

Spatial Accessibility to Kindergartens in Ho Chi Minh City: A Walk-Time and Distance Threshold Analysis



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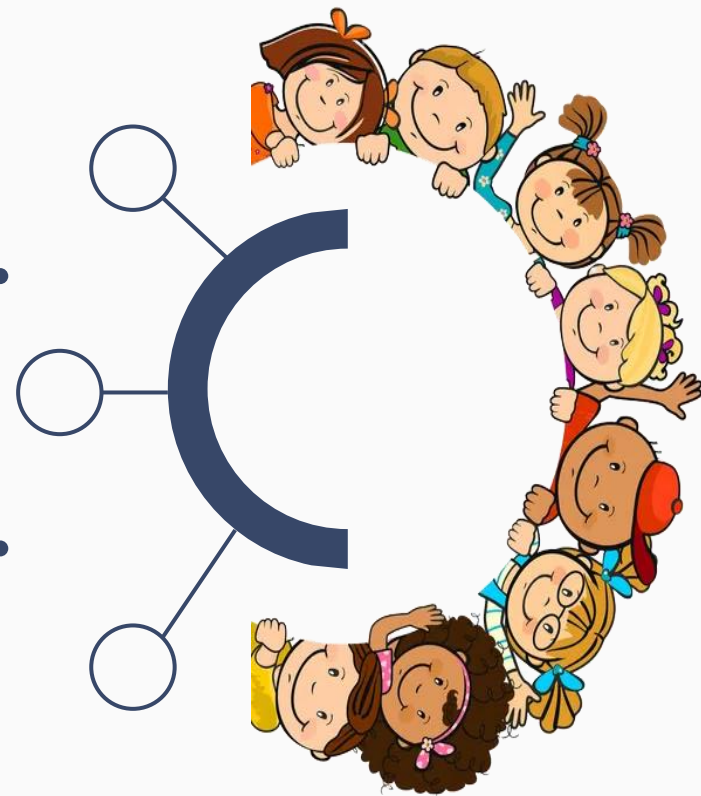
01. Introduction

Research Background and Motivation

Early childhood education serves as a fundamental pillar for child development, urban livability, and long-term social equity.

In fast-growing megacities of the Global South like Ho Chi Minh City, rapid demographic growth and spatial expansion consistently outpace public infrastructure provision.

Kindergarten trips present unique transport constraints because young children cannot travel independently; daily mobility is mediated by caregivers and is exceptionally sensitive to distance, travel duration, and pedestrian safety.



01. Introduction

Urban Sprawl and Early Childhood Education in HCMC

Rapid Demographic Expansion

Population influx continually outpaces social infrastructure delivery, generating severe spatial mismatches across peripheral districts.

Non-Substitutable Daily Trips

Preschool commutes are mediated by adult caregivers, exhibiting acute sensitivity to walking distance, physical impedance, and pedestrian safety.

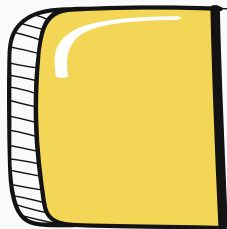
Compounding Social Inequity

Deficits in local facilities disproportionately burden lower-income suburban households with extended commute hours and modal dependency.

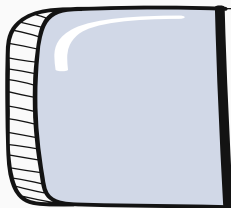


01. Introduction

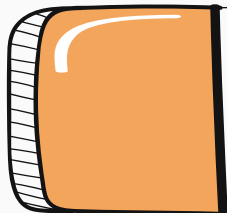
Research Objectives



Model network-based pedestrian accessibility to kindergarten points of interest across 312 wards and communes in Ho Chi Minh City.



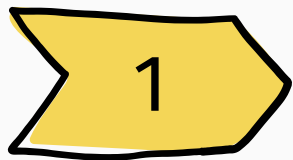
Quantify disparities using two complementary frameworks: walking time and availability within a 2-kilometer radius, and service density within a 15-minute walking catchment.



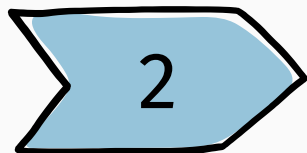
Provide empirical spatial evidence to support inclusive neighborhood planning and transit-oriented social infrastructure investments.

