

Ohio Opportunity Index Version 4

Final Report

June 30, 2026



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Executive Summary

The Ohio Opportunity Index (OOI) is a statewide, data-driven tool designed to show how opportunity is distributed across Ohio communities. By combining neighborhood conditions related to transportation, education, employment, housing, health, environment, and safety, the index provides a practical way to view the factors that shape opportunities for healthy living. Its purpose is to support policymakers, researchers, and public health leaders in identifying geographic variations in health opportunities, targeting resources, and informing decisions that can improve community conditions.

This report describes the conceptual foundation, construction, and validation of OOI Version 4. It outlines the seven domains included in the index, explains the indicator selection and imputation procedures, and details the standardization, ranking, and transformation methods used to generate both domain scores and the overall opportunity score. The report also presents validation findings showing that the OOI aligns with several external measures in expected ways, strengthening confidence in its usefulness as a measure of health opportunity at the census tract level.

Version 4 preserves the overall structure of prior OOI releases while incorporating meaningful updates to improve relevance and measurement quality. The updates include the addition of a measure of access to public libraries in the Education domain and cardiovascular disease hospital admission rate in the Health domain, both of which broaden the scope of measured opportunity sources in those domains. The change from median rent and median home value to rent distress and mortgage distress focuses the Housing domain by more specifically reflecting housing challenges in an area rather than the wealth of the population. A revision to the Low-Income Housing Tax Credit indicator ensures that units that were once eligible, but may no longer be, are now excluded, resulting in reduced noise and error. A second revision to this measure is a change from counting locations (which may refer to multi-unit structures) to counting units, which again reduces error in the measure. Taken together with refreshed data for all measures, the Version 4 release stands as the most current and most refined version of the OOI, to date.

Overall, OOI Version 4 offers an updated and practical framework for understanding community health opportunities in Ohio. By translating complex neighborhood conditions into an accessible index, it can help guide planning, evaluation, and investment decisions aimed at improving health and well-being across diverse communities.

Introduction

Neighborhood conditions have a powerful influence on the opportunities available to individuals and their families.¹ Opportunity is not determined by a single condition. It is the result of a combination of social and structural conditions that work together to shape access to education, employment, transportation, housing, and health care.^{2,3} Access to these resources often varies across communities. Understanding the geographic distribution of these conditions will support explanations for why some communities have access to more opportunities for health and economic success than others as well as policy choices aimed at enhancing resources where they are most needed.

Transportation is an important determinant of opportunity. Access to transportation makes it easier for individuals and families to travel to school, work, medical appointments, and grocery stores.⁴⁻⁹ On the other hand, limited transportation can lead to missed school days, lower academic performance, and increased risk of school dropout.^{7,8,10} These negative educational outcomes are associated with limited financial earnings and poorer long-term health.¹¹⁻¹⁴

Employment, housing, and neighborhood safety are closely linked. Stable, well-paying jobs support health, financial security, housing stability, and overall neighborhood quality. In contrast, unemployment, low wages, and housing instability are associated with increased mortality risk and adverse mental and physical health outcomes.¹⁵⁻¹⁹ In children and adolescents, overcrowding and frequent residential moves are associated with lower academic performance and adverse mental health outcomes.^{20,21} Furthermore, low-income housing in disadvantaged, high-crime neighborhoods is associated with increased mental and physical health challenges as well as negative academic outcomes.²²⁻²⁵

Health care and environmental conditions also interact to influence opportunity. Access to primary care, dental care, pharmacy, and behavioral health services can prevent chronic conditions and improve quality of life, whereas transportation barriers and provider shortages can lead to delays in care and negative health outcomes.²⁶⁻³¹ Communities with greater access to grocery stores and fewer convenience stores tend to have better health outcomes.³² Relatedly, access to green space, recreational parks,

and walkable neighborhoods is associated with better health, lower stress, and reduced mortality.^{33,34} Conversely, exposure to pollution may increase the risk of chronic disease.³⁵⁻³⁸

The Ohio Opportunity Index (OOI) brings all these factors together in a single, data-driven tool to better understand how opportunity is distributed across the state. With a primary focus on health, the index uses Ohio-specific data to measure opportunity at the local level, including census tracts, zip-codes, and counties. The OOI is updated regularly with the most recent data to support accurate and timely assessment of opportunity across Ohio.

Methods

Construction of the Ohio Opportunity Index

The OOI is a multidimensional, census tract-level index designed to capture socioeconomic, structural, and environmental determinants of opportunity. Below we outline the procedural steps that were used to construct the OOI. Aside from differences in domains and indicators, the analytic procedures are very similar to those used in prior OOI iterations and the Children's Opportunity Index (COI) methodology.

