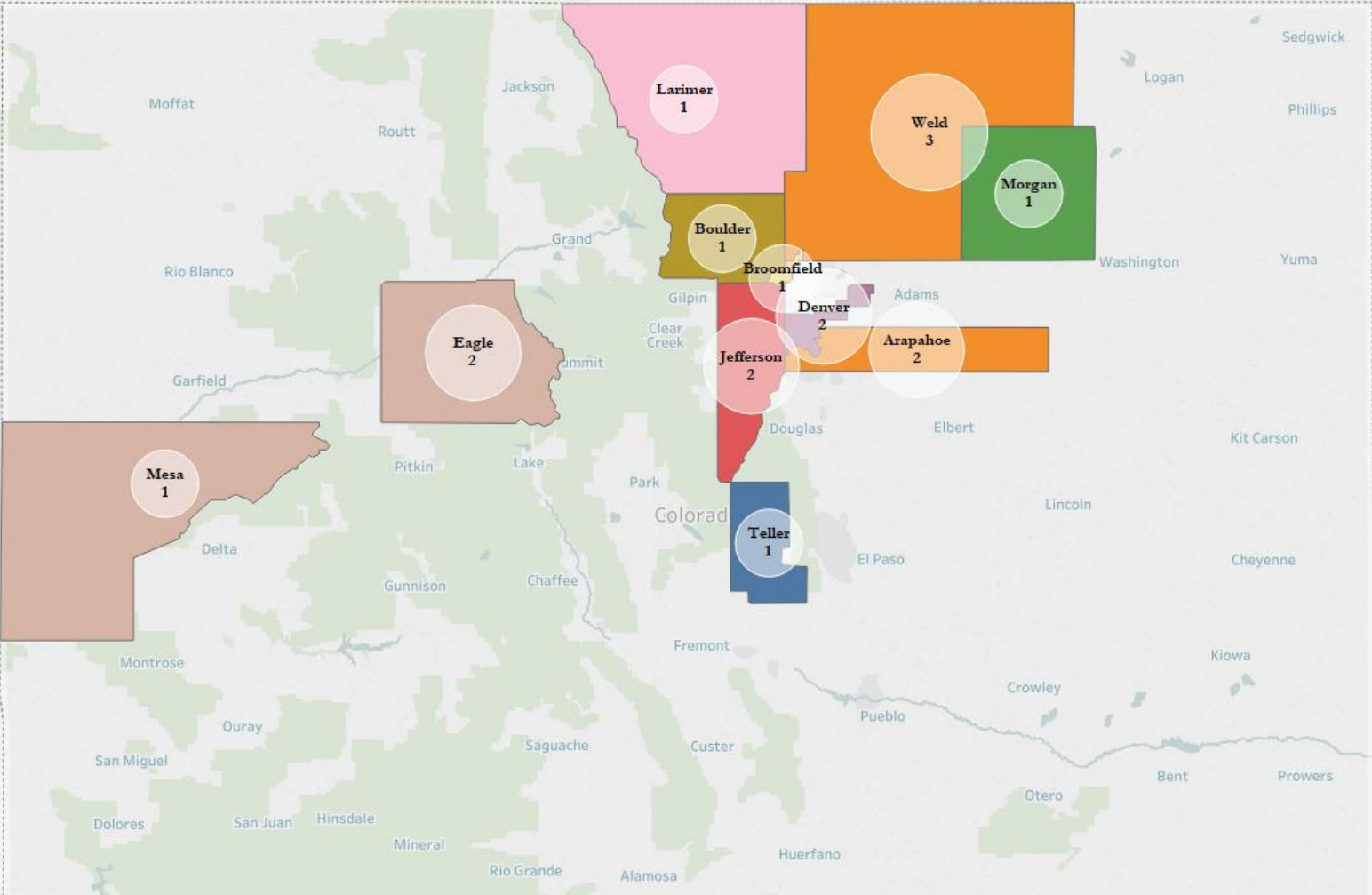
Sample Subject Location by Race – Native Hawaiian/Pacific Islander