02 Literature Review

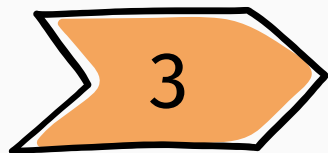
Spatial Accessibility to Early Childhood Education



Spatial accessibility represents the physical ease with which households reach educational services from their primary places of residence (Ashik et al., 2020).



Daily kindergarten commutes are heavily mediated by caregivers, making proximity critical in dictating transport mode choices, family schedules, and overall quality of life (Hu et al., 2024).



Lyu et al. (2025) demonstrated pronounced geographical inequalities in metropolitan Melbourne, where educational resources are clustered near the central business district while peripheral areas face significant infrastructure deficits.

02 Literature Review

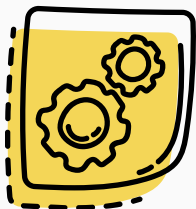
Spatial Inequality in Urban Public Services

- Developing metropolitan economies commonly display a core-periphery distribution pattern, wherein central urban districts concentrate high service density while suburban and peripheral zones face severe deficits (Kim & Wang, 2019).
- Partial clustering at distinct travel-time thresholds accentuates disparities, leaving transit-dependent populations at a structural disadvantage compared to areas with high private car ownership (Sharma & Patil, 2024).
- Rapid outward expansion in Ho Chi Minh City has deepened urban disparities, separating dense central networks with high service counts from sprawled, fragmented peripheral zones facing critical accessibility bottlenecks (Downes et al., 2024; Pham et al., 2015).



02 Literature Review

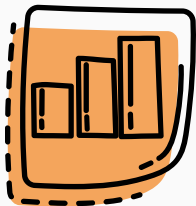
Human-Centric Urban Planning and Walkable City Models



Contemporary planning discourse is pivoting away from automobile-centric planning toward **human-centric frameworks prioritizing pedestrian mobility and localized livability** (Sonta & Jiang, 2023).



The 15-minute city concept popularized by Carlos Moreno emphasizes the structural decentralization of cities so that daily necessities, including education, are reachable within a short walk or bicycle ride (Moreno et al., 2021).



Daily travel for early childhood education is inherently non-substitutable and strictly constrained by the physical limits of young children and accompanying carers (Gorrini et al., 2023).

03 Methodology

Research Framework and Spatial Data

- Hexagonal tessellation provides optimal spatial symmetry and reduces directional bias compared to traditional square grids or administrative aggregations.
- Centroids derived from each hexagonal cell served as origin points to compute physical distance buffers and travel-time catchments along the road network.

