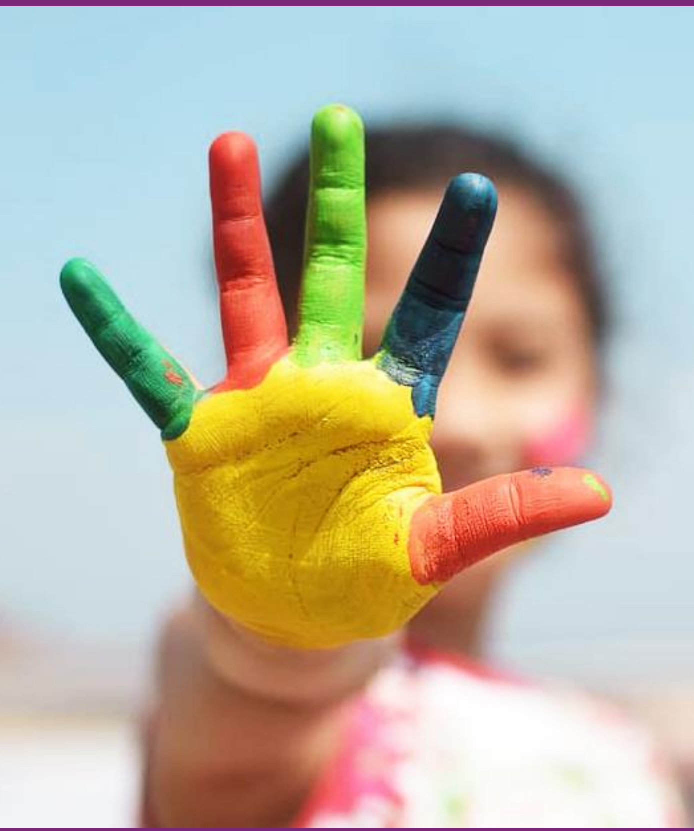

Measuring Access to Early Care and Education: 2024 Technical Report

CENTER ON THE FAMILY

TABLE OF CONTENTS

BACKGROUND AND OVERVIEW

Access to affordable, conveniently located, and high-quality early care and education (ECE) is essential to the well-being of children, families, and communities. To measure accessibility, policymakers most often use metrics such as the number of licensed seats in a geographic region, average cost, or the percentage of centers at different levels of a quality rating system.

As a field, we need to conceptualize and measure access in a more nuanced way. A rich approach to measurement would be multidimensional, localized, and spatially family-centered (Friese et al., 2017; Lin & Madill, 2019).

- Multiple dimensions of access should be considered simultaneously. Families' ECE choices are unlikely to be determined by a single consideration e.g., open seats, cost, distance, or hours, but rather, by a combination of factors. Furthermore, social justice requires equity in all key dimensions of access.

- Access should be measured at the local level. Data at the state, county, or municipal levels are not sufficiently granular to reflect disparities across and within communities. Families live and conduct their daily business in a relatively small orbit, and constraints such as cost, distance, and open seats vary from neighborhood to neighborhood. Family characteristics such as ethnicity, education, and income may also distinguish neighborhoods. From a policy perspective, the ability to identify "hot spots" of the highest need could result in more strategic and effective allocation of resources. Finally, highly localized data would allow grassroots advocates to speak with additional authority about the needs of their communities.

- Data should be based on the distance between the home and ECE providers and not on static boundaries such as county lines, census tracts, or ZIP codes. Since families often cross these abstract boundaries to go to work or access services, metrics given in a radius around a family's location offer a more authentic estimate of resource availability from a family's perspective (Davis, Lee & Sojourner, 2019). The use of static boundaries is widespread in the ECE literature. In contrast, other fields, including public health and urban planning, use distance-based approaches to measure access to resources such as health care and parks (e.g., Li, 2016; Luo & Wang, 2003).

In this technical report, we present the methodology used in a study of equitable ECE access in the state of Hawaiʻi. Our purpose was to develop an innovative approach to measuring multiple components of ECE access within a reasonable proximity of a family's home. Our measures take into account commuting time or distance, as well as the number of children potentially competing for the same nearby ECE seats. As a result, the measures provide an accurate metric of the likelihood that a family can obtain ECE services in their community.