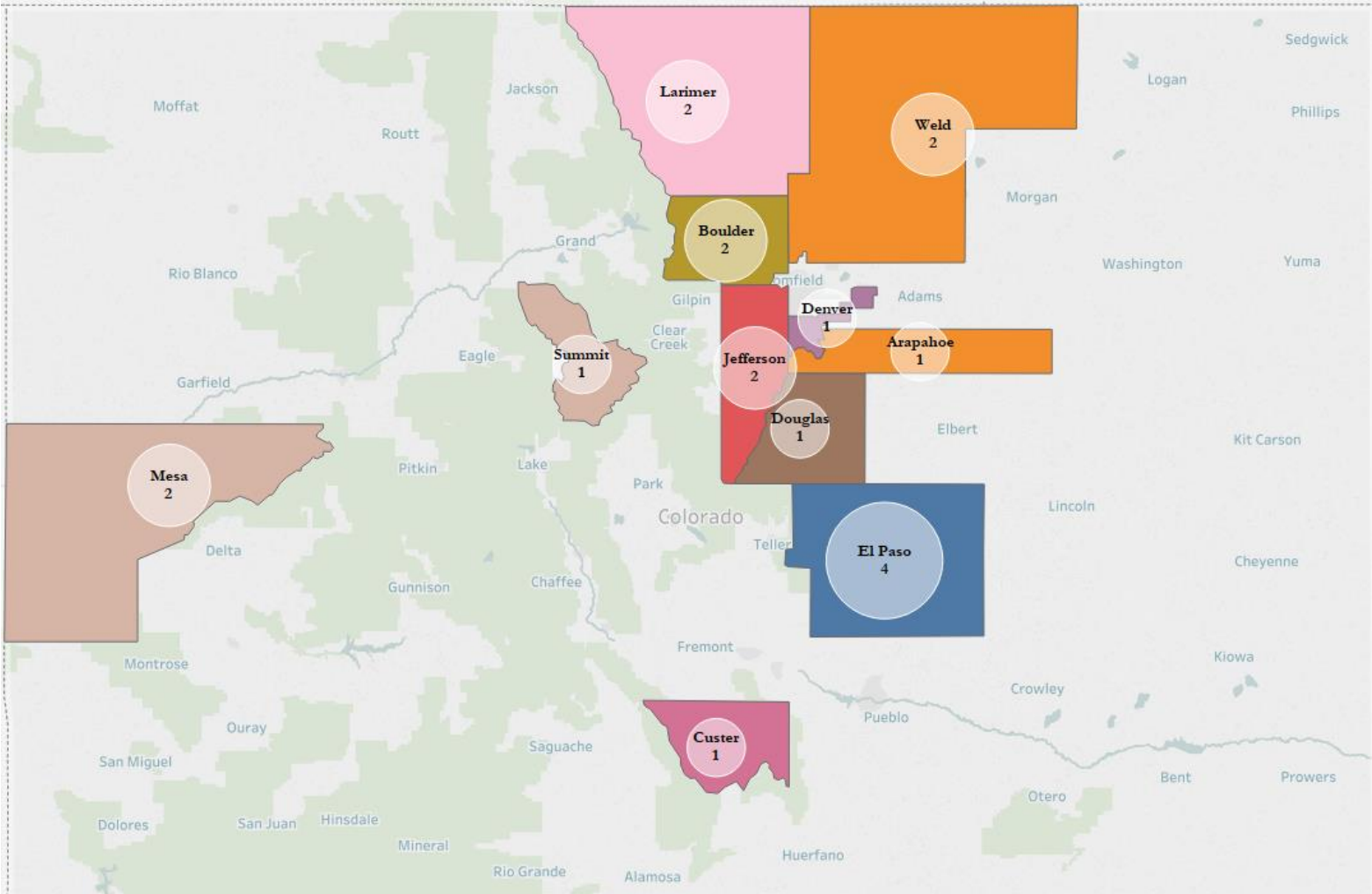
Sample Subject Location by Race – Other



Sample Subject Location by Race – Don't Know



Sample Subject Location by Race – Refused



Race Statistics

American Indian/Alaskan Native	28 1.06%
Asian	13 0.49%
Black	43 1.63%
Don't Know	17 0.64%
Native Hawaiian/Pacific Islander	2 0.08%
Other	288 10.91%
Refused	19 0.72%
White	2,229 84.46%

Race by TBI Severity

	American Indian/ Alaskan Native	Asian	Black	Don't Know	Native Hawaiian/ Pacific Islander	Other	Refused	White
No TBI	14 50.00%	13 100.00%	26 60.47%	12 70.59%	2 100.00%	179 62.15%	11 57.89%	1,368 61.37%
Mild TBI w No LOC	4 14.29%		5 11.63%	2 11.76%		55 19.10%	2 10.53%	327 14.67%
Mild TBI w LOC	6 21.43%		9 20.93%	2 11.76%		42 14.58%	3 15.79%	404 18.12%
Moderate/Severe TBI	4 14.29%		3 6.98%	1 5.88%		12 4.17%	3 15.79%	130 5.83%

Race by TBI Severity Statistical Comparison

	White	American Indian/ Alaskan Native	Asian	Black	Don't Know	Native Hawaiian / Pacific Islander	Other	Refused
White	-	0.0445	N/A	0.1742	0.1856	N/A	0.0189	0.0642
American Indian/ Alaskan Native		-	N/A	0.1414	0.1189	N/A	0.0168	0.1910
Asian			-	N/A	N/A	N/A	N/A	N/A
Black				-	0.1782	N/A	0.0743	0.1426
Don't Know					-	N/A	0.1512	0.1565
Native Hawaiian/ Pacific Islander						-	N/A	N/A
Other							-	0.0289
Refused								-
N/A = Can't do calculation because of too many zero values in TBI Severity Categories								
Alpha = 0.05/5 (Bonferroni correction)								
Only White versus Other used a chi-squared test; all else used Fisher's Exact								

Thank You

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Additional Information

Negative Outcomes SuperTable

Percentage Who Endorse the Negative Outcome

		Female	Male	Non-Hispanic White	Hispanic	Other Minority	No TBI	Mild TBI No LOC	Mild TBI w/LOC	Moderate/Severe TBI
Cognitive Complaints	<i>Urban</i>	51.4	44.8	46.3	51.7	61.4	42.5	48.6	59.8	68.7
	<i>Rural</i>	52.4	43.5	44.3	53.8	64.6	44.5	52.1	53.2	46.3
	<i>Frontier</i>	54.5	36.3	48.8	23.4	0.0	29.2	44.7	42.7	82.4
2+ Days/Month Poor Mental Health	<i>Urban</i>	38.3	27.5	31.6	36.2	42.6	28.4	36.2	39.8	48.5
	<i>Rural</i>	30.2	28.5	28.2	31.6	34.7	30.2	31.4	25.7	32.0
	<i>Frontier</i>	31.2	16.6	23.2	33.7	0.0	29.4	28.7	9.0	14.7
2+ Days/Month Poor Physical Health	<i>Urban</i>	29.7	27.1	29.0	24.2	30.6	22.0	34.8	37.9	44.1
	<i>Rural</i>	29.6	25.0	29.1	14.4	30.2	27.8	23.7	27.7	26.7
	<i>Frontier</i>	19.7	21.8	19.7	36.6	0.0	22.8	15.9	16.9	23.6
Disability	<i>Urban</i>	30.9	25.2	29.5	18.3	28.6	21.7	29.1	42.0	47.7
	<i>Rural</i>	33.6	31.0	35.4	13.8	45.7	27.0	32.0	38.4	61.1
	<i>Frontier</i>	25.9	19.1	23.2	23.1	0.0	24.7	15.7	29.1	17.6
Problem Alcohol Use	<i>Urban</i>	10.6	36.6	23.1	30.5	14.7	21.4	26.1	26.7	25.3
	<i>Rural</i>	17.7	28.1	22.7	20.0	33.7	22.4	14.4	26.4	37.1
	<i>Frontier</i>	6.6	17.3	13.4	2.0	0.0	7.1	15.7	15.6	19.2
Work Limitation	<i>Urban</i>	24.4	17.3	21.6	14.3	23.7	16.2	21.1	30.9	38.3
	<i>Rural</i>	21.8	22.9	22.9	12.9	43.6	17.3	22.3	28.8	47.0
	<i>Frontier</i>	16.1	16.4	17.6	10.7	0.0	18.7	16.0	11.2	14.0
Low Life Satisfaction	<i>Urban</i>	16.1	16.0	15.4	8.7	31.3	12.5	16.7	20.0	38.6
	<i>Rural</i>	10.1	10.0	9.7	9.7	18.1	7.1	7.2	16.0	21.6
	<i>Frontier</i>	9.3	8.9	10.0	4.5	0.0	6.7	9.8	7.7	15.1
General Health Fair or Poor	<i>Urban</i>	12.9	9.6	10.1	18.3	16.2	8.6	10.1	18.5	20.8
	<i>Rural</i>	14.2	14.7	13.0	26.0	7.2	12.8	5.3	19.3	32.5
	<i>Frontier</i>	8.4	24.1	17.4	16.8	0.0	11.6	11.8	27.8	26.4
Needs Help with ADLs	<i>Urban</i>	2.5	1.1	1.9	1.5	1.3	1.4	1.5	1.8	7.5
	<i>Rural</i>	1.1	1.4	1.5	0.5	0.0	1.4	0.2	0.3	6.9
	<i>Frontier</i>	2.3	0.0	1.3	0.0	0.0	0.0	5.8	0.0	0.0
Needs Supervision for ADLs	<i>Urban</i>	1.5	0.7	1.2	0.6	1.1	0.9	0.8	1.3	3.3
	<i>Rural</i>	1.1	0.7	1.0	0.5	0.0	0.8	0.0	0.3	6.9
	<i>Frontier</i>	2.3	0.0	1.3	0.0	0.0	0.0	5.8	0.0	0.0