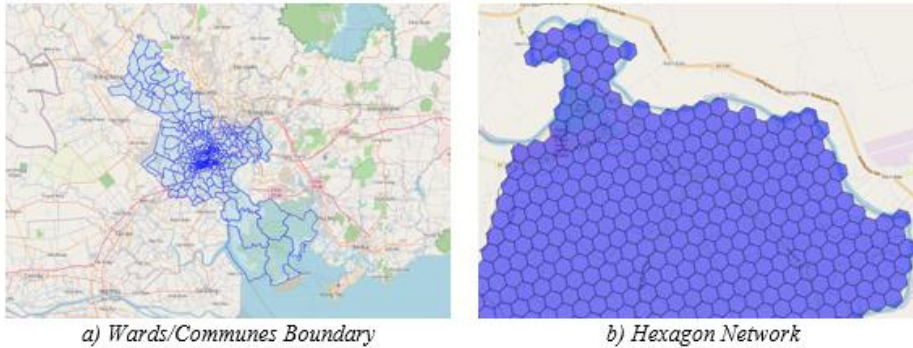


Fig. 2. Boundary Data Visualization and Hexagon Network

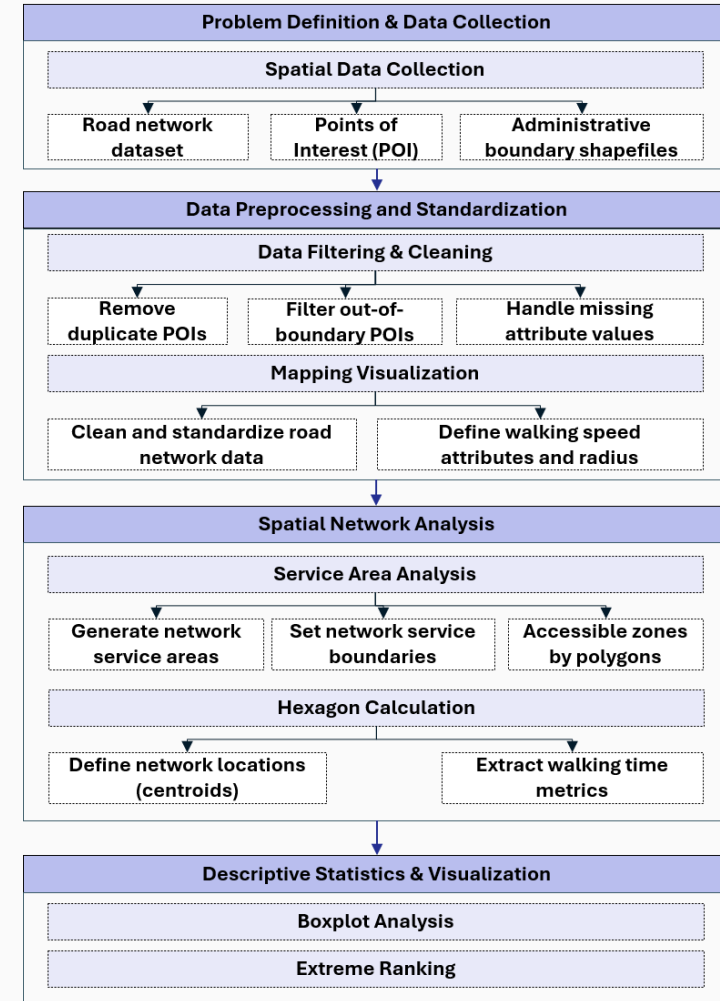


Fig. 1. Research Framework

03 Methodology

Data Scale and Dual Analytical Frameworks

16,858

Hexagonal Cells

Fine-grained, uniform spatial coverage across HCMC

1,757

Cleaned Kindergarten POIs

Retrieved and verified from official HCMC GIS portal

312

Wards & Communes

Standard baseline units prior to municipal mergers



Framework 1: 2 km Network Radius

Evaluates average walking duration and POI abundance within a standardized physical distance buffer along actual roads.



Framework 2: 15-Minute Walking Catchment

Measures accessible POI density under a realistic 1.0 – 1.2 km pedestrian threshold reflecting caregiver and child mobility.

Routing engine leverages Vietmap API to capture localized alleyway connectivity, dead ends, and real travel impedance.