Step 1: Select Domains of Opportunity

Seven domains were selected to reflect key dimensions of opportunity relevant to health, education, and socioeconomic well-being among Ohio's general population: (1) Motorized Transportation, (2) Education, (3) Employment, (4) Housing, (5) Health, (6) Environment, and (7) Crime and Safety. These domains were chosen to comprehensively represent neighborhood-level factors that influence access to resources, mobility, safety, and long-term life outcomes.

Step 2: Select or Refine Indicators to Measure Each Domain

The domains were operationalized using multiple indicators derived from publicly available and administrative data sources (see Table 1). Indicators were selected based on theoretical relevance, empirical support, and data availability at the census tract level (see Table 2).

Motorized Transportation: This domain captures the availability and accessibility of transit options that influence mobility and access to essential resources. The four indicators are public transit use, average commute time, households without vehicle access, and traffic proximity. OOI Version 4 retains the same four indicators used in OOI Version 3.

Education: This domain reflects educational attainment, school performance and outcomes, and access to knowledge-oriented resources that shape long-term health and economic outcomes. The five indicators are educational attainment, school performance, high school graduation rate, residential internet infrastructure, and access to public libraries. The free and reduced lunch indicator was removed since OOI Version 3 due to ambiguity about its contribution to an index of opportunity. A measure of access to public libraries was added to this domain.

Employment: This domain measures access to jobs and workforce training that influences economic stability and related social outcomes. The four indicators are low-wage job access, access to workforce or job training sites, unemployment, and poverty. OOI Version 4 retains the same four indicators used in OOI Version 3.

Housing: This domain captures housing affordability, quality, and neighborhood stability, which are linked to health, economic well-being, and social outcomes. The seven indicators are mortgage distress, rent distress, proportion renting, rate of existing Low-Income Housing Tax Credit (LIHTC) units per 1000 households, housing stock built pre-1980s (indicating an increased risk of lead exposure), residential overcrowding, and residential mobility. Between OOI Version 3 to OOI Version 4, several changes were made. Median rent and median home value measures were removed due to their lack of specificity about the financial housing experience of families and their more general reflection of the wealth of families in an area. They were replaced with mortgage distress and rent distress, which both represent the proportion of households for which the total monthly cost (mortgage payment or rent, depending on the measure) exceeds 50% of the household income. The LIHTC-based measure was also changed to measure the rate per household unit instead of per location, and the measure now only considers units that were listed within the last 15 years, reflecting tax policy about the

length of time such units must remain low-income housing in order for the owner to utilize the tax credit.

Health: This domain includes access to health-promoting resources and key population health indicators. The six indicators are geographic access to medical providers, geographic access to healthy food options, age-adjusted mortality, preventable emergency department admissions or visits, diabetes hospital admission rate, and cardiovascular disease hospital admissions. The difference between OOI Version 3 to OOI Version 4 is the addition of cardiovascular disease admission rate.

Environment: This domain reflects the physical environmental conditions, including air quality, walkability, and access to green space. The five indicators are access to green space, PM2.5 air pollution levels, walkability, air quality non-cancer health risk, and air quality cancer risk.

Crime and Safety: This domain measures neighborhood safety and exposure to violent and substance-related crime. The six indicators represent recorded crimes and are homicide and aggravated assault; robbery; public drunkenness and DUI; drug-involved crimes; burglary/larceny-theft/motor vehicle theft; and sexual assault.

Step 3: Imputation for Individual Measures

Missing values in each measure within each domain were imputed by the following procedure. A missing value for a tract was replaced with the mean value of the tract's adjacent neighbor tracts. If the adjacent neighbors also had no available data (rare), then those neighbors' adjacent neighbors were used to calculate a mean for the imputed value.

Step 4: Standardization of Variables and Combined Domains

As in previous OOI versions, all variables were obtained at the Census tract level. Because the measure values for Census tracts with zero population (e.g., airports) tend to be outliers, and because we largely are not concerned with opportunity in such tracts, the measure values of these tracts are set to be missing (if not missing already) and are not included in calculations for variable standardization to avoid skewing the standardization procedure (see step 5 for how zero-population tracts are treated). To combine all variables within a domain into a single measure, all variables

were standardized by converting them into z-scores. Importantly, some standardized variables were reversed by multiplying the values by negative 1 to ensure large and small values had consistent meanings with respect to opportunity across indicators. Next, the standardized variables were combined using an unweighted mean within each domain for each census tract. The domain scores were then re-standardized to have a mean of zero and a standard deviation of one. These standardized domain scores are the ones that are made available in the published OOI data along with the overall OOI score.