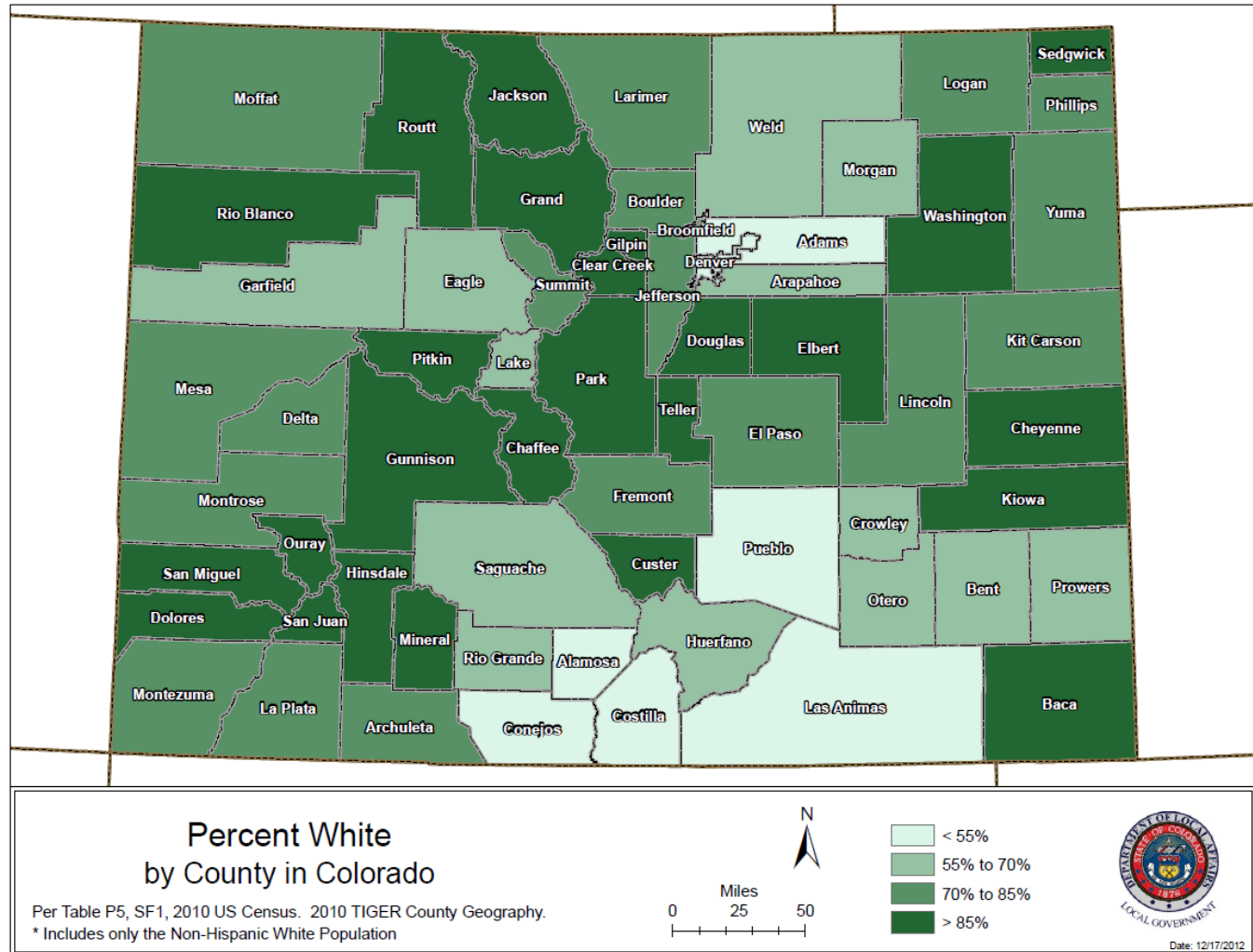
No statistically significant difference between groups.

Post-Concussive Symptoms SuperTable

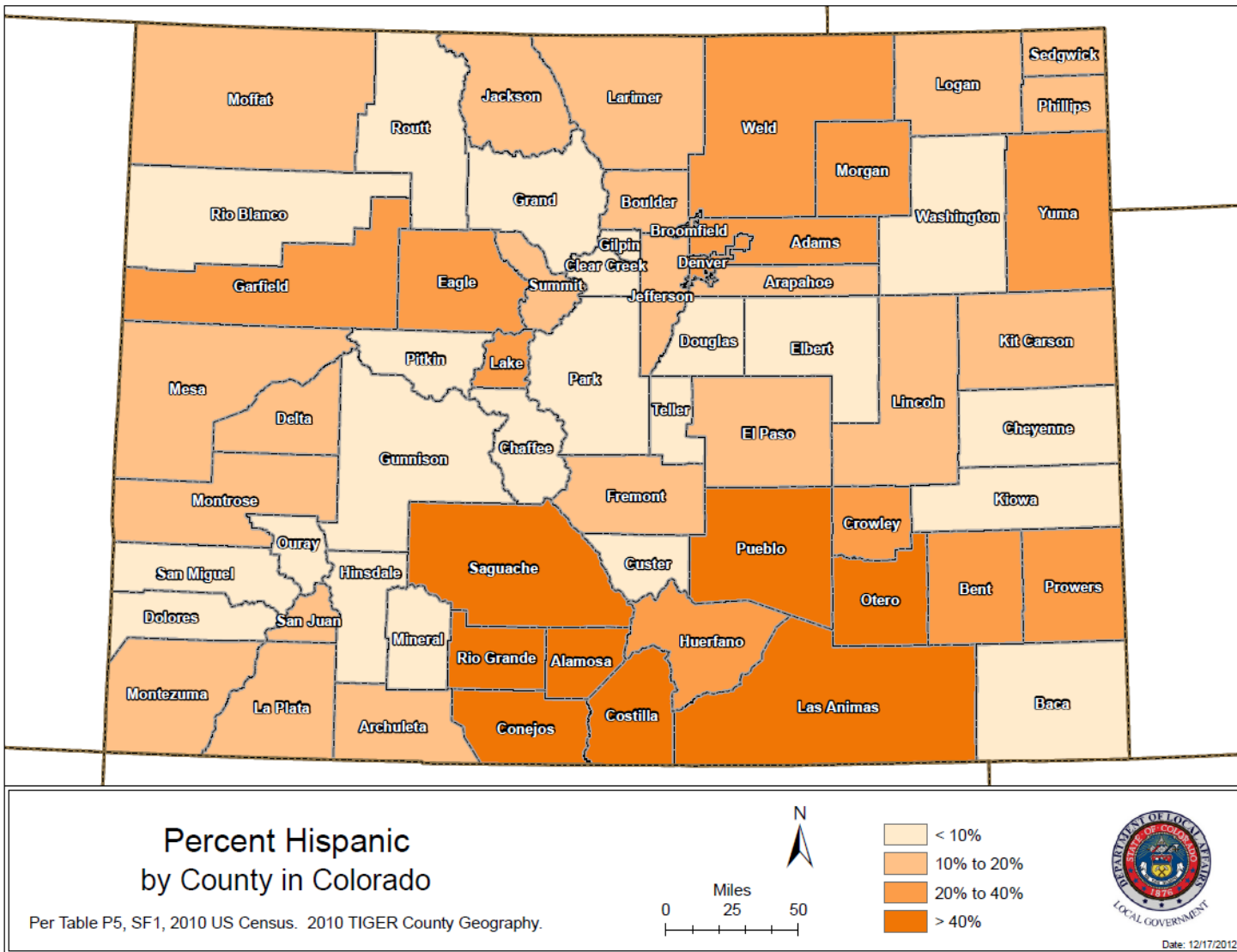
No statistically significant difference between groups.