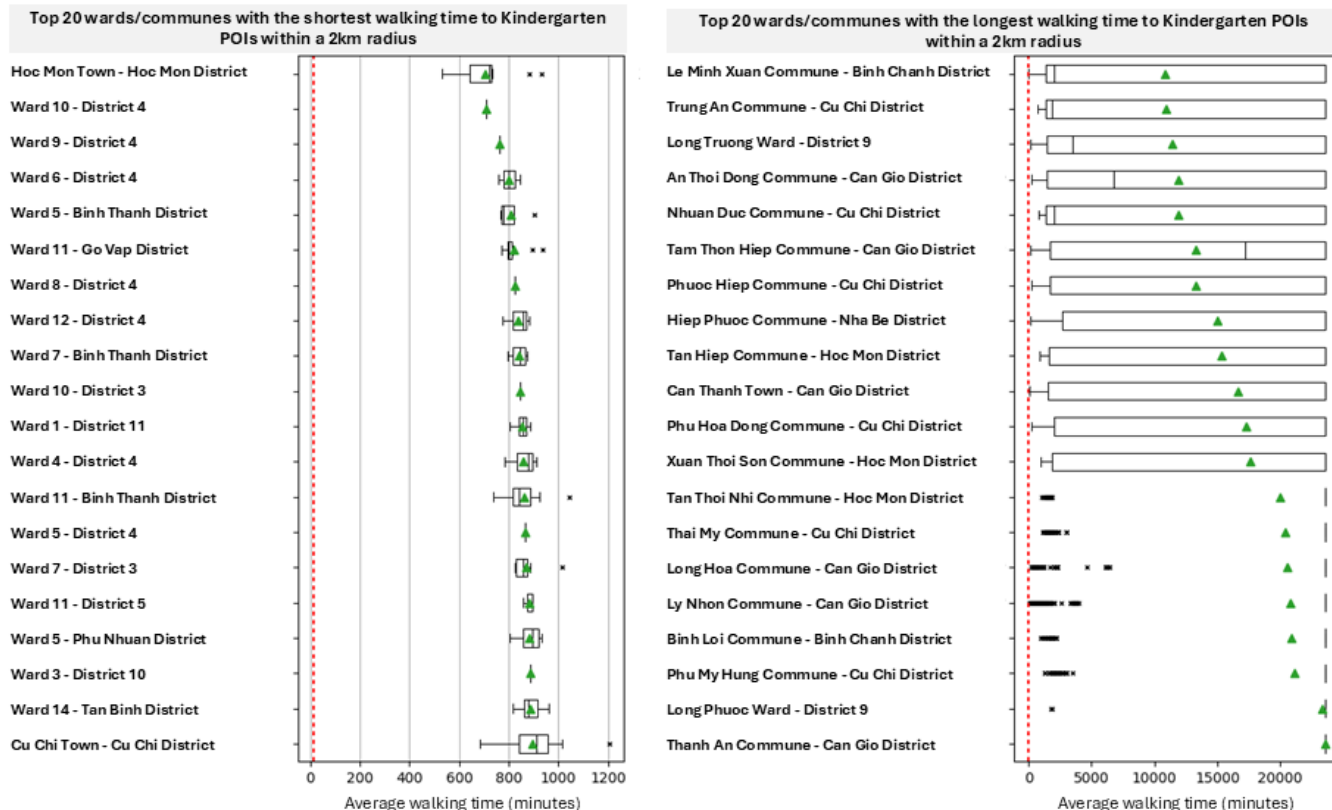
04. Results

Average Walking Times within a 2-Kilometer Buffer

- Top-performing urban core wards (e.g., District 4, District 3, District 10, District 11, Binh Thanh) exhibit compact interquartile ranges and low aggregated network walking times of 700 to 900 minutes.

- Peripheral communes in Can Gio, Cu Chi, Binh Chanh, and District 9 display widespread distributions with aggregated durations exceeding 20,000 minutes, indicating severe topological fragmentation and geographical voids

Fig. 3. Comparison of Average Walking Times to Kindergarten POIs within a 2km Radius: Top 20 Shortest vs. Longest Wards and Communes



