Methodology for a Health Disadvantage Index for California

Overview

This report documents a methodology to summarize cumulative health disadvantage at the census tract level in California. The methodology is adapted from international best practices for small-area measures of disadvantage, which typically aggregate measures of economic, social, political, and environmental conditions available from public data sources. Our **Health Disadvantage Index** integrates 27 economic, social, and environmental indicators available publically in California and may have application for targeting and prioritizing public and private investments to economically, socially and health disadvantaged communities.

Background

Several governmental entities, academic institutions, and private organizations have developed composite indexes of disadvantage. These measures allow policy makers and communities to target interventions and resources to areas with the greatest cumulative extent of deprivation.

Disadvantage indexes combine measures representing diverse domains of well-being, including area income, poverty concentration, housing conditions, education status, and employment status, occupational class, family structure, ethnic segregation, environmental quality and public safety. Some indexes further group individual indicators into thematic domains and give differing weights to indicators or domains. Detailed information about these indexes can be accessed through the links below.

- Townsend Index (UK)
- UK Indexes of Multiple Deprivation (UK)
- The Australian Index of Relative Advantage and Disadvantage (Australia)
- UC Davis Regional Opportunity Index (USA)
- US Opportunity Index (USA)
- Kirwan Institute Opportunity Mapping Project (USA)
- Child Opportunity Maps (USA)
- Area Disadvantage Index (USA)
- Healthy Communities Index (USA)

The international practice of disadvantage measurement shares several common concepts and approaches. First, the indexes define deprivation as having multiple dimensions. For example, according to Townsend, people are deprived when they lack the types of diets, clothing, housing, household facilities and fuel and environmental, educational, working and social conditions, activities and facilities which are customary (Townsend, 1987, p.125-126). Second, the experience of disadvantage is a

cumulative function of the number and types of deprivation that people experience. (Australian Bureau of Statistics, 2012) Accordingly, deprivation indexes at the small area level include the economic resources, social inclusion, health, educational resources, and shared public infrastructure, physical environmental hazards. Third, the individual domains comprising disadvantage are both components of and consequences of disadvantage. Neighborhood disadvantage predicts poorer human development outcomes, including lower levels of human health, impaired child development, lower educational achievement, and the experience of violence. At the same time, these outcomes may be considered elements of cumulative neighborhood disadvantage.

Health Disadvantage Index Methodology

Steering Committee

We developed the HDI methodology under the oversight of a project steering committee. The Public Health Alliance of Southern California organized the steering committee, which included representatives of local public health agencies in California as well as independent public health experts (See appendix for list of steering committee members).   The Steering committee members convened via telephone and in person to establish the definition of health disadvantage, select indicators and sources, develop methods to combine indicators, and evaluate findings. Records of the steering committee process can be obtained from the Public Health Alliance of Southern California.

Definition of Health Disadvantage

The HDI utilized the following definition of *health disadvantage*.

- Health disadvantage is the inability of people to fulfill basic human needs required for full social participation and optimal health and well being. These needs include but not limited to the needs for economic security, food, shelter, safety, transportation, education, social connection and political participation.

The definition incorporates a holistic concept of health and recognition that health is produced by community factors not addressed by our health care system. As articulated by the World Health Organization, health is "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" and the fundamental resources for health are   "… peace, shelter, education, food, income, a stable ecosystem, sustainable resources, social justice, and equity." Similarly, our definition of health disadvantage is inclusive of the diverse non-medical economic, cultural, political, and environmental factors that influence physical and cognitive function, behavior, and disease. These factors are often called health determinants or social determinants of health. A partial list of health determinants are enumerated in the table below.

Health Determinants with Established Relationships to Human Health and Well Being

Economic	Unemployment, poverty, food insecurity, housing instability, substandard dwellings, crowding
Social	Educational quality, social isolation, lack of social support, stressful life events, parenting, discrimination
Environmental	Ambient pollution, contaminated soil and water, noise, lack of green space, lack of health services, inadequate transportation, crime, violence
Political	Lack of political power

Selection of Spatial Units

The HDI measured health disadvantage at the level of the census tract. Many measures useful for characterizing disadvantage are available at this level. Characterizing disadvantage at the census tract level also allows the HDI to depict the variation of disadvantage among neighborhoods within a city. The HDI was computed for census tracts with a minimum population of 1500 persons and where less than 50% of the census tract population lives in group-quarters.

