# Mapping 15-Minute Walkable Accessibility of Public Services in China's 11 National Urban Agglomerations: A Data-Driven Spatial Coverage Assessment

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## 1 ABSTRACT

Cities worldwide are increasingly embracing the idea of the "15-minute city" as a pathway to more liveable, equitable and climate-responsive urban environments. This vision emphasizes walkable access to daily services, local resilience, and low-carbon lifestyles – features that have proven valuable in managing urban pressures and supporting recovery during and after the COVID-19 pandemic. In China, rapid urbanization and growing challenges such as air pollution, mobility congestion and widening social disparities have intensified the need for people-oriented, energy-efficient urban development. Responding to this, China's Ministry of Natural Resources issued the Spatial Planning Guidance for Community Life Units (2021), which provides a standardized framework for planning 15-minute walkable living areas and outlines spatial assessment methods for essential public service facilities.

Building upon this framework, this study conducts a comprehensive, data-driven evaluation of 13 categories of urban–rural public services across 170 cities within China's 11 national urban agglomerations. Using high-resolution POI datasets and GIS-based network analysis, we measure and visualize the 15-minute walkable service coverage of each facility type, generating a comparative landscape across cities, across agglomerations, and within each urban agglomeration. The analysis reveals spatial disparities in service provision, diverse facility configuration patterns, and distinctive intra-agglomeration hierarchies. The resulting visual "coverage mode maps" provide an intuitive tool for identifying local deficiencies and strengths, offering actionable insights for planners and policymakers seeking to promote climate-adaptive, resilient and low-carbon urban futures.

Keywords: 15-minute city, Walkable accessibility, Public service facilities, Urban agglomerations, Spatial coverage assessment

## 2 INTRODUCTION

### 2.1 From the Global "15-Minute City" to China's City-Region Strategy

The "15-minute city" has emerged as an influential planning paradigm aimed at improving liveability, social equity, and low-carbon urban lifestyles by ensuring that essential daily services are accessible within a short walk or cycle. Since its formulation by Moreno, the concept has evolved from an urban design vision into a governance-oriented framework that evaluates everyday accessibility through time-based thresholds.

The COVID-19 pandemic further reinforced the relevance of proximity-based planning. Mobility restrictions and pressure on healthcare systems revealed the importance of neighbourhood-level service availability and walkable environments, accelerating global debates on resilience, climate adaptation, and post-pandemic urban recovery.

In China, proximity planning has been institutionalised through the concept of the "community life circle," formally embedded in national spatial planning guidance issued in 2021. Rather than adopting the 15-minute city as a policy import, China reframed it as a standardised planning unit to support people-centred urbanisation and the equalisation of basic public services under the 14th Five-Year Plan.

Importantly, contemporary Chinese urbanisation is increasingly organised at the scale of urban agglomerations. These city-regions function as strategic carriers of population, economic activity, infrastructure investment, and governance coordination. China's 11 national urban agglomerations together account for nearly one billion residents and dominate national economic output, yet they differ markedly in development level, settlement structure, and spatial inequality. This diversity makes the city-region scale particularly relevant for examining how proximity-based accessibility is structured across China's urban system.

### 2.2 City-Regions, Inequality, and the Limits of Proximity Planning

Existing studies on public service accessibility in China consistently highlight persistent spatial inequality – between urban cores and peripheries, between large metropolitan centres and smaller cities, and especially between urban and rural areas. Even within economically advanced regions, fragmented governance and uneven facility distribution can produce substantial differences in everyday accessibility.

Urban agglomerations provide a critical lens for analysing these inequalities. Unlike single cities, city-regions encompass multiple jurisdictions, settlement hierarchies, and development trajectories. They are simultaneously sites of agglomeration economies and arenas of redistribution, where regional coordination can either mitigate or amplify spatial disparities.

Super city-regions such as the Yangtze River Delta and the Guangdong–Hong Kong–Macao Greater Bay Area benefit from dense settlement patterns and strong fiscal capacity, enabling more comprehensive service networks. In contrast, inland and peripheral agglomerations face dispersed settlements, complex terrain, and constrained public resources, increasing the difficulty of achieving walkable access. These structural differences suggest that a uniform application of the 15-minute standard may be neither realistic nor equitable across all regions.

### 2.3 Research Objectives and Scope

This study adopts a deliberately empirical and diagnostic research scope. Rather than developing causal models or policy evaluations, it focuses on systematically measuring and comparing 15-minute walkable accessibility to public service facilities across China's major urban agglomerations.

Specifically, the study quantifies the spatial coverage of 15-minute walkable access to 14 categories of urban–rural public service facilities across 174 cities in China's 11 national urban agglomerations, based on 2022 POI data and pedestrian network analysis. Urban agglomerations are treated as the primary analytical units in order to reveal regional patterns that remain obscured in single-city analyses.

The study further distinguishes between urban and rural accessibility outcomes, reflecting China's long-standing urban–rural dual structure. By presenting coverage outcomes as comparative indicators rather than causal explanations, the paper provides a nationwide baseline portrait of proximity conditions, highlighting where accessibility advantages and deficits are structurally concentrated across China's urban system.