04. Results

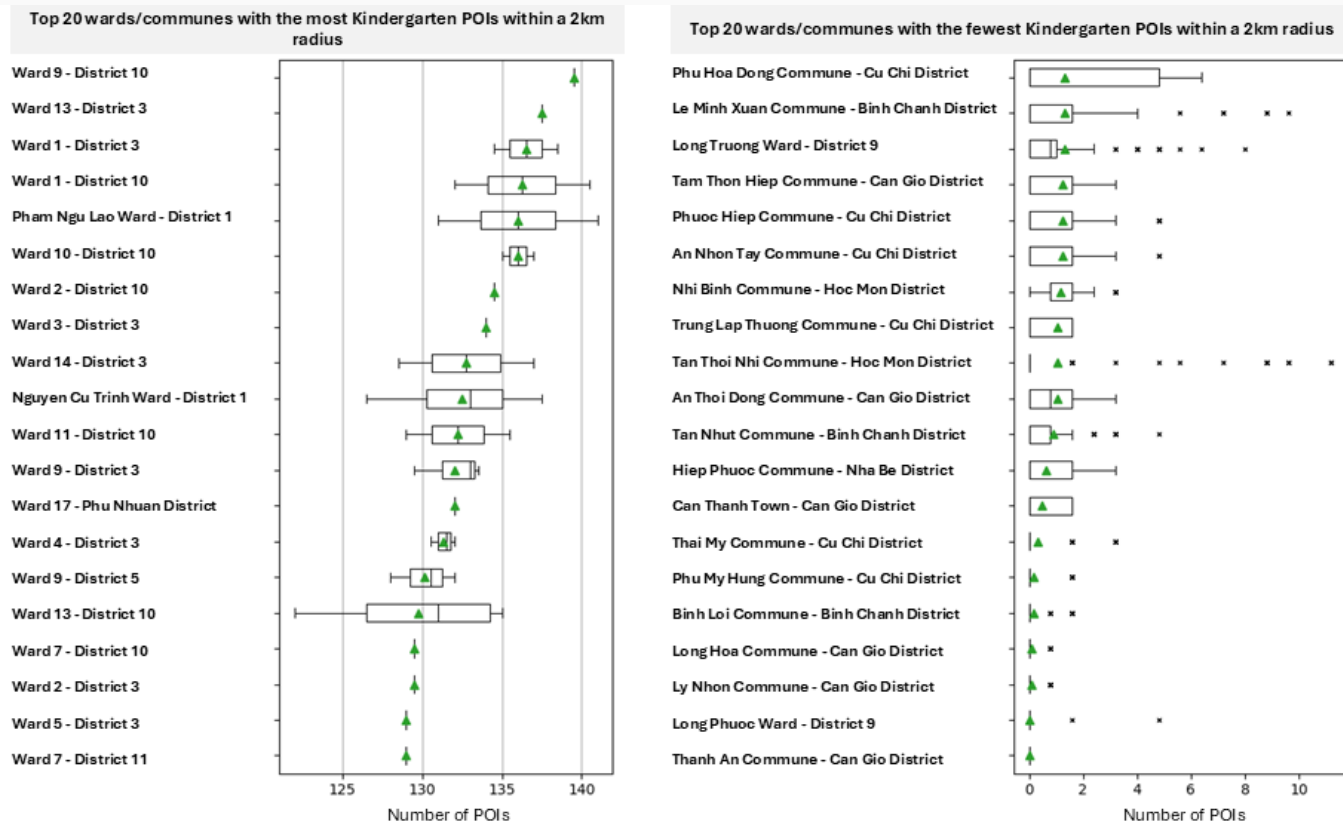
Kindergarten Density within a 2-Kilometer Radius

- Urban center wards offer substantial educational redundancy, with leading areas in District 10, District 3, and District 1 containing 130 to nearly 140 reachable kindergartens within 2 kilometers.

- In outer communes such as Thanh An, Long Phuoc, Ly Nhon, and Binh Loi, the median and mean count of reachable facilities drops to near zero.

- High facility abundance provides central residents with parental choice and capacity resilience, whereas suburban areas function as severe educational deserts.

Fig. 4. Comparison of Kindergarten POI Density within a 2km Radius: Top 20 Wards and Communes with the Most vs. Fewest POIs