Percentage Who Endorse the Post-Concussive Symptom										
		Female	Male	Non-Hispanic White	Hispanic	Other Minority	No TBI	Mild TBI No LOC	Mild TBI w/LOC	Moderate/Severe TBI
Tiredness	<i>Urban</i>	71.5	53.8	63.6	54.6	69.0	57.9	68.1	70.0	73.4
	<i>Rural</i>	68.9	68.5	67.6	65.4	86.4	67.8	64.1	68.9	88.1
	<i>Frontier</i>	54.7	35.1	46.1	40.0	15.3	57.5	48.8	17.5	26.4
Sleep Disturbance	<i>Urban</i>	56.2	52.6	56.0	40.2	58.2	49.2	61.7	58.3	71.4
	<i>Rural</i>	53.7	46.3	48.7	42.8	81.9	46.1	54.9	50.8	74.6
	<i>Frontier</i>	39.3	27.2	35.2	25.0	0.0	35.5	59.4	31.3	1.4
Irritability	<i>Urban</i>	48.7	42.6	45.0	44.2	48.0	38.8	58.4	51.9	56.5
	<i>Rural</i>	49.9	48.5	49.1	34.0	87.0	43.7	50.4	60.8	50.2
	<i>Frontier</i>	46.5	37.0	42.1	48.2	15.3	44.9	52.7	36.6	26.4
Headaches	<i>Urban</i>	48.5	33.7	39.5	45.4	48.5	36.1	43.3	50.4	58.5
	<i>Rural</i>	54.0	29.4	36.8	42.3	86.1	39.6	41.5	42.4	51.3
	<i>Frontier</i>	32.0	33.1	31.3	53.2	0.0	30.6	28.4	64.6	17.9
Poor Concentration	<i>Urban</i>	24.2	18.4	20.7	18.4	29.8	16.0	20.5	32.4	44.5
	<i>Rural</i>	19.8	16.0	13.6	27.5	40.3	11.5	23.6	25.1	38.4
	<i>Frontier</i>	15.4	11.4	13.6	14.3	0.0	15.5	5.8	13.6	14.7
Poor Memory	<i>Urban</i>	22.3	14.1	17.6	15.4	30.1	13.5	16.6	25.7	49.0
	<i>Rural</i>	18.4	17.6	16.4	21.5	23.2	18.5	13.5	17.5	25.7
	<i>Frontier</i>	34.2	7.8	22.3	9.1	0.0	13.3	10.8	6.5	56.6
Noise/Light Sensitivity	<i>Urban</i>	19.6	15.4	16.2	19.3	32.4	11.4	18.6	23.5	57.4
	<i>Rural</i>	16.7	16.6	18.4	10.6	0.0	14.0	18.7	21.0	20.2
	<i>Frontier</i>	10.9	6.7	7.1	24.2	0.0	11.4	10.4	7.8	1.1
Dizziness	<i>Urban</i>	21.1	13.2	17.2	18.4	15.3	13.7	15.1	27.1	29.4
	<i>Rural</i>	18.4	9.9	14.3	16.0	6.1	13.7	19.2	11.2	16.8
	<i>Frontier</i>	38.0	8.9	23.9	23.0	0.0	12.7	6.5	12.6	70.3
Tinnitus	<i>Urban</i>	15.2	16.3	15.6	13.3	23.4	13.2	15.3	19.5	31.9
	<i>Rural</i>	16.2	17.9	15.6	28.6	0.0	17.1	8.6	15.4	46.3
	<i>Frontier</i>	36.6	19.1	26.8	39.9	0.0	19.6	30.5	9.6	56.6
Poor Balance	<i>Urban</i>	19.3	11.9	15.9	9.0	25.1	12.1	15.3	17.8	45.1
	<i>Rural</i>	16.8	14.5	14.2	24.3	13.4	12.1	11.9	22.6	30.4
	<i>Frontier</i>	32.3	13.6	25.0	8.4	0.0	9.0	18.7	7.7	70.3
Poor Vision	<i>Urban</i>	12.2	7.4	8.6	16.9	12.9	7.3	7.7	16.9	21.3
	<i>Rural</i>	14.2	6.0	10.5	6.9	0.0	7.4	17.1	10.8	16.7
	<i>Frontier</i>	6.1	5.5	3.0	24.9	0.0	5.0	12.2	7.8	0.0

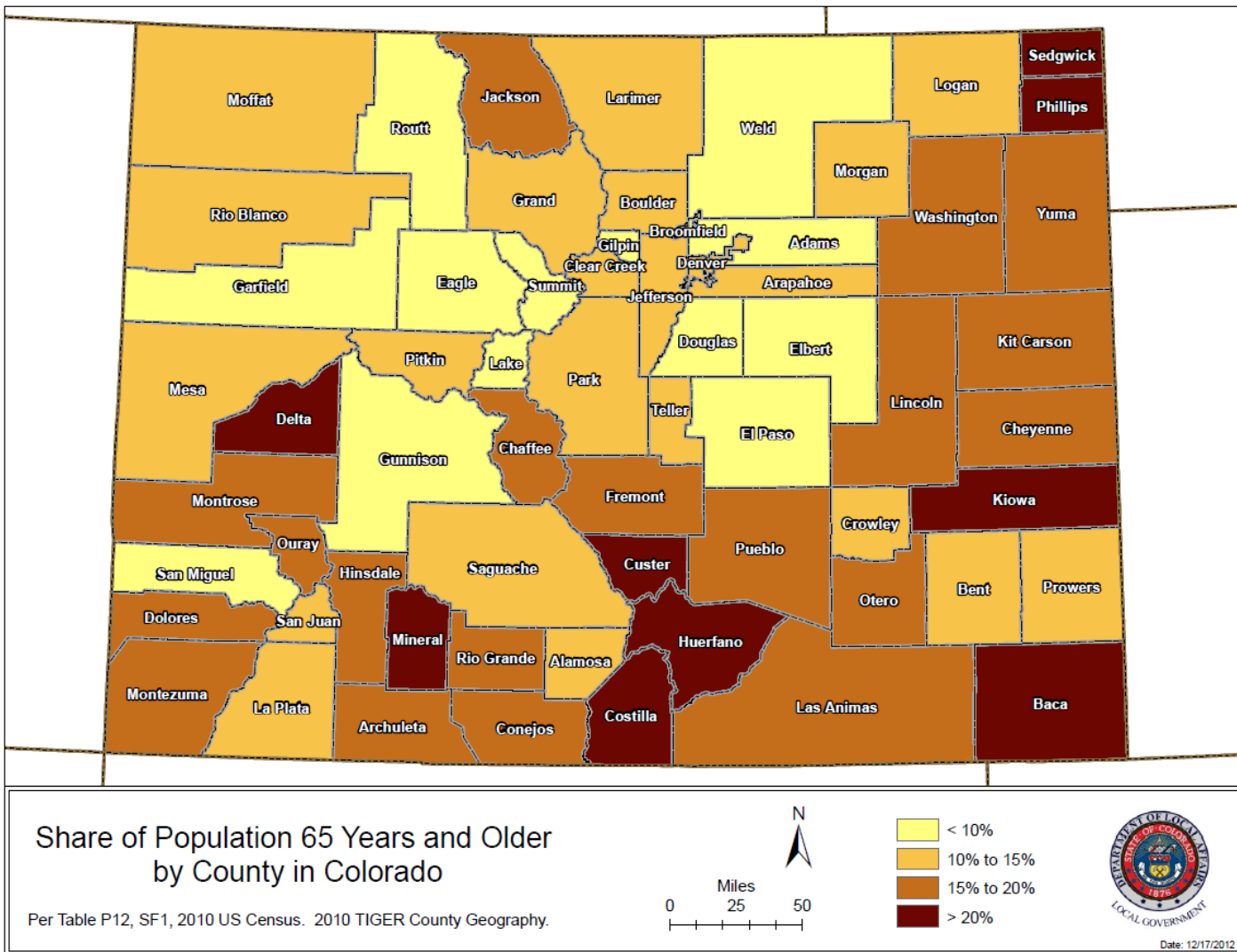
Colorado 2010 Census Maps (CO Department of Local Affairs)