## 3 STUDY AREA, DATA, AND METHODOLOGY

### 3.1 Study Area

The analysis covers China's 11 national-level urban agglomerations, encompassing 174 prefecture-level cities. These city-regions represent the core spatial framework of contemporary Chinese urbanisation and regional development. They include globally competitive coastal clusters, interior growth poles, and emerging or peripheral regions, together accounting for the vast majority of China's urban population and economic activity.

Urban agglomerations are adopted as the analytical scale for three reasons. First, they reflect China's dominant spatial organisation of development and governance. Second, they encompass diverse settlement types, enabling systematic comparison of urban–rural accessibility. Third, many national policy agendas related to public service provision, resilience, and low-carbon development are explicitly framed at the city-region level.

### 3.2 Data Sources and Processing

The analysis is based on a national POI dataset of public service facilities for 2022, collected from mainstream Chinese digital mapping platforms. Following national spatial planning guidance, 14 categories of essential public service facilities were identified, covering education, healthcare, food services, culture, sports, elderly care, and other daily welfare-oriented functions.

Data cleaning involved removing duplicates, correcting invalid coordinates, and standardising facility classification to ensure nationwide comparability. While POI data may underrepresent informal services – particularly in rural areas – it remains one of the most effective data sources for large-scale accessibility analysis due to its spatial precision and national coverage.

Pedestrian road network data were constructed for all cities by processing detailed road vectors to represent walkable infrastructure. Motorways and access-restricted roads were excluded, while local streets and pedestrian pathways were retained. Network cleaning addressed connectivity errors to ensure consistent modelling conditions across regions.

### 3.3 Measuring 15-Minute Walkable Service Coverage

The study evaluates proximity-based accessibility using a network-based 15-minute walkability approach consistent with China's "community life circle" framework. For each facility POI, a 15-minute pedestrian service area is generated based on a standard walking-speed assumption (1.5 m/s), corresponding to approximately 1,350 m of network distance. Where national guidelines specify facility-specific service radii, those thresholds are applied.

Accessibility is operationalised as an area-based indicator: the share of built-up land that falls within a 15-minute walkable catchment of a given facility type. Coverage is calculated separately for urban and rural built-up areas within each city and then aggregated to the urban agglomeration level using population-weighted averaging. This approach emphasises the distributional significance of accessibility outcomes for residents and enables consistent comparison across regions.

## 4 RESULTS

The results reveal pronounced differences in 15-minute walkable public service coverage across China's 11 urban agglomerations. Aggregated outcomes display a clear tiered pattern, with coastal and economically advanced regions generally outperforming inland and peripheral agglomerations.

Urban areas consistently exhibit higher coverage than rural areas, but the magnitude of the urban–rural gap varies substantially. In some city-regions, strong urban accessibility is accompanied by relatively robust rural performance, while in others, high urban coverage contrasts sharply with limited rural access, producing significant internal inequality.

The Guangdong–Hong Kong–Macao Greater Bay Area emerges as a clear outlier, exhibiting exceptionally high coverage across most facility categories and the smallest urban–rural gap. Dense urban form, compact settlements, and mature service networks contribute to near-comprehensive walkable access, particularly in Hong Kong and Macao.

By contrast, the Capital Economic Circle demonstrates more modest average performance. While core metropolitan areas show strong urban coverage, extensive peripheral and rural areas with weaker accessibility reduce the overall regional outcome, highlighting pronounced internal heterogeneity.

Mid-tier agglomerations – including the Yangtze River Delta, Chengdu–Chongqing, and the Middle Reaches of the Yangtze River – display intermediate performance, typically combining strong urban accessibility with uneven rural outcomes. At the lower end of the spectrum, western and northern agglomerations exhibit consistently lower coverage, particularly in rural areas, reflecting dispersed settlements and constrained service networks.

Across facility categories, education and basic healthcare generally achieve higher coverage than cultural, sports, and elderly-care services. However, substantial regional variation persists, underscoring the multi-dimensional nature of proximity-based accessibility.

## 5 DISCUSSION

The city-region comparison highlights a key finding: rural accessibility is the binding constraint shaping China's 15-minute performance. While metropolitan cores often achieve relatively high walkable coverage, persistent rural deficits significantly lower regional averages, particularly in Tier 2 and Tier 3 agglomerations.

High-performing regions such as the Greater Bay Area demonstrate that proximity planning can function as a region-wide public good when dense settlement patterns, strong fiscal capacity, and integrated governance align. In contrast, large and fragmented city-regions reveal that political or economic centrality does not automatically translate into equitable everyday accessibility.

Facility-type contrasts further suggest that market-driven services achieve proximity faster than welfare-oriented services. Healthcare and education accessibility reflect not only facility supply, but also institutional organisation, spatial morphology, and network permeability. In this sense, the 15-minute metric operates as a diagnostic tool that captures how urbanisation, governance, and spatial form jointly shape everyday accessibility.