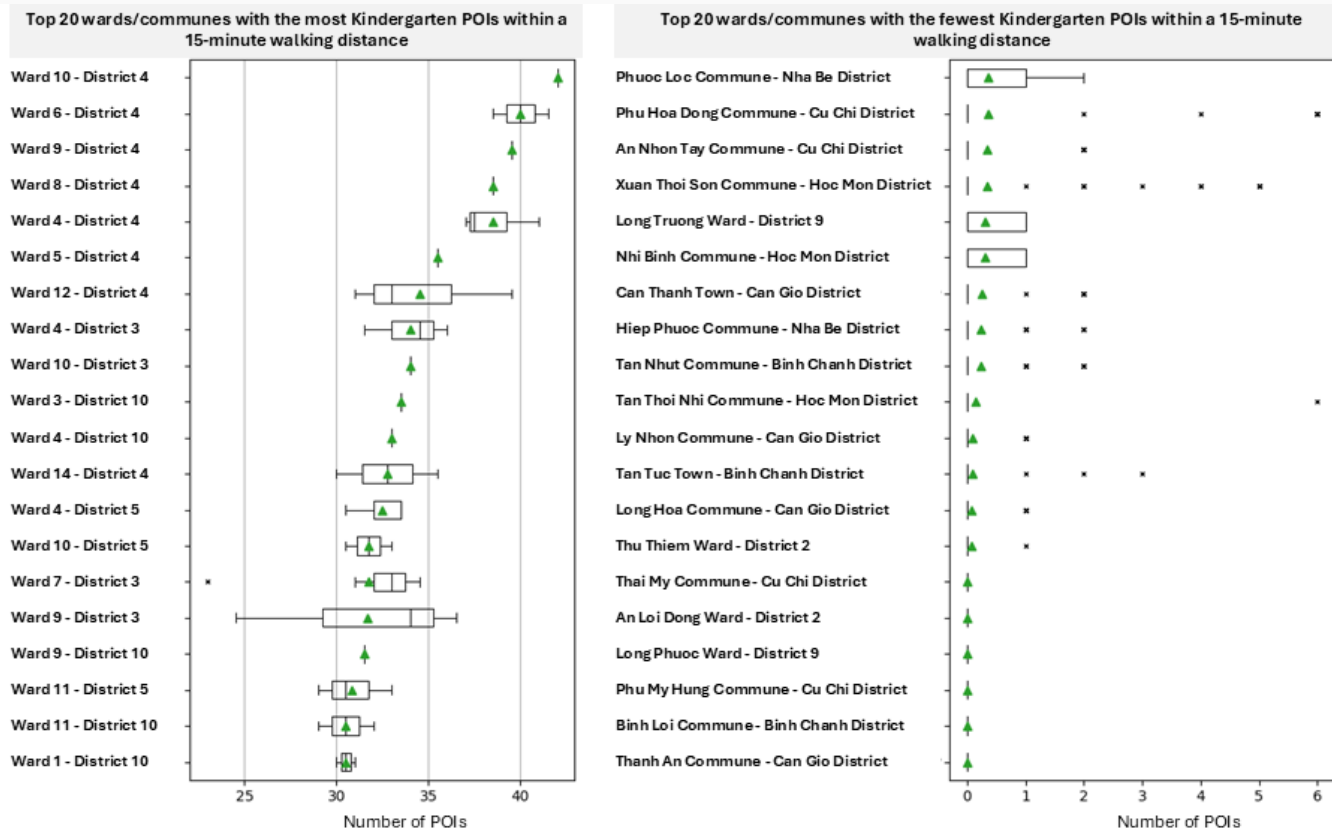


04. Results

Kindergarten Density within a 15-Minute Walking Catchment

- Applying a strict 15-minute walking catchment (approximately 1.0 to 1.2 kilometers) starkly widens the accessibility gap.
- Inner wards offer extensive pedestrian coverage; Ward 10 District 4 exceeds 40 reachable facilities, while numerous central wards consistently provide 30 to 40 options.
- Across peripheral communes in Nha Be, Cu Chi, Hoc Mon, and Can Gio, reachable facilities within a 15-minute walk remain strictly between 0 and 2 facilities, rendering daily pedestrian commutes unfeasible.

Fig. 5. Comparison of Kindergarten POI Density within a 15-Minute Walking Distance: Top 20 Wards and Communes with the Most vs. Fewest POIs



05. Conclusion, Limitations, and Policy Implications

Concluding Remarks

- The study confirms a profound, systemic core-periphery divide in early childhood education accessibility across Ho Chi Minh City.
- Physical distance buffers and temporal walk catchments demonstrate that standard walkability thresholds cannot be met under current suburban layouts.



Research Limitations

- Routing models assume uniform pedestrian speeds without accounting for micro-environmental barriers such as sidewalk quality, sidewalk encroachment, and localized weather factors.
- Point-of-interest data lack attributes regarding school capacity, operational quality, public versus private ownership, and tuition structures.
- Administrative boundaries reflect the baseline preceding ongoing municipal ward consolidation programs.



05. Conclusion, Limitations, and Policy Implications

Policy and Planning Implications

Contradiction in administrative logic

Standard quotas requiring at least one public kindergarten per ward or commune are structurally flawed in geographically expansive suburban units.

Risks of facility consolidation

Merging physical campuses into centralized hubs to reduce administrative costs increases travel distances and isolates peripheral communities, undermining educational equity.

Policy recommendations

Integrate early childhood social infrastructure with transit-oriented development corridors, expand satellite community-based childcare facilities, and tailor infrastructure targets to spatial network reach rather than administrative boundaries.

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Thank you for your attention!



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