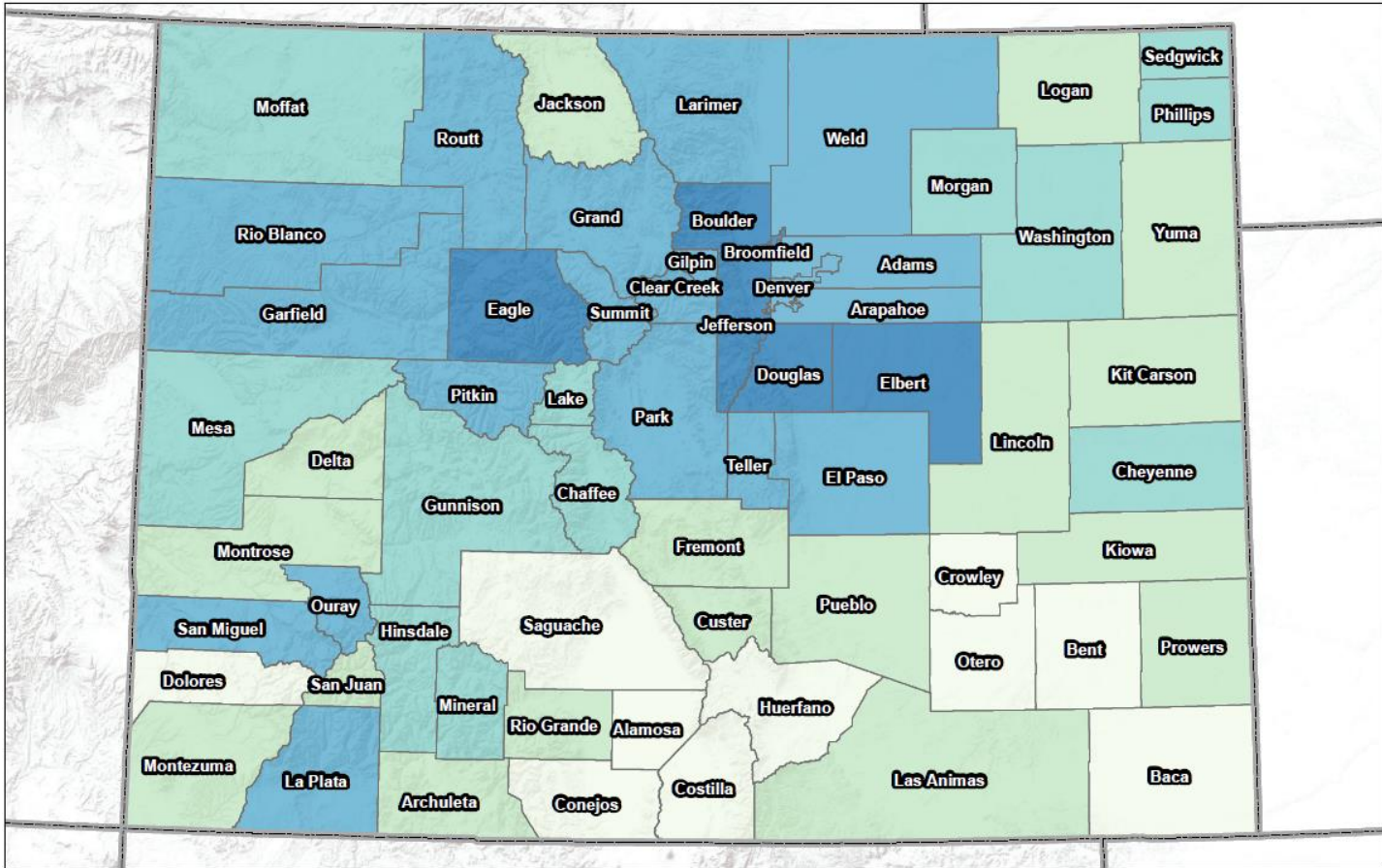
Colorado 2010 Census Maps



Colorado 2010 Census Maps



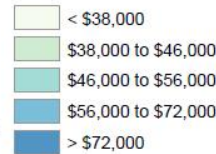
Colorado 2012-2016 Maps



Median Household Income

Per Table B19013, ACS 5-Year 2012-2016.

The American Community Survey is a sample, not a census. Results are subject to a margin of error.