We developed the following indexes:

- *Seat Density*: The demand-adjusted supply of ECE seats close to a child's home, expressed as seats per child. This represents the likelihood that a child can be seated. For this index, high scores are desirable.

- *Cost burden*: The availability-weighted average cost of a nearby seat as a percentage of that area's median family income. This index represents the typical cost burden relative to family income. For this index, low scores are desirable.

- *Quality*: The availability-weighted likelihood that a nearby seat is in a center with a national ECE accreditation or in a public pre-K, Head Start, or Early Head Start classroom. For this index, high scores are desirable.

- *Overall Access*: The average of the standardized scores for seat density, cost burden, and quality, reflected as needed so that high scores represent better access.

Indexes were calculated for three different catchment area scenarios: 5-mile driving distance, 10-mile driving distance, and a 30-minute public transit ride.[1] These catchment areas were chosen based on stakeholder input on what constitutes a reasonable commute for urban and rural areas, and for families using private cars vs. public transportation.

Results were made available to community users via an interactive mapping website. When viewing each index, users can select among the three catchment areas (5- or 10-mile drive, 30-minute bus ride) and two levels of granularity (residential lot vs. census tract). We expect that tract-level data will be more useful for most policy and planning purposes. The lot-level data should be useful for highly localized questions, such as specific locations within a census tract where new seats would serve the largest number of nearby children.

This project was intended to serve as a proof-of-concept and model for other states and municipalities. The methods are flexible and can be adjusted to meet the needs of different users.

DATA SOURCES

ECE PROGRAM DATA

The ECE programs included in the project were registered family childcare homes, licensed group childcare homes, licensed infant-toddler and preschool centers, and public pre-K classrooms.[2] The state Executive Office on Early Learning and the State of Hawaiʻi Public Charter School Commission provided data on the location and capacity of public pre-K sites. The statewide Child Care Resource and Referral Agency (CCRRA) provided data on all other ECE programs. The CCRRA administrative data were current as of October 2022 and included the following fields: license number, license type, street address, licensed and desired capacity, ages served, tuition fees, and accreditation status. While the State of Hawaiʻi Department of Human Services determines the license type and maximum site capacity, most other fields were based on provider self-report on an annual market rate survey.

To approximate the number of seats available for specific age groups, we used the following procedures:

- All seats in public pre-K were counted as preschool-age seats.
- All seats in infant-toddler centers were counted as infant-toddler seats.

[1] Based on bus routes only, the Honolulu train system was not yet in operation at the time these data were prepared.

[2] Based on stakeholder input, we included the main providers of formal, regulated ECE services that offer a school-day or full-time schedule. ECE sectors not included were military childcare; early intervention; self-contained public special education preschool classrooms; family, friend, and neighbor care; and family-child interaction programs.

- When family child care providers reported their enrollment by age group, we allocated these known counts to the relevant age group, i.e., infant-toddler vs. preschool. Seats known to be occupied by school-age children were not counted. If a provider did not report an age breakdown, we assumed their distribution of seats across age groups was in proportion to the known distribution of other family child care providers in the same county.
- If a licensed preschool center only accepted children age 3 and older, we included their total capacity in the preschool seat count. If a preschool center accepted 2-year-olds, a share of their capacity was included in the infant-toddler seat count. When such providers reported their enrollment by age group, we used the known counts of 2-year-old vs. preschool-age seats. Otherwise, we assumed that the distribution of seats for younger vs. older children matched the known distribution of other preschool centers in the same county.

If a provider charged different tuition rates depending on a child's age, their expected cost was calculated as the average age-specific tuition weighted by age group enrollment.

EARLY CHILDHOOD POPULATION

Population estimates for the number of children under age 3, age 3 and 4, and under age 5 were obtained from the American Community Survey (ACS) 2020 five-year estimates (U.S. Census Bureau 2022a,b). We excluded children who lived on military bases because data for on-base ECE facilities were not publicly available.[3] There were an estimated 88,179 children age birth through four.

RESIDENTIAL LOCATION

Residential property information was extracted from a commercially available real property database that included the coordinates for each property, whether the property was a residential lot, and if so, the number of housing units on the lot (Digital Lightbox 2022). In total, there were 272,162 residential lots comprising over 465,000 housing units (e.g., single-family homes, discreet apartments inside a condominium or apartment building). These data were used to approximate the spatial distribution of young children's residences.

