



Social Determinants of Health in Colorado: A Spatial Analysis of Housing Affordability and Multiple Health Issues

Jieun Lee¹, Ivan J. Ramirez^{2,3}

¹Department of Geography, GIS and Sustainability, University of Northern Colorado, Greeley, CO,

²UDepartment of Geography and Environmental Sciences, University of Colorado, Denver, CO, ³Consortium for Capacity Building, University of Colorado Boulder, CO



Department of Geography
& Environmental Sciences

COLLEGE OF LIBERAL ARTS AND SCIENCES
UNIVERSITY OF COLORADO DENVER

ABSTRACT

A burgeoning area of cross systems research focuses on the social determinants of health (SDoH): “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.” Despite a known relationship between housing and physical/mental health and the importance of health care accessibility, the geographic context of this link is less explored. Using statewide data at the census-tract level, this collaborative study employed Geographic Information Systems (GIS) and multivariate analysis to investigate the spatial relationships between asthma, mental health and other health issues as compared to availability of affordable housing and other SDoH in Colorado. In addition, this study developed two indices to measure the spatial overlap of population vulnerability to multiple health issues. In this poster we discuss preliminary results, mainly a series of maps that can potentially assist the state and other governmental partners to more effectively implement affordable housing strategies that better address disparities in public health and SDoH.

INTRODUCTION

Housing affordability is a major concern for many Coloradans. For example, 50% of renter households (income of 50,000 or less) are cost burdened. Furthermore, it appears that there is a supply issue in terms of affordable housing meaning there are not enough units available (Shift Research Lab 2018). The importance of housing as a social determinant of health has become increasingly known, particularly with regards to physical and mental health outcomes affecting vulnerable subpopulations such as minority and lower socioeconomic groups. Some health issues of importance include children's exposure to lead, asthma prevalence and hospitalization for both adults and children, psychological distress, suicide, and substance use related problems (Colorado Health Institute 2015; National Center for Health Housing 2017). Housing and health challenges illuminate the importance of not only household living conditions, but also neighborhood-level conditions and vulnerability faced by communities, particularly geographic differences, which is the focus of this pilot study. It appears that at the institutional level many states such as Colorado and New York, for example, recognize the need for integrating population health issues into housing policy, and vice versa (public health integrating housing affordability into broader policy and intervention strategies).