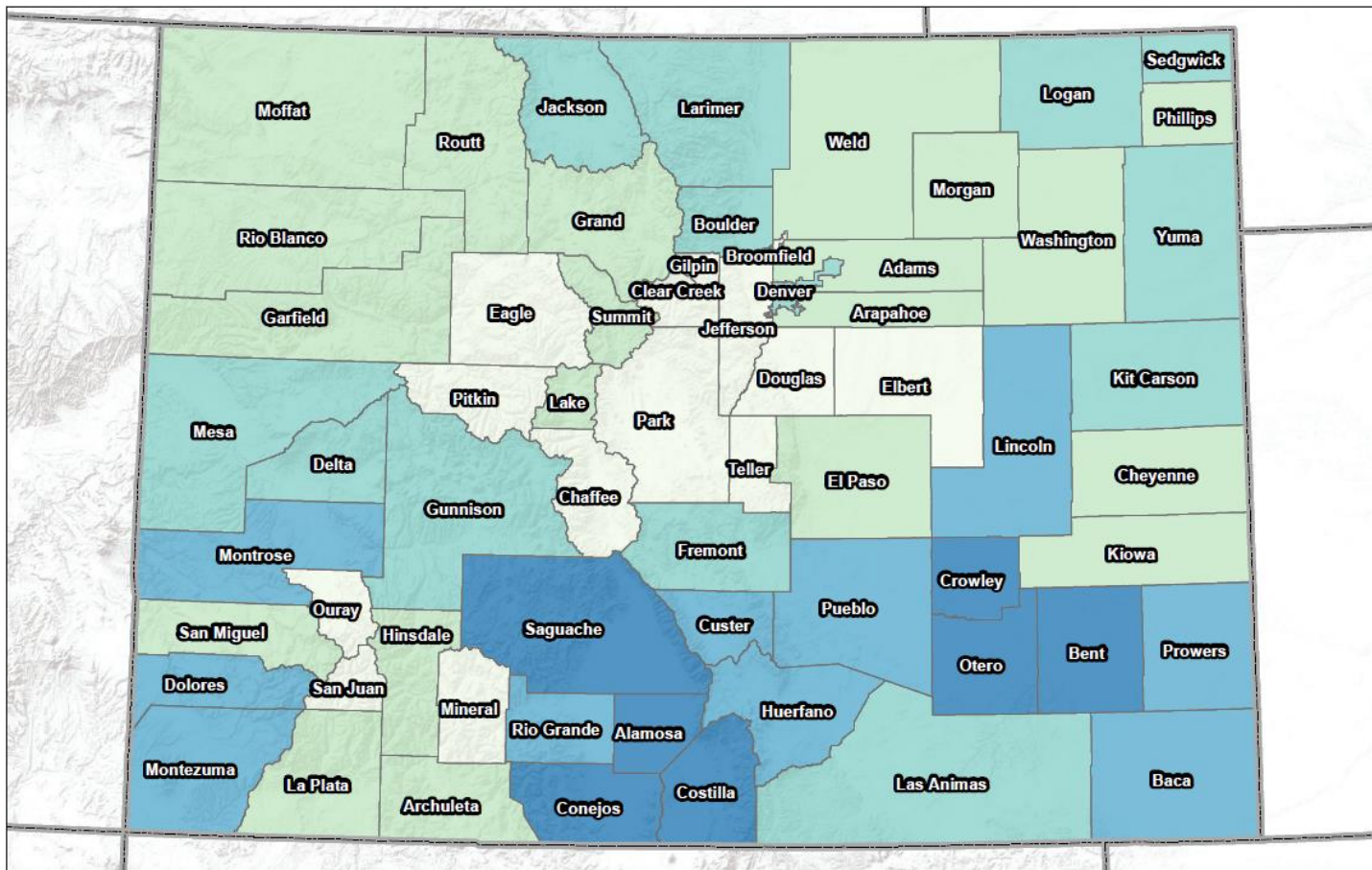


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Colorado 2012-2016 Maps



Percent in Poverty

Per Table C17002, ACS 5-Year 2012-2016.

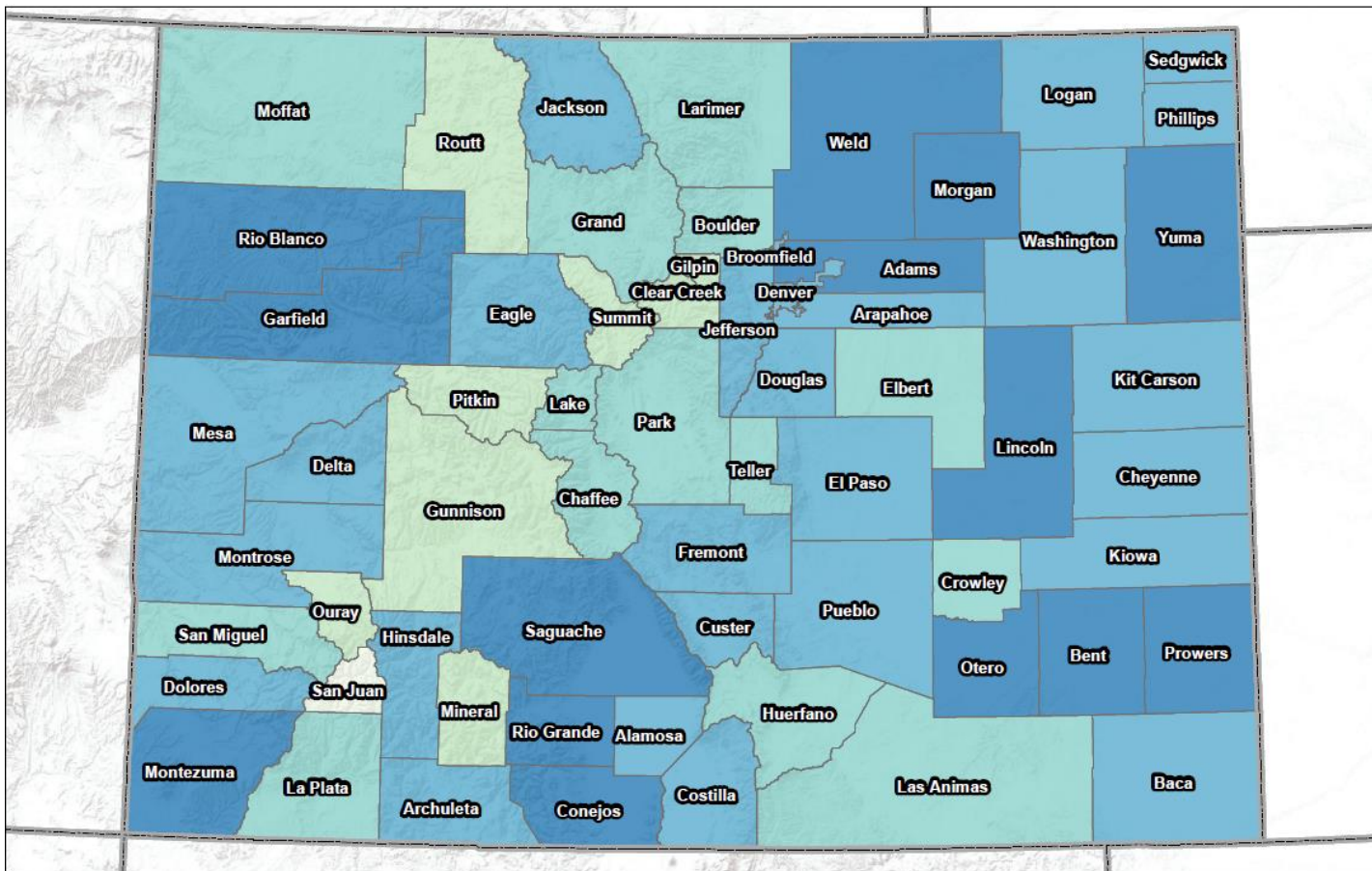
The American Community Survey is a sample, not a census. Results are subject to a margin of error. Data represents the percentage of the population living in poverty



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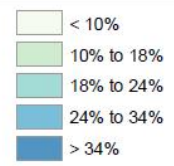
Colorado 2012-2016 Maps



Children in Poverty

Per Table C17001, ACS 5-Year 2012-2016.

