

Alameda County – Heat Vulnerability Indicators

Data Sources Overview:

The United States Census' American Community Survey 5- year estimate from 2013-2017 was used for disability (hearing, ambulatory, cognitive, self-care, independent living, and vision), children, older adult, people of color, educational attainment, poverty, linguistic isolation, older adult isolation, and population density. Each of the variables are calculated as a percentage of their respective universe (Table 1), and using the provided margin of error, the coefficient of variation is calculated using the methods provided by the US Census Bureau. Those with a coefficient of variation greater than 30% were marked as “unstable”, meaning the sample for that census tract has too large of a variation to be considered reliable. A 30% cutoff was used to ensure data reliability when subpopulations were small.¹ Older adult poverty was excluded from the principal component analysis (PCA) due to a substantial portion of census tracts being unstable; those census tracts account for about 85% of the population of the county, so this indicator was deemed too unstable to include in the analysis.

CalEnviroScreen 3.0

Both cardiovascular disease and asthma estimates for census tracts in Alameda County were derived directly from Cal EnviroScreen 3.0 and are originally sourced from the California Office of Statewide Health Planning and Development from 2012-2016. The data provides age-adjusted rates of hospitalization per 10,000 people for heart attacks and asthma by census tracts between the years 2011-2013. PM2.5 is an estimate, in micrograms per square meter, of the annual mean PM2.5 concentration and is directly measured by the California Air Resources Board and was extracted from CalEnviroScreen 3.0. Similarly, ozone estimates are derived from 50 stations across the state by California Air Resources and measures daily maximum 8-hour ozone concentrations. These values were extracted from air quality monitors for 2012-2013 for the months May to October. Housing Burden is also extracted from CalEnviroScreen 3.0 but is originally from Housing and Urban Development (HUD) Comprehensive Housing Affordability Strategy (CHAS), accounting for years 2009-2013.

NASA MODIS/Terra Satellite

Surface temperature was collected using Terra Modis land surface temperature satellite data from NASA for September 1, 2017, during a record-breaking heat wave in the San Francisco Bay Area. The resolution of the data is 1km. Surface temperature was overlaid with the spatial area of census tracts in the county to calculate the average minimum and maximum temperature over the 24-hour period and within the county boundary. The result was converted from Kelvin to Fahrenheit for ease of use.

¹ King, K., Starsinic, M., Viver, A. H., & Beaghen, M. (2015). The Reliability of ACS 5-Year Estimates of Race Groups and American Indian and Alaska Native Populations.

April 2019

CalBRACE

Impervious surface and tree canopy measures were extracted directly from the California Building Resilience Against Climate Effects (CalBRACE) Project, but the original source is the Multi-Resolution Land Characteristics Consortium, National Land Cover Database (NLCD), 2011.