FAMILY INCOME

Because no data source for individual family income exists, we used ACS five-year estimates of the median income of families as a proxy measure (U.S. Census Bureau, 2022c). We assumed that the family income at each residential lot was equal to that of the census tract in which the lot was located.

ROADS AND PUBLIC TRANSIT NETWORKS

Street centerline (road) data of each county were accessed through the state geospatial open database (Hawaiʻi State Office of Planning, 2022). This database contained information on the direction of travel, speed categories, and access restrictions. We also obtained public transportation information from the Department of Transportation Services of each county. Transportation data were in the form of a General Transit Feed Specification (GTFS) that included transit agencies, routes, and schedules (i.e., stops, trips, and stop times). For an overview of GTSF feeds, see MobilityData (n.d.)

[3] A total of 292 census tracts were used in to compute index scores. We omitted tracts that comprised military bases, uninhabited coastal areas with ACS population estimates of zero, and tracts with no residential properties.

DATA PREPARATION

ECE PROVIDER LOCATION AND COST

Provider addresses were geocoded to the street level and assigned longitude and latitude coordinates using Google Geocoding API. To calculate each provider's average fee for full-time monthly care, we first considered whether the provider charged a single or age-variable rate. In the latter case, tuition was the weighted average based on cost and enrollment for each age group served. If a provider reported age-based fees but not enrollment by age group, we assumed that the age distribution served was the same as that for other providers of the same type in the same county. Public pre-K and most Head Start and Early Head Start classrooms are free of charge; these programs were assigned an average tuition of zero dollars. (Tuition was included for the small number of Head Start and Early Head Start classrooms that offered full-day care for a modest fee.) Note that tuition represented published market rates and did not reflect scholarships or needs-tested subsidies that could lower out-of-pocket costs for some families. In addition, not all families are eligible to enroll in Head Start, Early Head Start, or public pre-K.

ESTIMATING THE POPULATION OF CHILDREN FOR A TARGET AGE GROUP AT EACH RESIDENTIAL LOT

ECE access is often more limited for infants and toddlers than it is for preschool-age children. For this reason, we developed parallel access measures for infant-toddler seats (ages 0-2), preschool seats (ages 3-4) and all ECE seats (ages 0-4). To estimate the number of young children of a specific age group living at each residential lot, we used the ACS 5-year population estimates by census tract (U.S. Census Bureau 2022a,b). The target age groups were children under 3 years of age, 3- and 4-year-olds, and all children under 5 years of age.

We assumed that every residential lot housed young children, and that children were distributed to residential lots within a census tract in proportion to the number of housing units at each lot. The number of children for a specific target age group (P_i) per residential lot i was approximated as follows:

$$P_i = (H_i/H_b) * P_b \quad (1)$$

where P_b where is the number of children for a specific target age group within census tract b, H_i is the number of residential units at the lot, and H_b is the number of residential units within census tract b.

CREATING ROAD MAPS, TRANSIT NETWORK DATABASES, AND CATCHMENT AREAS

The first step in calculating catchment areas was to create road and public transit-enabled network datasets, respectively. We created the road network dataset from the street centerline geodata using the ArcGIS Network Analyst extension tool. We created the public transit-enabled network dataset from the GTFS and street centerline data, again using the ArcGIS Network Analyst extension.

The second step was to use the road and public transit network datasets to create catchment area boundaries for each ECE provider, using the Generate Service Areas tool from the ArcGIS Pro Network Analysis toolset. We used the road network data to create driving distance catchment areas; these catchment areas contained all street surfaces falling within a given driving distance (5-mile and 10-mile, respectively) from the provider.[4] The 30-minute public transit catchment included areas for which a commuter could reach the provider within a 30-minute commute and arrive by 8 a.m.

[4] Because they are based on road layout, catchment areas are complex polygons, not symmetric circles centered on each provider.

CREATING INDEXES

SEAT DENSITY INDEX

For each residential lot, the seat density index was calculated as follows:

Step 1.1. For each provider j, we calculated the capacity-to-population ratio R_j by summing the number of children for a specific age group at each lot within a defined catchment area D from provider j:

$$R_j = C_j / \sum_{i \in U_j} P_i \quad (1)$$

where C_j is the capacity of provider j, P_i is the number of children for a specific age group at residential lot i, and $U_j = \{i : d(i,j) \leq D\}$ is a set of residential lots (i) within the defined catchment area D (e.g., 5 miles, 10 miles, or 30-minute transit time) centered at a given provider j.