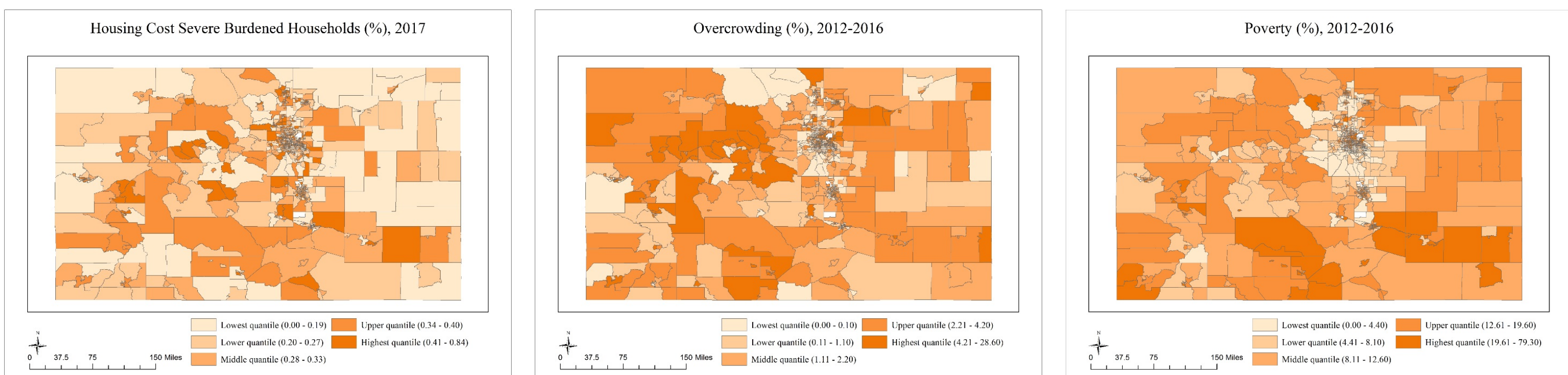


Figure 1. Housing Affordability, Overcrowding and Poverty

RESEARCH DESIGN

Spatial overlap (target area/communities) analysis		Public health (asthma and mental health)	
Housing affordability and quality	High	High housing cost areas with high prevalence of public health issues (target areas/communities with the highest priority)	High housing cost areas with low(er) prevalence of public health issues
	Low	Low(er) housing cost areas with high prevalence of public health issues (secondary target areas/communities with the highest priority)	Low(er) housing cost areas with low prevalence of public health issues

Box 1. Spatial Conceptual Framework for Housing Affordability and Public Health

Data (scale=census tract):

Health - Population-weighted rates of Asthma (Age-Adj. Incidence and Prevalence), Diabetes (Age-Adj. Incidence and Prevalence), Mental Health Distress (Prevalence), Drug Poisoning or Drug Overdose involving either Prescription Opioid Analgesic or Heroin (Age-Adj Mortality) and Suicide (Age-Adj. Mortality). Prevalence data is modeled, not direct survey estimates. Colorado Department of Public Health and Environment (CDPHE) (2012-2016, 2013-2017)

Social Vulnerability - Indicators of various socioeconomic characteristics that include economic status, household composition, minority status, housing and transportation. Centers for Disease Control and Prevention (CDC 2016).

Housing - Total (%) of population that is severely cost burdened. U.S. Census Bureau, Community Survey, Census (2017)

Methods (adapted from Ramirez et al. 2018):

1. Generate thematic maps of individual health and housing outcomes and select SVI indicators at the state and metropolitan levels.
2. Calculate z-scores (standard deviations) and ratios (divide value by state average).
3. Estimate and geovisualize a *descriptive* Health Vulnerability Index (counts) - Count # of diseases present per census tract that are at least 1 standard deviation.
3. Estimate an *analytical* Health Vulnerability Index (composite) - Construct a composite index using Principal Components Analysis (PCA) and scale index from 0 to 1.
4. Compare health outcomes ratios with housing ratios, according to the Health Vulnerability Index (by counts).
5. Visualize using interactive mapping tool in ArcGIS online.