Variable	Source	Universe	Units/Definition
Disability	American Community Survey - 5 year estimate, 2013 - 2017	Percent of non-institutionalized population	Percent of individuals with the following difficulties of status: hearing, ambulatory, cognitive, self-care, independent living, and vision.
Children	American Community Survey - 5 year estimate, 2013 - 2017	Percent of the population	Percent children, less than 5 years old
Older Adults	American Community Survey - 5 year estimate, 2013 - 2017	Percent of the population	Percent elderly, older than 65 years
People of Color	American Community Survey - 5 year estimate, 2013 - 2017	Percent of the population	Percent non-white
Educational Attainment	American Community Survey - 5 year estimate, 2013 - 2017	Percent of the population 25 years and older	Percent with no high school diploma (or equivalent)
Poverty	American Community Survey - 5 year estimate, 2013 - 2017	Population for whom poverty status is determined	Percent under poverty threshold (400% FPL)
Linguistic Isolation	American Community Survey - 5 year estimate, 2013 - 2017	Households/ census tract	Percent of households that are "limited English-speaking"
Social Isolation	American Community Survey - 5 year estimate, 2013 - 2017	Percent of population 18 years and over	Percent of adults who live alone
Older Adult Isolation	American Community Survey - 5 year estimate, 2013 - 2017	Percent of population 18 years and over	Percent of adults who are older than 65 and live alone
No Access to Transit	Bay Area MTC, 2012	Census tract population	Percent of population not residing within 0.5 mile of bus/ferry/ferry stop with <15 minutes waiting time during peak commute hours
Population Density	American Community Survey - 5 year estimate, 2013 - 2017	Total population	Population per square mile
Asthma	California Office of Statewide Health Planning and Development (2011-2013) via CalEnviroScreen 3.0	Census Tract population	Emergency Department Visits per 10,000
Cardiovascular Disease	California Office of Statewide Health Planning and Development (2011-2013) via CalEnviroScreen 3.0	Census Tract population	Heart attack emergency department visits per 10,000 people
Max Surface Temperature	NASA MODIS Satellite data	Labor Day, 2017 (heat wave)	Fahrenheit
Min Surface Temperature	NASA MODIS Satellite data	Labor Day, 2017 (heat wave)	Fahrenheit
Percent Impervious Surface	Multi-Resolution Land Characteristics Consortium, National Land Cover Database (NLCD) 2011, extracted from CalCRACE	Census Tract area	Percent of the land area covered by impervious surfaces (population weighted)
PM2.5	California Air Resources Board via CalEnviroScreen 3.0, 2011-2013	Annual Mean PM2.5 concentration	ug/m3

Ozone	California Air Resources Board via CalEnviroScreen 3.0, 2012-2013	Mean summer ozone	Parts per million
Tree Canopy	Multi-Resolution Land Characteristics Consortium, National Land Cover Database (NLCD) 2011 extracted from CalCRACE	Census Tract area	Percent of area not under tree canopy (population weighted)
Housing Burden	Housing and Urban Development (HUD) Comprehensive Housing Affordability Strategy (CHAS) 2009-2013 via CalEnviroScreen 3.0	Households/ census tract	Percent of households in a census tract that are both low income (making less than 80% of their county's median family income) and severely burdened by housing costs (paying greater than 50% of their income for housing costs)

Unstable Data

Due to low sample size or under sampling, some variables are relatively unstable, which is defined as 30% or greater coefficient of variation. The table below shows the coefficient of variation for all variables, including the percent of population living in census tracts where the coefficient of variation is above 30%.

Variable	Percent of population in unstable tracts	Percent of unstable census tracts ²
Older Adults	1.8%	2.7%
People of Color	3.3%	4.4%
Education*	33.1%	36.3%
Older Adult Poverty**	86.2%	85.3%
Older Adult Isolation *	47%	45.1%
Living Alone/ Social Isolation	4.5%	4.4%
Linguistic Isolation*	50.5%	53.7%
Children	23.2%	27.7%
Disability	2.9%	3.9%
Population Density	0%	0%
Poverty	1.3%	1.7%