Step 1.2. Some children will have access to more than one provider within the driving distance or public transit trip of interest. Thus, for each lot i, the seat density index A_i was calculated by summing R_j for all providers a family could reach within the D-mile/time commute.

The equation is:

$$A_i = \sum_{j \in U_i} R_j \quad (2)$$

where $U_i = \{j : d(i,j) \leq D\}$ is a set of providers j within the time or distance that defines catchment area D.

The seat density index A_i can be interpreted as the number of seats per child within the catchment area of interest. Seat density indexes were calculated for the infant-toddler, preschool, and combined age groups.

COST BURDEN INDEX

For each residential lot, the cost burden index was calculated as follows:

Step 2.1. For each lot location i, we calculated childcare cost S_i as the availability-weighted average tuition fees of nearby providers:

$$S_i = \sum_{j \in U_i} \left(E_j * R_j / \sum_{j \in U_i} R_j \right) \quad (3)$$

where E_j is the monthly tuition of provider j, R_j is the capacity-to-population ratio within the D-mile (or 30 minute) catchment area centered at provider j, and $U_i = \{j : d(i,j) \leq D\}$ is a set of providers j that are within a D-mile (or 30-minute) commute.

Step 2.2. For each lot location i, the cost burden index F_i was computed as the ratio of the availability-weighted average tuition S_i to the annual median income of families at lot i:

$$F_i = S_i / I_t \quad (4)$$

where I_t is the monthly median income for lot i, (as estimated by the census tract median family income). Note that lots with no nearby ECE providers (i.e., with an A_i score of zero) will not have a cost burden index score. Cost burden indexes were calculated for the infant-toddler, preschool, and combined age groups.

QUALITY INDEX

The quality access index was determined by the availability-weighted average quality score of nearby ECE services. Because Hawai‘i has no quality rating improvement system (QRIS) and does not collect systematic data on program quality, our options for quality data were limited. We defined quality as a dichotomous variable (scored 0 vs. 1). Providers with a national early childhood accreditation (NAEYC, NECPA, NAFCC), public pre-K, Head Start, or Early Head Start classrooms were considered to be high quality[5]. For each lot location $i,$ we calculated the quality index Q_i as the availability-adjusted average of the quality scores of all nearby providers:

$$Q_i = \sum_{j \in U_i} \left(V_j * R_j / \sum_{j \in U_i} R_j \right) \tag{5}$$

where V_j is the quality score of provider j, R_j is the capacity-to-population ratio within the D-mile (or 30 minute) catchment area centered at provider j, and $U_i = \{j : d(i,j) \leq D\}$ is a set of providers j that are within a D-mile (or 30-minute) commute. Lots with no nearby ECE providers (i.e., with an A_i score of zero) will not have a quality index score. Cost burden indexes were calculated for the infant-toddler, preschool, and combined age groups.

AGGREGATING INDEXES AT THE CENSUS TRACT LEVEL

For each census tract t, aggregated index $Index_t^T$ was summarized as a population-weighted average of lot level index scores, $Index_i$:

$$Index_t^T = \sum_{j \in t \& j \in U_j} Index_i * P_i / P_t \tag{6}$$

where P_i is the number of children for a specific target age group at residential lot i, P_t is the total number of children for a specific target age group at census tract t, and $U_j = \{i : d(i,j) \leq D$ is a set of residential lots (i) that are in the D-mile (or 30-minute) catchment area centered at a given provider j.

OVERALL ACCESS INDEX

Overall access index scores represented the combined accessibility for each census tract, taking seat density, cost burden, and quality into account. The combined overall index $\widehat{O_{\iota w}}$ was calculated by taking the unweighted-average of the Z-scores of seat density A_i, cost burden F_i and quality Q_i as follows:

$$\widehat{O_{\iota w}} = \left(Z_i^A + (-1) \times \ Z_i^F + \ Z_i^Q \right)/3 \tag{7}$$

where $Z_i^k = \left(k_i - \bar{k}\right)/S_k$; k_i is seat density A_i, cost burden F_i, or quality access Q_i for each residential lot i; $\bar{k}$ is the average of seat density A_i, cost burden F_i or quality access Q_i for all lots the state; and S_k is the standard deviation of seat density A_i, cost burden $F_i,$ or quality access Q_i.for all lots. Higher values on the seat densityA_i and quality indexes Q_i indicate a more desirable level of access, while low values on the cost burden index F_i are desirable; thus, we reversed the values of the cost burden index in equation 7.