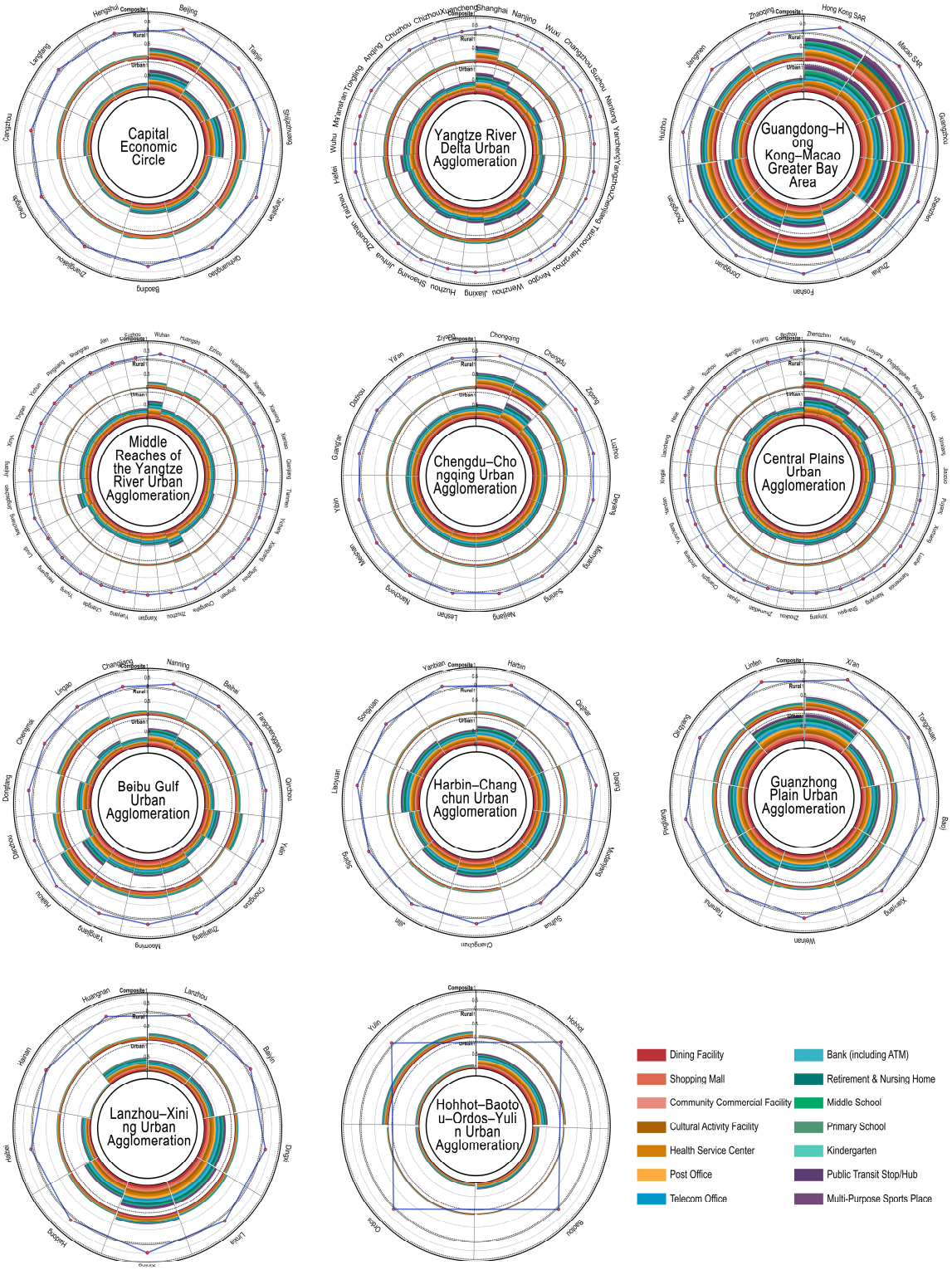


Fig. 1: D3.js-Based Radial Visualization of 15-Minute Walkable Public Service Accessibility across China's 11 Urban Agglomerations. Note: Each radial chart presents the cumulative 15-minute walkable coverage of public service facilities for cities within a given urban agglomeration. The innermost ring represents urban (built-up area) facility coverage, the middle ring represents rural facility coverage, and the outermost ring represents the integrated urban–rural facility coverage, calculated by weighting urban and rural results by their respective population shares. Together, the three concentric rings illustrate both internal urban–rural disparities and the overall proximity performance of each city within the urban agglomeration.

## 6 CONCLUSION

This study provides a nationwide, city-region-level assessment of 15-minute walkable access to public services across China's 11 national urban agglomerations. Three conclusions stand out.

First, proximity-based accessibility exhibits clear regional tiering, but the decisive factor is rural performance rather than metropolitan capacity. Second, different facility types follow distinct distribution logics, revealing structural constraints beyond simple under-supply. Third, under post-pandemic fiscal constraints, proximity planning must prioritise equity-efficient interventions – such as improving pedestrian connectivity and coordinating service provision at the city-region scale.

Overall, the "15-minute city" is viable in China only if reframed from an urban design slogan into a spatial justice principle aimed at urban–rural integration and time-based equity across diverse territorial conditions.

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