Step 5: Domain-Level Imputation for Zero-Population Tracts

A final imputation step addresses zero-population tracts. Many of the measures in the index are not reliable or meaningful in tracts with a zero population. Moreover, because opportunity is intended to apply to people, it may not be necessary to have a reasonable domain or opportunity score in tracts where people do not live. However, with consideration of the possibility of errors in geocoding of analytic units (e.g., Medicaid members), it could prove valuable to have reasonable opportunity values representing tracts even if no people truly reside in them. Therefore, for all zero-population tracts, and for all domain scores, the research team imputed the mean of the domain in tracts neighboring the zero-population tract.

Step 6: Ranking and Transformation of Domain Scores

When combining domain scores to form an overall index, the research team followed previous iterations of the OOI by transforming domain scores prior to combination. The purpose of the transformation was to impart a desirable cancellation property to the index such that the impact of a single low-value domain score on the overall index value is not completely counteracted by a single high-value domain. This builds in the assumption that low opportunity with respect a single domain carries risks for the population that are not easily counteracted by other opportunities. The index, therefore, favors a balance of opportunity among the domains over imbalance, even if an imbalanced tract has very high scores on some domains.

The transformation first ranked the values in each domain and divided the ranks by the number of tracts to get scores in the range 0 to 1 with 1 being the most deprived

score. This resulted in a uniform distribution that was then transformed into an exponential distribution for the purpose of combining with other domain scores into an overall OOI.

The exponential transformed domain scores are not provided in the published data file because their use as individual domain scores is not recommended. But they can be reproduced from the data provided. Instead, if users want to use individual domain scores, we recommend using the standardized, but otherwise untransformed domain scores, which are provided in the published data file.

Step 7: Combining Domains into Measure of Opportunity

Finally, domain scores were added together and divided by the number of domains (seven). The result was reversed—so that higher values represented more opportunity—and then rescaled to range from 0 to 100. The result constitutes the Opportunity Index Score.

Validation of the Index

The index was validated by examining correlations between the OOI and auxiliary variables representing constructs that we expect, *a priori*, to be correlated with the OOI. The validation variables include the following (expected relationship direction in parentheses):

- CDC's Social Vulnerability Index (expect negative correlation)
- The National Child Opportunity Index (expect positive correlation)
- Economic Connectedness – Adult (expect positive correlation)
- Economic Connectedness – Child (expect positive correlation)
- Rate of fast-food establishments per 100,000 population (expect negative correlation)
- CDC PLACES: Dental care utilization (expect positive correlation)
- CDC PLACES: Leisure-time or physical activity (expect positive correlation)

These variables were selected because they capture related dimensions of opportunity, deprivation, and health behaviors that are conceptually aligned with the

OOI. The CDC's Social Vulnerability Index (SVI) is a composite measure of community-level disadvantage based on socioeconomic conditions. It was included because it reflects deprivation constructs similar to those represented (in the reverse) in the OOI. The National Child Opportunity Index (NCOI) is a multidimensional index measuring neighborhood-based resources and conditions for child development. It was included due to its similar conceptualization of opportunity. Economic Connectedness (Adult and Child), derived from the Social Capital Atlas, measures the extent of social and economic interaction across socioeconomic groups, and was included as an emerging indicator of social capital and structural opportunity. The rate of fast-food establishments per 100,000 population, obtained from County Business Patterns, serves as a proxy for the local food environment, which can be related to health behaviors of people in the area. CDC PLACES, a database of health-related data about small areas (including census tracts) across the USA, was the source for the final two validation measures. Dental care utilization was included as an indicator of access to and use of preventive dental services, and lack of leisure-time and physical activity available to people in the area was also included. The latter measure was reversed for clarity in the validation to represent leisure time and physical activity.

The results of validation are presented in the *Results* section as correlation coefficients, *p*-values, and r-squared values. The correlation value indicates the strength and direction of the correlation. A *p*-value below 0.05 indicates statistical significance of the correlation using a traditional threshold. The R-squared represents the proportion of variance in the validation measure explained by the OOI. Prior to these calculations, our expectations are that all of the validation measures will be significantly correlated with the overall OOI in the direction hypothesized in the bulleted list above.

Results

Below is a table showing the correlations, *p*-values, and R-squared values for each correlation examined for an assessment of validity of the OOI.