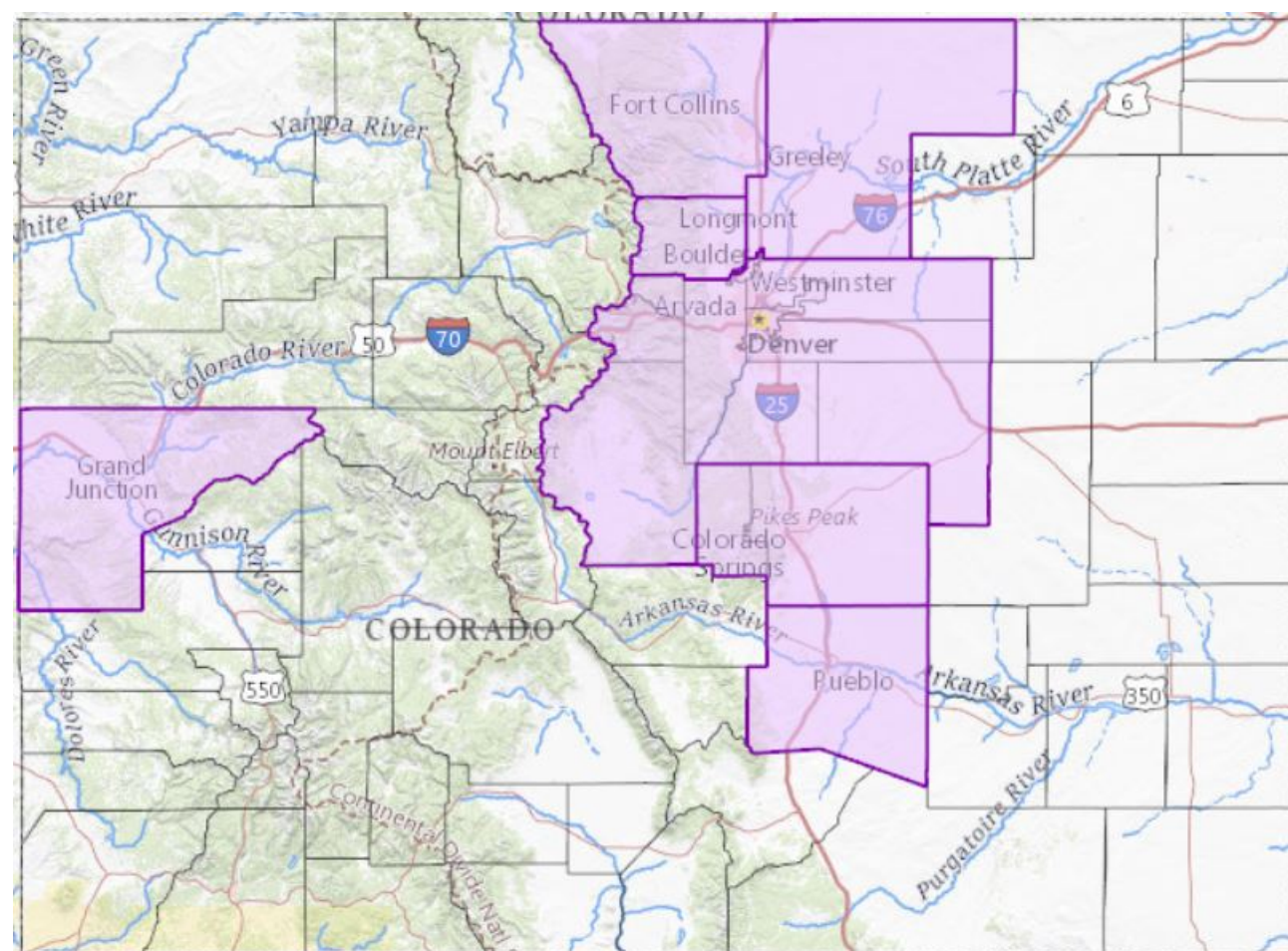


Figure 2. Map of Colorado (Counties and Metropolitan areas)