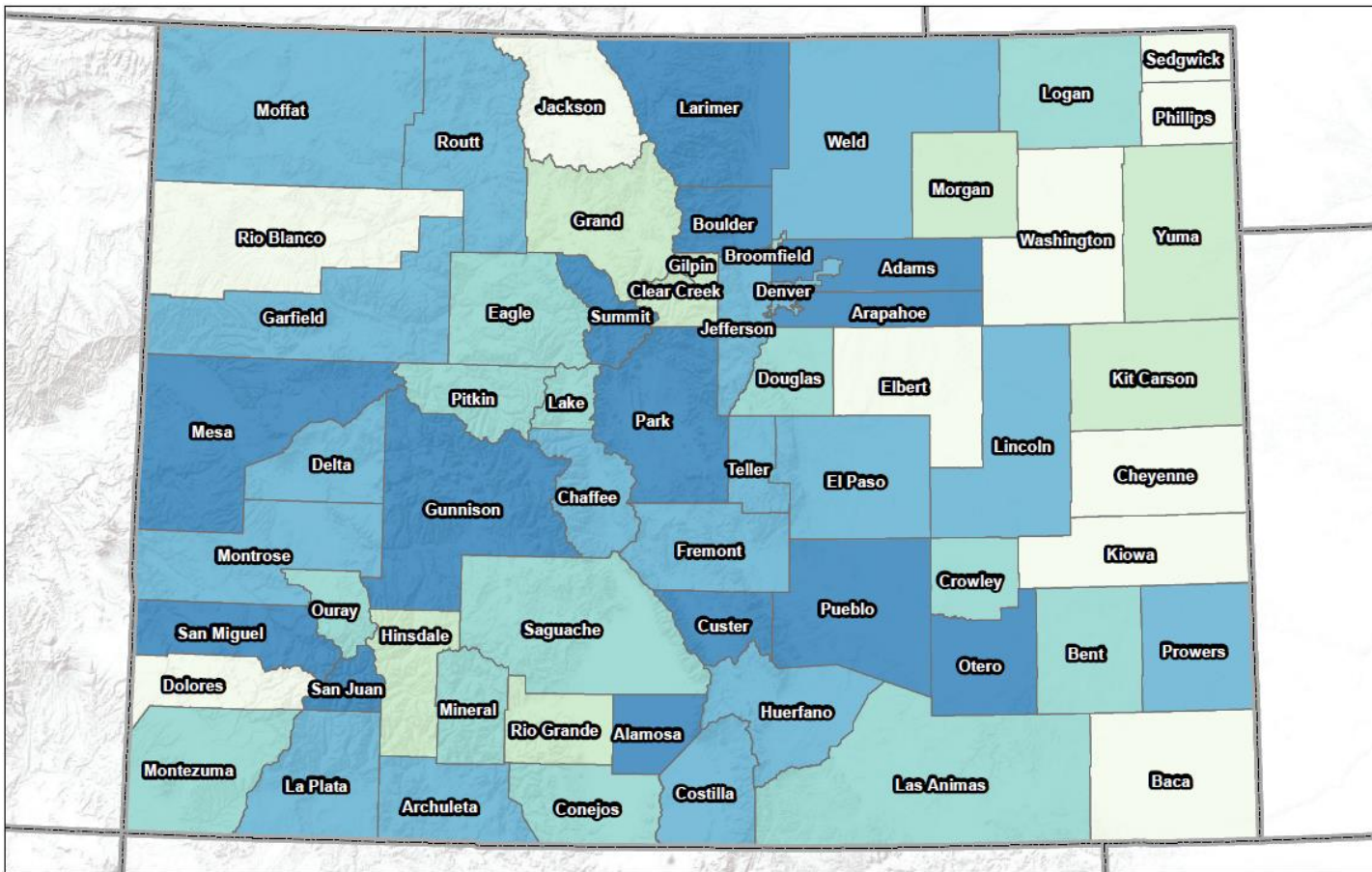
The American Community Survey is a sample, not a census. Results are subject to a margin of error. Data represents the percentage of the population under 18 who are living in poverty



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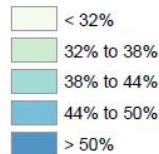
Colorado 2012-2016 Maps



Percent of Renters Spending >30% of Household Income on Housing Costs

Per Table GCT2515, ACS 5-Year 2012-2016.

The American Community Survey is a sample, not a census. Results are subject to a margin of error. Data represents the percentage of all renters spending 30% or more of household income on selected monthly owner costs.