Table 1. Quantitative results of correlation analysis between OOI and multiple validation measures.

Validation Measure	Correlation with OOI (p-value)	R-squared
CDC Social Vulnerability Index 2022	-0.59 (0.00)	0.53
Adult Economic Connectedness	0.17 (0.00)	0.18
Childhood Economic Connectedness	0.18 (0.00)	0.12
Rate of Fast Food Establishments per 100,000 Population	0.06 (0.00)	0.29
The National 2023 Child Opportunity Index, state normed	0.73 (0.00)	0.66
Dental Care Utilization	0.74 (0.00)	0.69
Leisure-time or physical activity	0.72 (0.00)	0.64

All of the validation measures were significantly correlated with the OOI ($p < .05$). With one exception, they were all correlated with the OOI in the expected direction. The exception was the rate of fast food establishments per 100,000 people, which was positively and significantly correlated with OOI.

Discussion

Version 4 of the OOI improves the measurement of opportunity and builds on the work of other well-known indices that assess how neighborhood conditions affect people's lives.^{2,3,39} The OOI brings multiple factors together, including transportation, education, employment, housing, health, the environment, and safety, to facilitate a better understanding of how they work together to influence health and economic outcomes.^{2,3}

The theoretical and empirical basis of the OOI emphasizes the interconnectedness of the domains. For example, access to transportation can affect a person's ability to go to school or get a job, which in turn affects their health and financial earnings.^{4,8} Similarly, employment is closely linked to housing, both of which are affected by neighborhood conditions like safety, air pollution, and built environment. However, when individuals

experience unemployment or housing instability, they are more likely to face challenges to education and health.^{17,24,25,35,40,41} These patterns highlight that opportunity is best understood as a set of interconnected factors that work together. It is therefore valuable to be able to explore these domains separately. Consequently, the OOI data outputs include domain scores for each census tract in addition to an overall score representing total opportunity for healthy living.

In the development of the OOI, health is thought of both a cause and outcome of opportunity. For example, access to primary care can improve health, quality of life, and reduce the risk of early death.⁴²⁻⁴⁴ Conversely, poor health can make it difficult for people to attend school, work, and earn a living.^{45,46} This two-way relationship shows that improving health can improve opportunity more broadly, and explains why the OOI includes measures of health to represent opportunity for health.

Methodological contributions of the OOI include the use of census tract-level data, which provide detailed neighborhood-level information that enable the identification of differences that would otherwise be missed in larger geographic analyses at the county or regional level.⁴⁷ Next, standardization and transformation of domain rankings prevent challenges in one domain from being offset by strengths in another domain, preserving the multidimensional nature of opportunity. Lastly, the inclusion of Ohio-specific datasets, including restricted-access Medicaid administrative and Vital Statistics data, makes the index more relevant for state programs and policies than national indices, which are limited by a requirement to standardize measurement across the entire country.

The structure of the OOI remained intact between Version 3 and 4. Measures were updated with the most recent data available. Improvements included the addition of a cardiovascular disease indicator, housing-related financial distress, and a measure of access to public libraries. Validity checks confirmed that OOI Version 4 is measuring approximately what it was intended to measure—opportunity for healthy living. One exceptional component of the validation results was that the concentration of fast-food restaurants was higher in higher opportunity areas, as opposed to lower, as expected. One interpretation of this is, to some degree, high opportunity for healthy living is correlated with income, and fast-food producers rationally place fast-food restaurants in

locations where they expect the most money will be spent. Which is to say that the measure of concentration of fast-food restaurants is not likely measuring what we believed prior to the analysis.

Limitations

A limitation of the index is that all factors are given equal importance, even though it is unlikely that each factor contributes equally to health. However, earlier testing showed that using different weights did not lead to meaningful differences in the overall index scores. Moreover, the domain scores are provided in a public-use data file and could be used to construct a weighted index if a research team or policy maker had this preference. A second limitation is that multiple health indicators were sourced from Medicaid claims data, which may not be representative of all Ohio residents. Third, the index is not designed to be compared across other versions of the OOI. The OOI is a relative index of opportunity as opposed to an absolute index. In other words, the values only have meaning relative to the values of other tracts in the same version of the OOI.

Conclusion

The OOI Version 4 is a comprehensive tool that shows how opportunity is distributed across communities. This is particularly important in a state like Ohio where rural and urban areas face different social and structural barriers. Policymakers, public health professionals, and researchers can use the OOI to guide decisions in resource allocation and inform intervention planning.

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