² “Unstable” includes those where the Coefficient of Variation > 30%

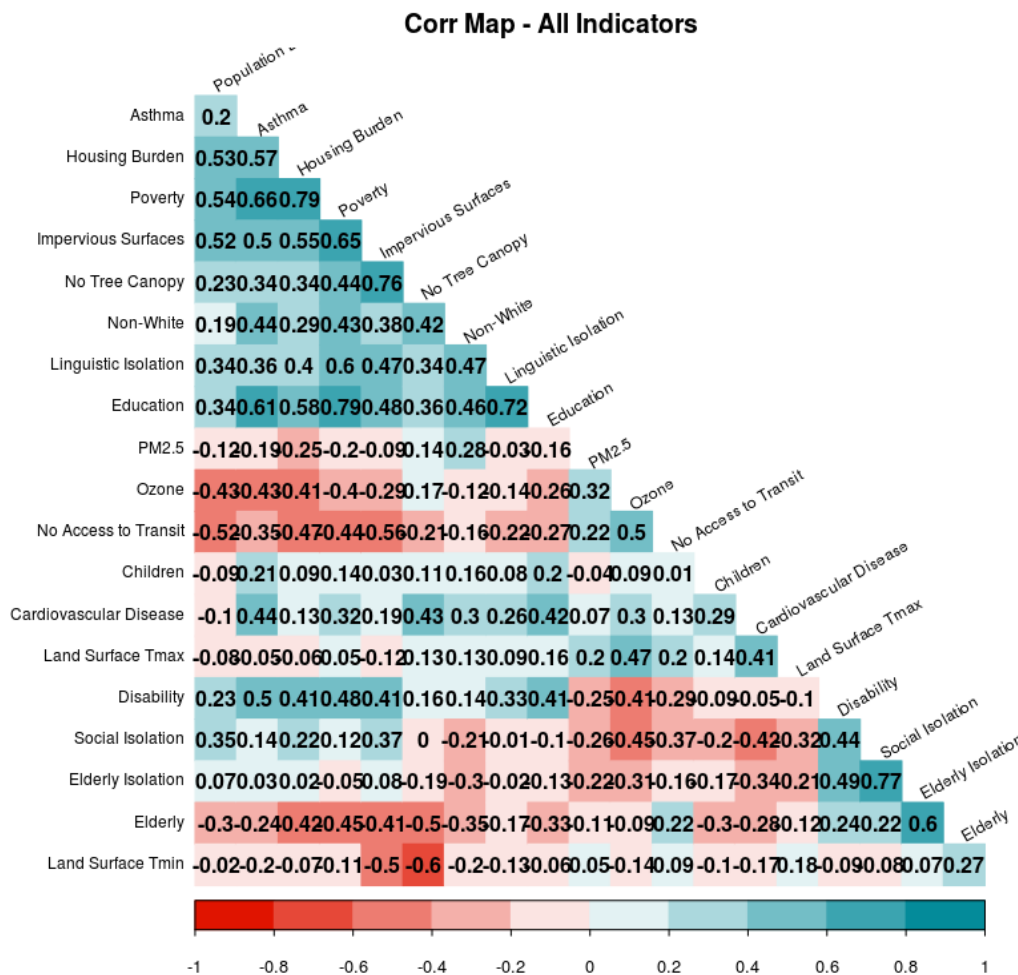
* Included in PCA despite >30% exceedance