RESULTS: PUBLIC HEALTH CONTEXT

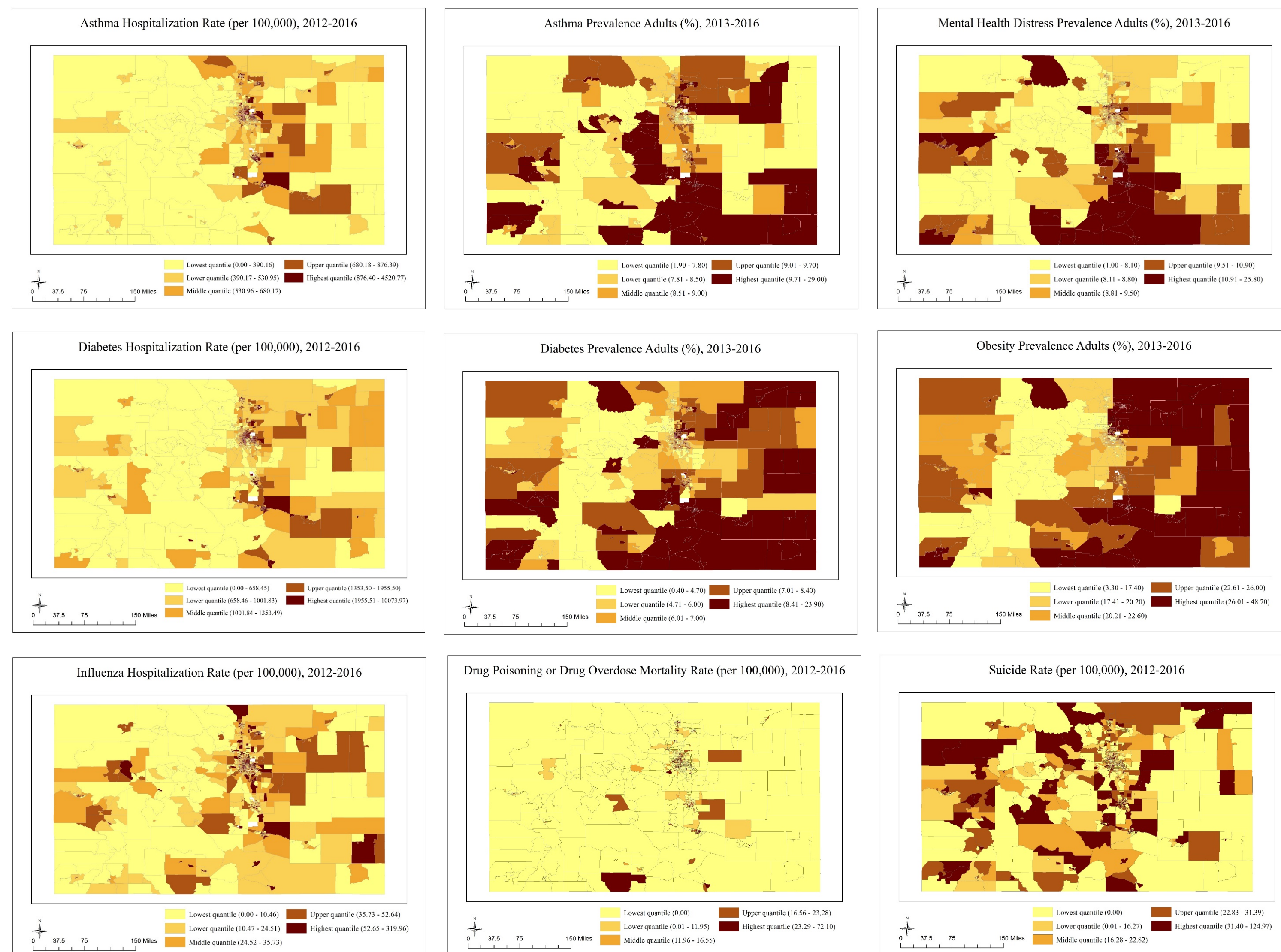


Figure 3. Multiple Health Issues (per 100,000) in Colorado, quantile classification

Although Asthma and Mental Health-related outcomes (Drug Overdose and Suicide Mortality) are the focus of this pilot study, we also highlighted other related issues that may overlap, such as Diabetes, Obesity, and Influenza, in terms of health disparities.