Selection of Disadvantage Indicators and Groups

The HDI sought to include the breadth of indicators in other small-area indexes of disadvantage (see list above). For our index, we obtained indicator data from online public sources, including the US Census Bureau, the California Departments of Public Health and Environmental Protection, and the US EPA. Data from the American Community Survey was aggregated for five years from 2008 to 2012. The proportion of voters was derived from precinct level data maintained by U.C. Berkeley. Virginia Commonwealth University provided access to their analysis of life expectancy at the California census tract level. We assigned each indicator to the following thematic groups: economic resource, social resources, educational resources, health outcomes, environmental hazards, and neighborhood infrastructure.

Data was not readily available for several desirable indicators including measures of crime, trees, school quality and performance, health outcome measures, and measures of health care quality. Many of these measures are not currently published publically at the census tract level but could be computed from available public data sources in the future.

Indicators Used to Construct the Health Disadvantage Index

Indicator	Definition	Group	Source	Year
Household Crowding	Proportion of households with more than 1 occupant per room	Economic Resources	ACS	2012
High Housing Costs	Share of renter households paying more than 30% of income on rent	Economic Resources	ACS	2012
No Auto Access	Proportion of households without access to an automobile	Economic Resources	ACS	2012
Unemployment Rate	Proportion of population aged 25-64 who are unemployed	Economic Resources	ACS	2012
Poverty	Proportion of the population under aged 64 with household incomes below twice the Federal Poverty Line	Economic Resources	ACS	2012
Median Income	Median household income	Economic Resources	ACS	2012
Uninsured	Proportion of the population without health insurance	Economic Resources	ACS	2012
No Kitchens	Proportion of the population in homes lacking complete kitchen facilities	Economic Resources	ACS	2012
Not High School Graduates	Proportion of population over age 25 without a high school education	Social Resources	ACS	2012
No English Spoken	Proportion of household where no person at least 14 years old speaks English well	Social Resources	ACS	2012
Renter Occupied	Proportion of occupied housing units not occupied by property owners	Social Resources	ACS	2012
Not Voting 12	Proportion of registered voters not voting in the 2012 general election	Social Resources	UCB	2012

Indicator	Definition	Group	Source	Year
Not Voting 10	Proportion of registered voters not voting in the 2010 general election	Social Resources	UCB	2010
Single Parent Households	Proportion of family households with children under 18 with only one parent	Social Resources	ACS	2012
Not in Pre-school	Proportion of 3 and 4 year olds not enrolled in school	Educational Opportunity	ACS	2012
Not in High School	Proportion of 15-17 year olds not enrolled in school	Educational Opportunity	ACS	2012
Population Disabled	Proportion of the non-institutionalized population with any disability	Health Outcomes	ACS	2012
Low Birth Weight	Proportion of live born infants with low birth weights	Health Outcomes	CalEPA	2013
Years of Life Lost	Years of life lost per capita	Health Outcomes	VCU	2010
Asthma ER Visits	Annual rate of emergency room visits for asthma	Health Outcomes	CalEPA	2012
Pedestrian Injuries	Annual rate of pedestrian injuries	Environmental Hazards	CDPH	2011
PM 2.5 Concentration	Annual average PM 2.5 level	Environmental Hazards	CalEPA	2013
Traffic Density	Traffic density on highways within 150 feet of census tract boundaries	Environmental Hazards	CalEPA	2013
No Nearby Supermarket	Share of the population living more than one mile from a supermarket or large grocery store	Complete Neighborhoods	USDA	2013
No Nearby Park	Share of the population not living within a half-mile of a park, beach, or open space greater than 1 acre	Complete Neighborhoods	CDPH	2012
Retail Density	Combined employment density for retail,	Complete	USEPA	2011

Indicator	Definition	Group	Source	Year
	entertainment, and educational uses	Neighborhoods		
Transit Service	Aggregate frequency of transit service within 0.25 miles of block group boundary per hour during evening peak period	Complete Neighborhoods	USEPA	2011

An online supplement to this report (HDI Indicators and Descriptive Statistics) provides definitions, meta-data, and descriptive statistics for all of the indicators used to compose the Health Disadvantage Index.

Combining Indicators into an Index

In computing the HDI, we excluded census tracts with a population size less than 1500 people or a share of the population in group-quarters greater than 50%. All indicator values were aligned in orientation so that increasing values could be consistently interpreted as increasing disadvantage. Each indicator was scaled and centered as a Z-score and the Z-score was additional constrained to a range of 0 and 5, with 0 representing the mean value of the indicator and 5 representing the greatest level of disadvantage.