**Excluded from PCA

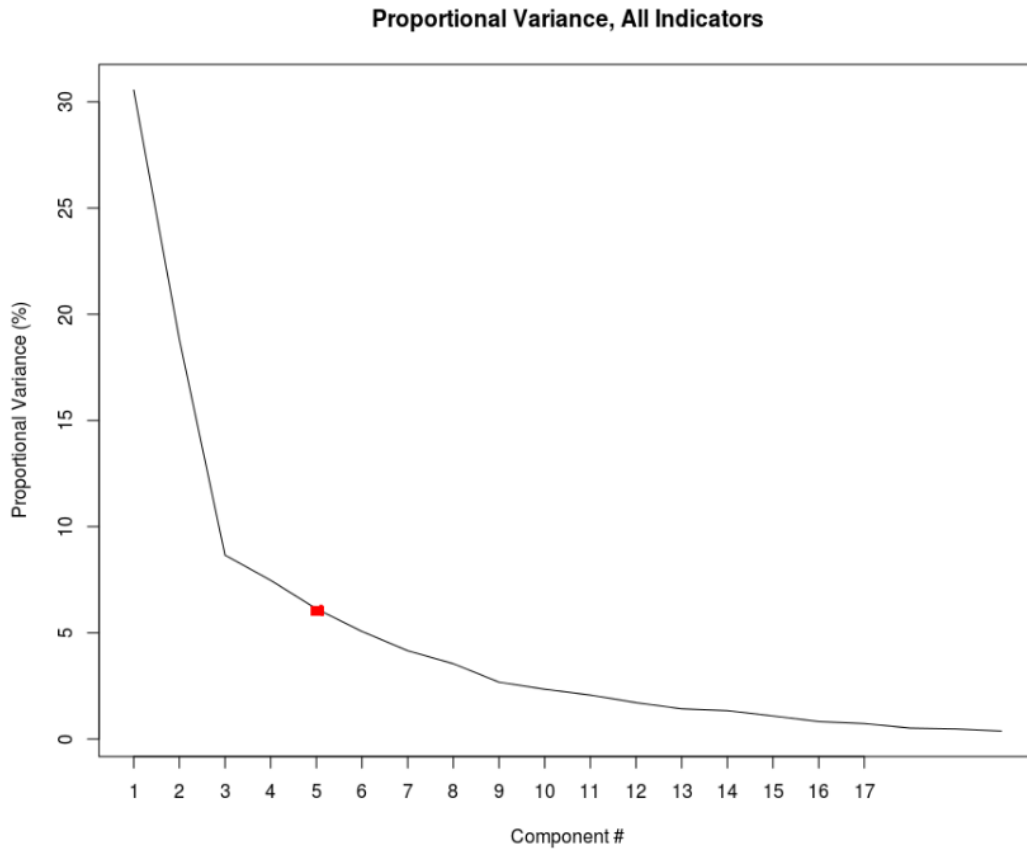
Principal Component Analysis

Principal Component Analysis (PCA) analysis was used to reduce the dimensionality in the **twenty** variables and create independent factors based on the amount of explained variance, making the new factors more statistically independent than the original variables.

We retained five factors based on the percentage of variance explained by the factors and used a standard loadings cutoff of +/- 0.3. Factor scores were then calculated for each of the five factors for each census tract and converted into 0-100 range. Original measures values (i.e., percent of...) were first transformed to z-scores. All census tracts, regardless of stability, were included for the purposes of calculating factor loadings and the resulting index.



The PCA analysis found five significant independent factors explained 72% of the total variance.



Indicators	Factor 1	2	3	4	5
Disability	0.51		0.67		
PM2.5					0.69
Linguistic Isolation	0.76				
Asthma	0.69				-0.42
Education	0.89				
Cardiovascular Disease	0.50	0.53			
People of Color	0.61				
Living Alone/ Social Isolation		-0.52	0.68		
Housing Burden	0.63	-0.50			
Population Density	0.38	-0.70			
Impervious Surfaces	0.51	-0.42			
Poverty	0.84	-0.35			
Ozone		0.70			
Children			-0.33		-0.54
No Access to Transit		0.70			
Older Adults			0.74	-0.37	
No Tree Canopy	0.41			0.82	0.13
Older Adult Isolation			0.89		
Land Surface Tmax	0.33	0.54			
Land Surface Tmin				-0.89	
SS Loadings	4.74	3.10	2.73	2.37	1.38
Proportional Variance	24%	16%	14%	12%	7%
Cumulative Variance	24%	39%	53%	65%	72%

Data notes:

All data extraction and processing were conducted using python. R was used for data reduction, including the PCA vari-max rotation.

April 2019

A Four Twenty Seven publication

Copyright © 2019, by Four Twenty Seven.

The data provided in this report were prepared by Four Twenty Seven. Publications of Four Twenty Seven are for information purposes only. Other than disclosures relating to Four Twenty Seven, the information contained in this publication has been obtained from sources that Four Twenty Seven believes to be reliable, but no representation or warranty, express or implied, is made as to the accuracy, completeness, reliability or timeliness of any of the content or information contained herein. As such, the information provided 'as-is,' 'with all faults' and 'as available.' The opinions and views expressed in this publication are those of Four Twenty Seven and are subject to change without notice, and Four Twenty Seven has no obligation to update either the information contained in this publication. Further, neither Four Twenty Seven nor its directors, officers, employees or agents shall be held liable for any improper or incorrect use of the information described and/or contained herein and assumes no responsibility for anyone's use of the information. Under no circumstances shall Four Twenty Seven or any of its directors, officers, employees or agents be liable for any direct, indirect, incidental special, exemplary or consequential damages (including, but not limited to: procurement of substitute good or services; loss of use, data or profits; or business interruption) related to the content and/or to the user's subsequent use of the information contained herein, however caused and on any theory of liability. User agrees to defend, indemnify, and hold harmless, Four Twenty Seven and its directors, officers, employees and agents from and against all claims and expenses, including attorneys' fees, arising out of the use of information herein provided.