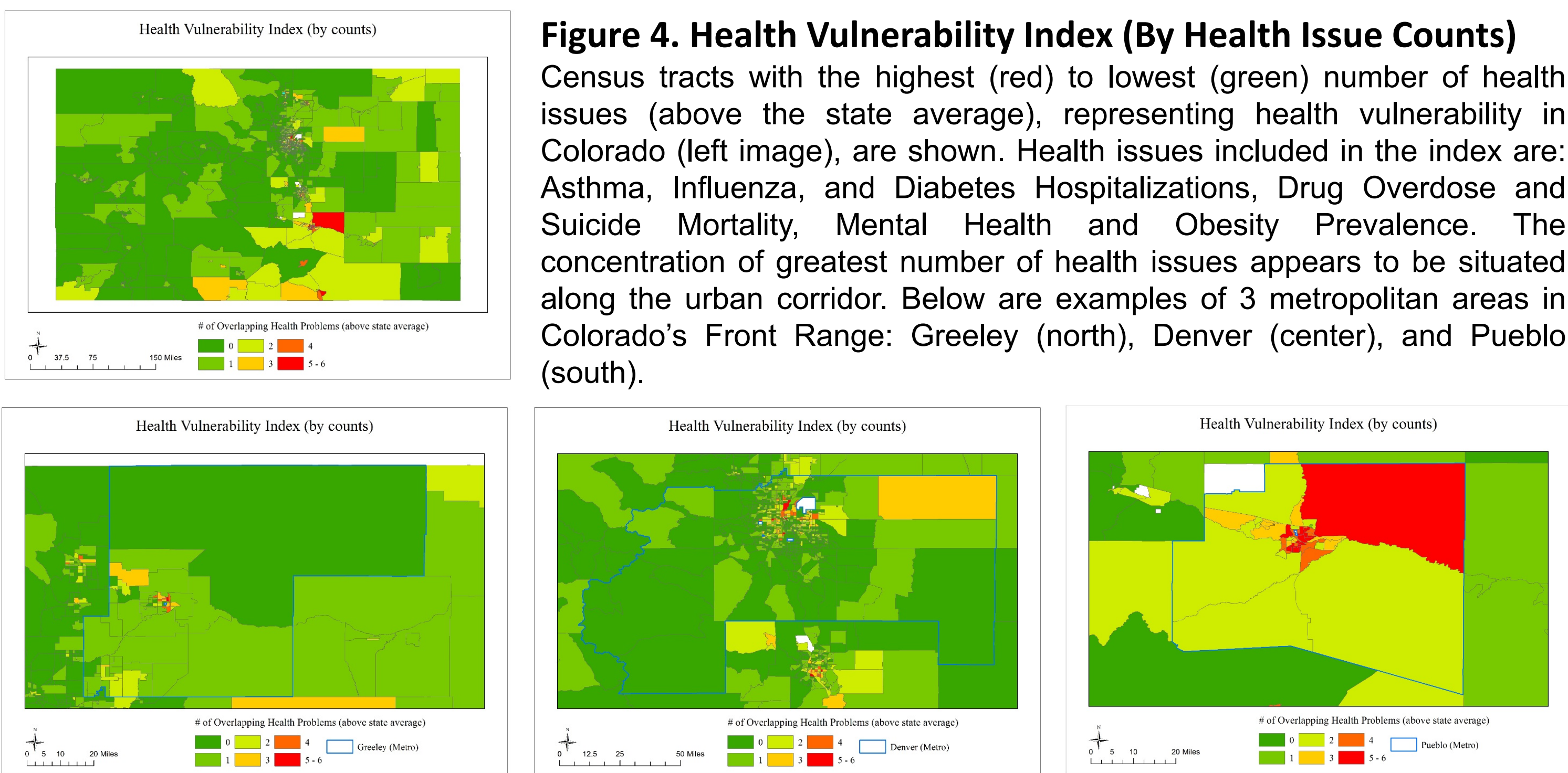


Figure 4. Health Vulnerability Index (By Health Issue Counts)

Census tracts with the highest (red) to lowest (green) number of health issues (above the state average), representing health vulnerability in Colorado (left image), are shown. Health issues included in the index are: Asthma, Influenza, and Diabetes Hospitalizations, Drug Overdose and Suicide Mortality, Mental Health and Obesity Prevalence. The concentration of greatest number of health issues appears to be situated along the urban corridor. Below are examples of 3 metropolitan areas in Colorado's Front Range: Greeley (north), Denver (center), and Pueblo (south).