Each indicator was given equal weight and assigned to an indicator domain. We computed a raw score for each domain as the un-weighted mean of the individual indicator Z-scores for indicators within each group. We then computed the raw index score as a weighted mean of the indicator domain scores. We established baseline weights for each domain based on the expert judgement of the author and steering committee as to the influence of the domain on health and well-being. These weights were roughly similar to the weights applied by the UK index of Multiple Deprivation.

Indicator Domain Weights

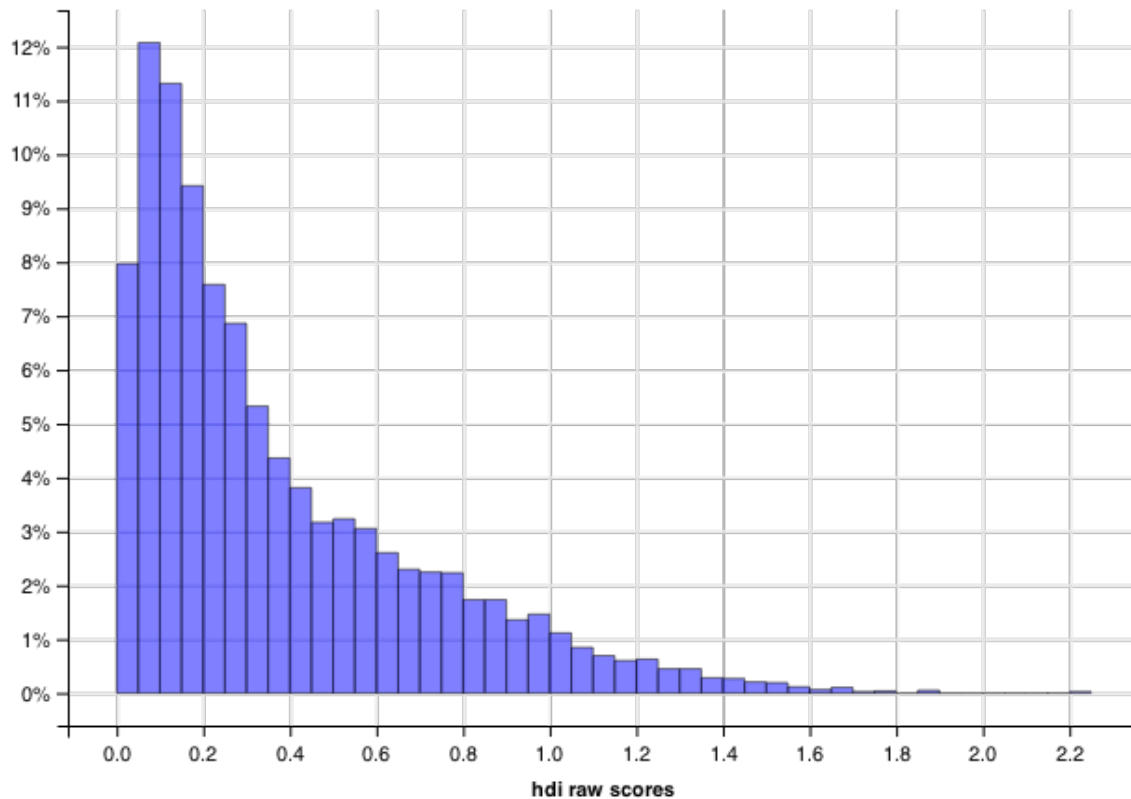| Domain	Weight
Economic Resources	50
Social Resources	15
Educational Opportunity	10
Health Outcomes	10
Environmental Hazards	10
Complete Neighborhoods	5