[5] National Association for the Education of Young Children, National Early Childhood Program Accreditation, and National Association for Family Child Care. Programs with any of these three national accreditations receive a higher subsidy reimbursement rate. Hawai‘i is among a small number of states to achieve the highest possible quality rating for its public pre-K program from the National Institute for Early Education Research.

REFERENCES

Davis, E., Lee, W.F., & Sojourner, A. (2019). Family-centered measures of access to early childhood care and education. *Early Childhood Research Quarterly*, *47,* 472-486.

Digital Lightbox. (2023). *Smart Parcels*. [Dataset]. https://www.digmap.com/platform/smartparcels/

ESRI. (n.d.) *ArcGIS Pro 2 Generate Service Areas tool*. [Website]. https://pro.arcgis.com/en/pro-app/latest/tool-reference/ready-to-use/itemdesc-generate-service-areas.htm

ESRI. (n.d.). *ArcGIS Network Analyst extension*. [Website]. https://desktop.arcgis.com/en/arcmap/latest/extensions/network-analyst/what-is-network-analyst-.htm

Executive Office on Early Learning. (2022). *Public pre-K classroom location and capacity*. [Unpublished data].

Friese, S., Lin, V., Forry, N., & Tout, K. (2017). *Defining and measuring access to high quality early care and education: A guidebook for policymakers and researchers.* OPRE report #2017-08. Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services.

Google Developers. (n.d.). *Geocoding API*. [Website]. https://developers.google.com/maps/documentation/geocoding/overview

Hawaii State Office of Planning. (n.d.) *Hawaii statewide GIS program geospatial data portal*. [Website]. https://geoportal.hawaii.gov/

Li, M. T., Yang, L.B., & Wei, Y. (2016). Improved Gaussian based 2-step floating catchment area method: A case study of green space accessibility in Shanghai. *Progress in Geography, 35*(8), 990–996

Lin, V., & Madill, R. (2019). *Incorporating spatial analyses into early care and education research*. OPRE Research Brief #2019-88. Office of Planning, Research and Evaluation, U. S. Department of Health and Human Services.

Luo, W., & Wang, F. (2003). Measures of spatial accessibility to health care in a GIS environment: Synthesis and a case study in the Chicago region. *Environment and Planning B: Planning and Design, 30*, 865–884.

MobilityData. (n.d.) *GTSF*. [Website] https://gtfs.org/

State of Hawaiʻi Department of Human Services, Child Care Office. (2022). *Licensing and market rate survey, October 2022 update.* [Unpublished data].

State of Hawaiʻi Public Charter School Commission (2022). *Public charter school preschool classroom location and capacity*. Unpublished data.

U.S. Census Bureau. (2022a). *2016-2020 American Community Survey 5-year estimates, Table B01001 Sex by Age.* [Dataset]. Available at https://data.census.gov/cedsci/

U.S. Census Bureau. (2022b). *2016-2020 American Community Survey 5-year estimates, Table B09001 Population Under 18 Years by Age.* [Dataset]. Available at https://data.census.gov/cedsci/

U.S. Census Bureau. (2022c). *2016-2020 American Community Survey 5-year estimates, Table B19125: Median family income in the past 12 months (in 2016 inflation-adjusted dollars) by presence of own children under 18 years*. [Dataset]. Available at https://data.census.gov/cedsci/

SUGGESTED CITATION AND ACKNOWLEDGMENTS

Suggested citation: Azuma, J., DeBaryshe, B. D., & Stern, I. R. (2024). *Measuring access to early care and education: 2024 technical report.* Honolulu, HI: University of Hawaiʻi Center on the Family.

This project was supported by grants from the Robert Wood Johnson Foundation, the Samuel N. and Mary Castle Foundation, and National Institute of Food and Agriculture Hatch project 1017907. We are grateful to our sponsors for making this work possible.

CENTER ON THE FAMILY