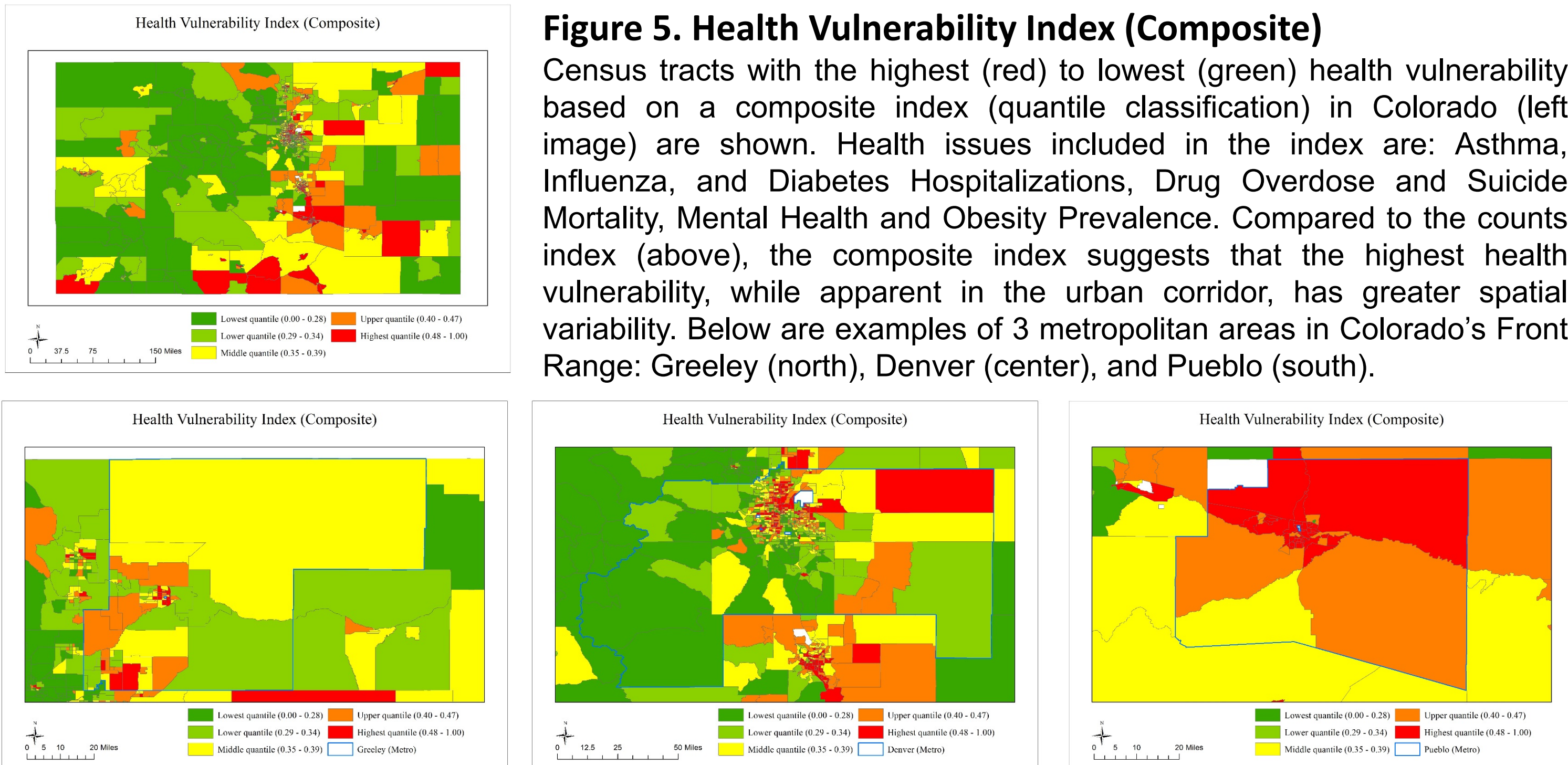


Figure 5. Health Vulnerability Index (Composite)

Census tracts with the highest (red) to lowest (green) health vulnerability based on a composite index (quantile classification) in Colorado (left image) are shown. Health issues included in the index are: Asthma, Influenza, and Diabetes Hospitalizations, Drug Overdose and Suicide Mortality, Mental Health and Obesity Prevalence. Compared to the counts index (above), the composite index suggests that the highest health vulnerability, while apparent in the urban corridor, has greater spatial variability. Below are examples of 3 metropolitan areas in Colorado's Front Range: Greeley (north), Denver (center), and Pueblo (south).