Alternative Summary Methods

To assess whether the method of combining indicators would affect the index, we also computed the HDI using two alternative methods and compared results.
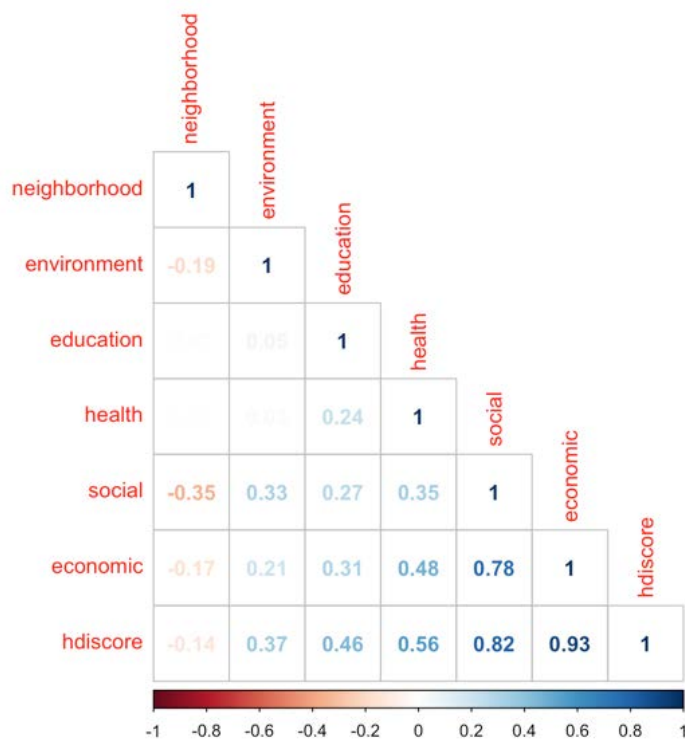
- **Ordered Ordinal Variable** In the first alternative method, each indicator variable was transformed into a new ordinal variable based on its distribution. Values below the median of the distribution were assigned 0 and values in the top half of the distribution were assigned levels 1 through 10 based on equally spaced cut-points. The index raw score was a weighted mean of the transformed indicator values.

- **Rank Fractions** In the second alternative method, we computed the fractional rank for each variable value with "1" representing the greatest level of disadvantage. The index raw score was a weighted geometric mean of indicator fractional ranks.

Implementing the Health Disadvantage Index in California

The figure below illustrates the distribution of raw census tract health disadvantage index (HDI) scores using our primary method. The distribution of the HDI raw scores is skewed, reflecting the methodology's constraint on the component indicator z-scores to between 0 and 5.

Most indicator domains are positively correlated with each other. The figure below shows spearman correlations among the raw health disadvantage index score and component un-weighted indicator domain scores. Correlations between the individual domain scores and the overall index score are influenced by domain weights. Domain scores for economic and social indicators have the highest correlations with each other and with the overall score for the disadvantage index. Economic indicators have the highest correlations to health status indicators followed by social and educational indicators.

	neighborhood	environment	education	health	social	economic	hdiscore
neighborhood	1						
environment	-0.19	1					
education		0.05	1				
health			0.24	1			
social	-0.35	0.33	0.27	0.35	1		
economic	-0.17	0.21	0.31	0.48	0.78	1	
hdiscore	-0.14	0.37	0.46	0.56	0.82	0.93	1

-1 -0.8 -0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8 1

The tables below provide the number of census tract in each quintile of disadvantage score for major California regions. Quintile one represents the least disadvantaged 20% of census tracts and quintile five represents the most disadvantaged 20% of census tracts. The Central Valley region of California has the highest share of disadvantaged tracts relative to total number of census tracts in the Region.

Distribution of Disadvantaged Census Tracts by Region in California

Region	Quintile of HDI Score					Percent of Region Disadvantaged
	Lowest 20%	20% - 40%	40% - 60%	60% - 80%	Top 20%	
Central Valley	27	103	164	227	248	32%
Los Angeles	520	527	537	599	818	27%
Inland Valley	50	121	200	220	210	26%
San Diego and Imperial	159	160	138	111	74	12%
Sacramento	126	123	117	83	52	10%
Other	106	121	144	117	44	8%
Bay Area	571	404	258	202	113	7%

The table below enumerates the population in each quintile of disadvantage score for major California regions. The Central Valley has the highest fraction of disadvantaged populations followed by the Los Angeles Region and the Inland Empire.

Distribution of Disadvantaged Population by Region in California

Region	Quintile of HDI Score					Fraction of Regional Population Disadvantaged
	Lowest 20%	20% - 40%	40% - 60%	60% - 80%	Top 20%	
Central Valley	194,932	572,509	901,069	1,132,313	1,232,757	31%
Los Angeles	2,406,923	2,395,002	2,458,449	2,794,698	3,477,049	26%
Inland Valley	283,466	661,337	1,073,291	1,122,386	1,032,151	25%
San Diego and Imperial	839,781	816,040	637,783	548,988	372,234	12%
Sacramento	593,897	563,804	516,596	368,505	241,806	11%
Other	480,175	560,762	658,755	528,234	204,891	8%
Bay Area	2,678,719	1,894,188	1,165,172	916,852	433,932	6%

Generally, across regions, the relative level of disadvantage for individual domains is the same as the relative level of disadvantage based on the HDI. However, there are exceptions. For example Los Angeles has relatively high performance on health status and neighborhood infrastructure indicators while relatively poorer performance on economic, social and environmental indicators.