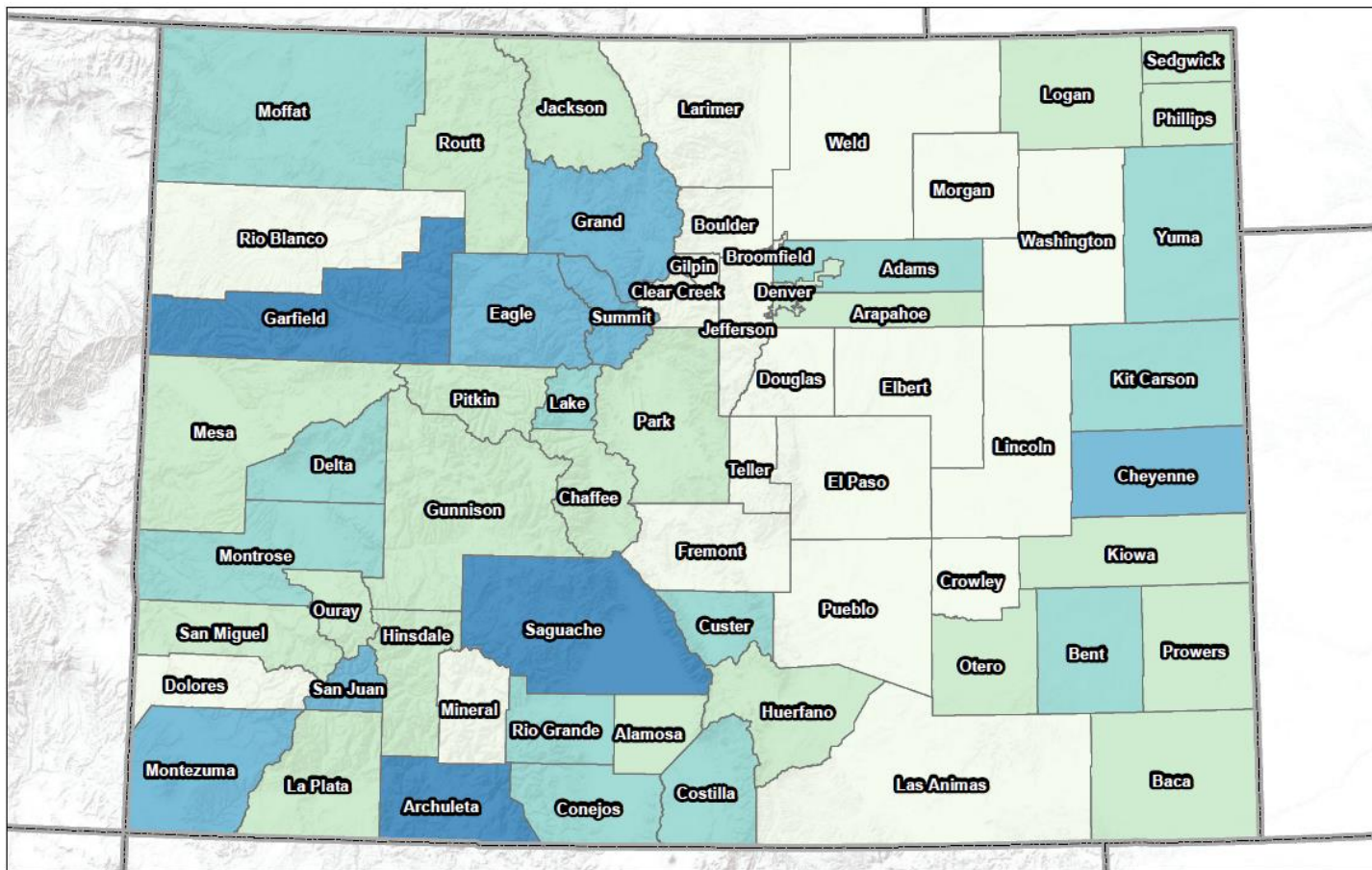


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Colorado 2012-2016 Maps




Percent Not Insured

Per Table B05002, ACS 5-Year 2012-2016.

The American Community Survey is a sample, not a census. Results are subject to a margin of error. Data represents the percentage of the civilian non-institutionalized population that was not covered by health insurance

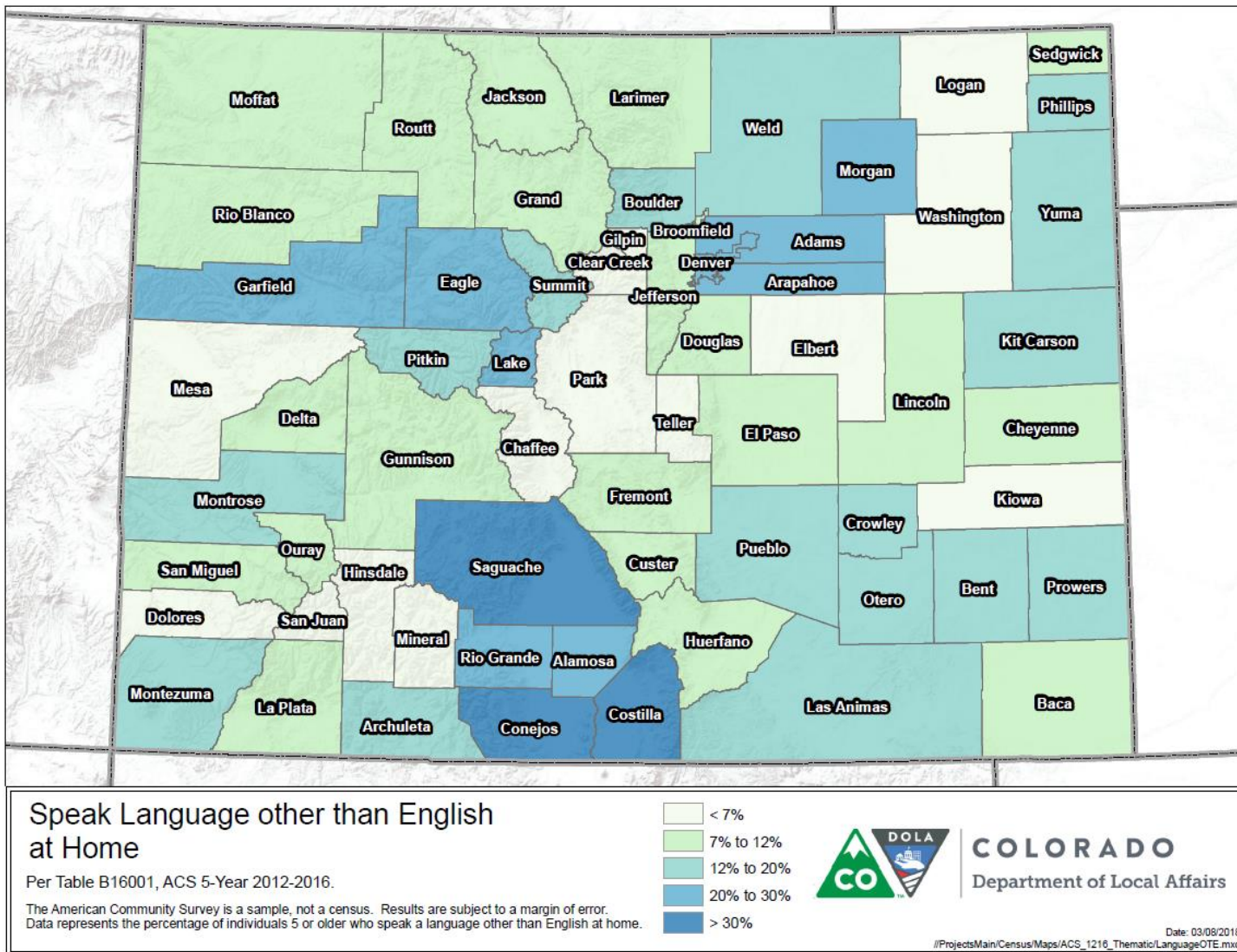
- < 11%
- 11% to 14%
- 14% to 17%
- 17% to 20%
- > 20%



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//ProjectsMain/Census/Maps/ACS_1216_Thematic/NotInsured.mxd

Colorado 2012-2016 Maps





Colorado Study Publications

- Whiteneck GG, Cuthbert JP, Corrigan JD, Bogner JA. Prevalence of Self-Reported Lifetime History of Traumatic Brain Injury and Associated Disability: A Statewide Population-Based Survey. J Head Trauma Rehabil. 2016 Jan-Feb;31(1):E55-62.
- Whiteneck GG, Cuthbert JP, Corrigan JD, Bogner JA. Risk of Negative Outcomes After Traumatic Brain Injury: A Statewide Population-Based Survey. J Head Trauma Rehabil. 2016 Jan-Feb;31(1):E43-54.
- Cuthbert JP, Whiteneck GG, Corrigan JD, Bogner J. The Reliability of a Computer-Assisted Telephone Interview Version of the Ohio State University Traumatic Brain Injury Identification Method. J Head Trauma Rehabil. 2016 Jan-Feb;31(1):E36-42.