RESULTS: PUBLIC HEALTH CONTEXT AND VULNERABILITY

COUNTY	LOCATION	ASTHMAA	DIABETESA	PODA	MNTHP	OBESITYP	SUICIDEP	HCOSTSEVBR	COUNTS
Pueblo	Census Tract 24	1.6	2.0	5.3	1.7	1.5	2.8	1.7	6
Pueblo	Census Tract 6	2.1	3.1	4.4	1.6	1.6	2.4	1.7	6
Pueblo	Census Tract 36	2.0	2.8	0.0	1.6	1.5	1.8	1.5	6
Pueblo	Census Tract 12	1.9	3.2	6.1	1.7	1.6	1.6	1.5	6
Pueblo	Census Tract 22	2.8	3.8	8.6	1.5	1.6	0.0	1.8	5
Pueblo	Census Tract 11	2.4	3.3	3.0	1.9	1.6	1.6	1.7	5
Larimer	Census Tract 5.05	2.2	2.2	0.0	1.0	0.7	2.2	2.2	4
Mesa	Census Tract 6.02	1.2	1.2	2.6	1.4	1.0	1.7	1.8	4
Pueblo	Census Tract 28.01	1.3	1.9	2.2	1.5	1.5	1.4	1.8	4
Pueblo	Census Tract 10	1.8	2.6	1.5	1.8	1.5	0.7	1.7	4
Adams	Census Tract 88.01	1.7	2.2	0.0	1.0	1.2	1.7	1.7	4
Denver	Census Tract 41.02	2.0	2.1	0.0	1.3	1.1	0.6	1.7	4
Denver	Census Tract 7.02	2.0	2.2	1.9	1.2	1.0	0.0	1.6	4
El Paso	Census Tract 54	1.9	2.1	0.0	1.4	1.1	0.6	1.6	4
Pueblo	Census Tract 9.05	1.5	1.9	0.0	1.5	1.4	0.0	1.5	4
Larimer	Census Tract 13.05	2.7	2.2	4.2	0.9	0.8	0.0	1.5	4
El Paso	Census Tract 21.01	1.9	2.0	4.2	1.2	1.1	2.4	1.5	4
Arapahoe	Census Tract 73.02	2.6	3.0	2.0	1.0	1.1	0.5	1.5	4
Adams	Census Tract 79	2.3	2.6	2.3	1.1	1.2	0.8	1.5	4
El Paso	Census Tract 20	1.8	1.8	1.9	1.2	1.1	1.7	1.5	4
Denver	Census Tract 9.04	2.0	2.5	2.7	1.1	1.0	1.6	1.5	4

Table 1. Comparing Housing with Health Issues and Health Vulnerability (By Counts)

Table 1 shows the top 21 most vulnerable census tracts (by counts – red is highest) and relative health issue burdens (Asthma and Diabetes hospitalizations, Drug Overdose and Suicide Mortality, Mental Health and Obesity Prevalence) and severe housing cost burden (ratios [above state average]).

RESULTS: WEB-BASED VISUALIZATION (ArcGIS ONLINE)