Average Regional Indicator Group Disadvantage Scores

	Indicator Domain					
Region	**Economic**	**Education**	**Environment**	**Health**	**Neighborhood**	**Social**
Central Valley	6.186	6.572	6.188	7.021	6.236	5.909
Inland Valley	6.075	6.571	5.604	6.099	6.723	5.246
Los Angeles	5.514	5.615	6.385	4.597	4.313	6.186
Other	4.898	5.753	3.466	5.755	6.792	4.363
Sacramento	4.536	5.707	4.096	5.989	5.298	4.434
San Diego and Imperial	4.487	5.721	5.116	4.699	4.625	4.817
Bay Area	3.753	5.413	4.508	4.718	4.460	4.567

Recommendations For Improving the Disadvantage Index

I   Explore how potential users will apply the HDI

The anticipated consumers for the health disadvantage index include advocates, businesses, non-profits, hospitals, government policy makers and regulators working to increase community investments in disadvantaged communities. These groups could provide useful feedback for the further development of the HDI.

- Government policy makers might use the HDI to allocate public funding intended for community and economic development to neighborhoods with relatively greater levels of cumulative disadvantage.

- Government regulators can also use the HDI to evaluate both whether public and private investments are meeting requirements for targeted investments and to evaluate whether disadvantaged neighborhoods may be disproportionately impacted by investments;

- Local public health agencies can use the HDI to design and target public health improvement campaigns to the needs of the most disadvantaged communities;

- Local public health agencies can use HDI to support Community Health Assessments required for public health Accreditation;

- Businesses or private investors can use the HDI to ensure investments are helping to achieve double bottom line social improvement goals;

- Hospitals can use the HDI to support their community health needs assessments required under Federal rules;

- Advocates can use the HDI to champion greater investment in underserved communities and to monitor the investments by businesses, non-profits and public agencies.

II   Access and Include indicators to address gaps in the HDI

- **Educational Opportunity Measures.** The California Department of Education (CDE) makes available several indicators of school performance at the school level. These indicators include reading levels at various grades, truancy, teacher tenure, chronic absence, and student graduation rates. CDPH working with CDE could translate these school-level quality indicators to measures at the census tract level.

- **Crime Measures** Crime is a high value measure of neighborhood quality. Local government provides crime data to the Federal Bureau of Investigations and this data is aggregated and made available at the city level. Several cities in California have made crime data available at

the small area level but this is not a consistent practice. Local public health agencies could encourage local jurisdictions to share crime data by location or aggregated by census tracts. CDPH could ask the State Attorney General's Office to make available indicators of crime (e.g. homicide) uniformly by location.

- **Health Status Measures** Because of limited data availability, the HDI included only three health status measures - low birth weight, asthma emergency room visits, and life expectancy. Improving the index could benefit from additional measures of health status across the life course. Opportunities to create additional measures of health status at the census tract level are listed below.

    o **Self-rated Health:** Survey measures of self-rated health and functional status predict both poor health outcomes and mortality. Surveys conducted at the census tract level, such as the American Communities Survey, currently do not include any survey measures of health or function. Health officials, potentially through the CDC and national professional organizations could advocate for the inclusion of these measures into the ACS and other programs.

    o **Preventable Hospitalizations and Discharges** The California Department of Health Services Hospitals maintains records on all patient discharges from hospitals, including emergency room visits. Discharge data can be used to construct and report aggregate rates of preventable hospitalizations. Currently, aggregate discharge data is reported and available for common conditions at the level of the zip code. To align this data resources with available measures of health disadvantage, the State could require and hospitals could report this data by census tract without compromising confidentiality interests.

    o **Vital Statistics Records** The California Department of Public Health (CDPH) maintains records of births and deaths for California. The state currently makes available de-identified birth and data. CDPH could report selected aggregate data from vital statistics records including deaths for prevalent causes, low birth weight, and pre-natal care with a census tract identifier without compromising confidentiality interests.

    o **Physical Fitness:** All students in grades five, seven, and nine take a physical fitness test (FITNESSGRAM). CDE could publish aggregate results of fitness exams at the level of the census tract for tracts with sufficient children without compromising confidentiality interests.

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Appendix I

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Appendix II

Online Supplemental Material

- Downloadable HDI data:
  https://drive.google.com/file/d/0B0HaSCoHrhxzSGNadFNzRVBpemM/view?usp=sharing

- CSV file of HDI scores for census tracts:
  https://drive.google.com/file/d/0B0HaSCoHrhxzNjh3NWdhMWlTNTg/view?usp=sharing

- HDI descriptive statistics available here:
  http://www.thecivicengine.org/resources/hdi/HDI_Indicators.html