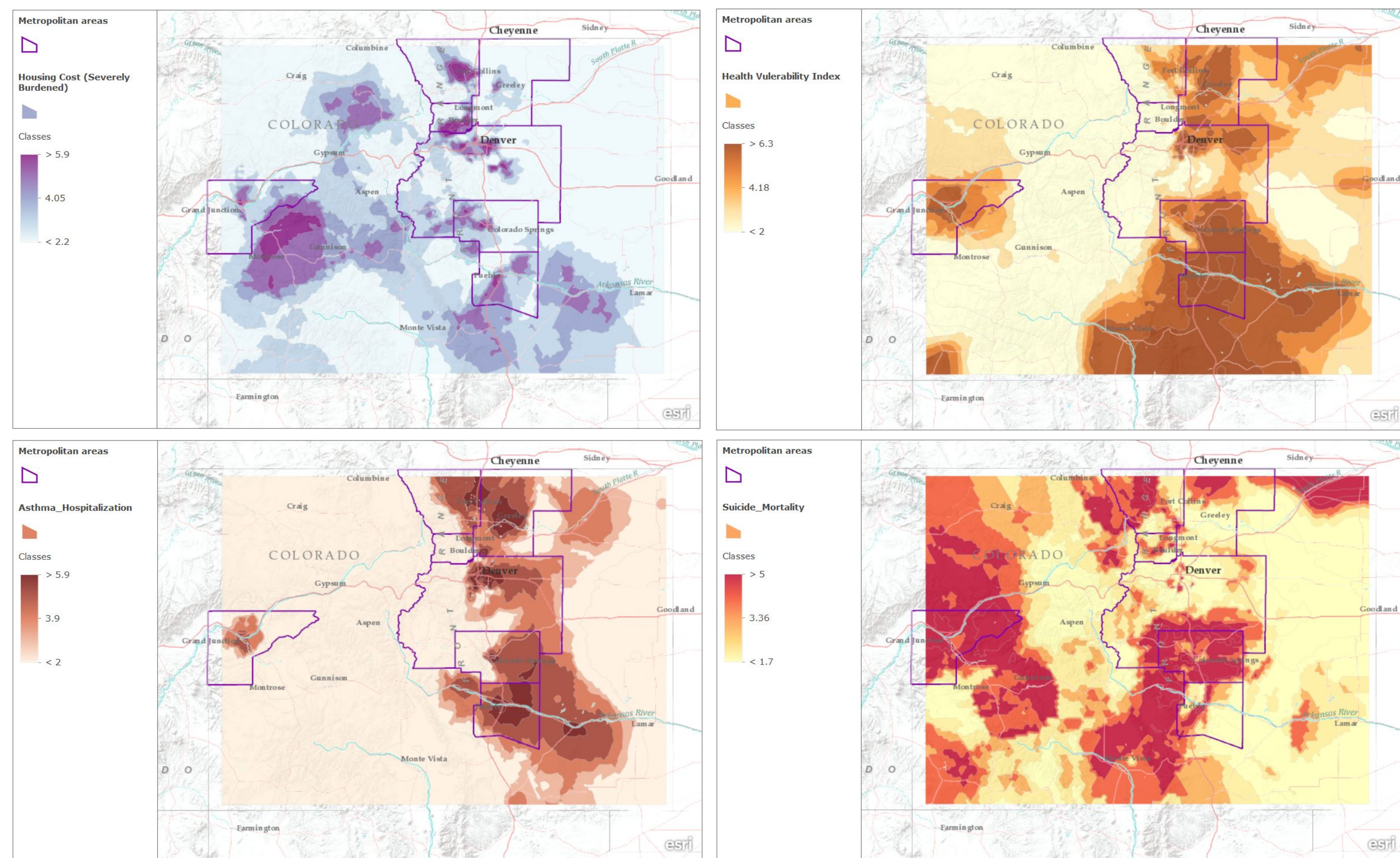


Figure 6. Interactive Web-Based Visualizations (Interpolation) of Severely Housing Cost Burdened Households, Health Vulnerability Index (Composite), Asthma Hospitalizations, and Suicide Mortality across Colorado

CONCLUDING THOUGHTS

The preliminary results of this ongoing project suggest that housing in-affordability (i.e. housing cost burdened) appears to be linked with places that also have overlapping health problems, implying that severely cost-burdened areas face greater public health burdens. In particular, within the urban corridor, Central and South Colorado (e.g., Pueblo) warrants attention for its concentration of spatial health clusters, including suicide mortality, which extends beyond the urban periphery to rural areas in Colorado.

ACKNOWLEDGEMENTS

This project was funded by the Colorado Evaluation and Action Lab (Quick-Turnaround, Actionable Research Grants). We also thank governmental agency partners and collaborators, including the Department of Local Affairs (Division of Housing).

REFERENCES

- Colorado Health Institute. 2015. Mental Health in Colorado. https://www.coloradohealthinstitute.org/sites/default/files/file_attachments/Mental%20Health%20in%20Colorado%202%20page2.pdf
- National Center for Health Housing. 2017. Colorado. https://nchh.org/resource-library/Healthy-Housing-Fact-Sheet_CO.pdf
- Ramirez, I.J.; Lee, J.; and Grady, S.C. 2018. Mapping multi-disease risk during El Niño: an ecosyndemic approach. *International Journal of Environmental Research and Public Health*, 15, 2639. <https://doi.org/10.3390/ijerph15122639>
- Shift Research Lab. 2018. Executive summary: Exploring Colorado's Housing Affordability Challenges in All of Their Complexity. http://www.garycommunity.org/sites/default/files/Shift-ExecutiveSummary-2018_Final_0.pdf