Who Can Reach What? Travel-Time-Based Accessibility and Urban Inequality in Los Ángeles, Chile

Richard Weidlin [1], Guido Staub [1]

[1] University of Concepción, Department for Geodetic Sciences and Geomatics, Los Ángeles, Chile – rweidlin@udec.cl, gstaub@udec.cl

Keywords: Accessibility, Travel Time Analysis, Urban Mobility, Transportation Modes, Spatial Inequality

Abstract

Urban accessibility is a key factor in understanding spatial inequality, as it conditions residents’ ability to reach essential services and urban opportunities. This study analyses accessibility in the intermediate city of Los Ángeles, Chile, characterized by a centralized concentration of services and expanding peripheral residential areas. Accessibility to educational, healthcare, and commercial facilities was evaluated using approximate travel times generated through the TravelTime API, considering walking, public transport, and private vehicle modes. Travel times were calculated from the centroids of residential census blocks, and opportunity-based accessibility was assessed using travel-time thresholds to identify the range of accessible commercial establishments.The results reveal marked spatial disparities. Central areas exhibit the highest levels of accessibility due to the density and diversity of amenities, with walking emerging as the most efficient mode for short distances. In contrast, peripheral neighbourhoods show limited access to healthcare and educational facilities and depend largely on private vehicles to reach central services, despite having higher population densities. Commercial accessibility in these areas is primarily restricted to small-scale neighbourhood establishments. These findings indicate that accessibility is influenced not only by travel time and transport networks but also by the spatial distribution and variety of urban functions. The study highlights the usefulness of routing APIs as an alternative methodological tool for accessibility analysis in contexts where official mobility data are outdated or incomplete, offering valuable insights for urban planning and policies aimed at reducing spatial inequalities.

1. Introduction

Accessibility is a central concept in urban and transport studies, yet it remains complex and multidimensional, lacking a single, universally accepted definition. Its meaning varies according to disciplinary perspectives and the spatial, social, and institutional contexts in which it is applied. In broad terms, accessibility refers to the ability of individuals or groups to reach opportunities, services, and resources distributed across urban space. From this perspective, accessibility is not merely a technical attribute of transport infrastructure but a relational outcome shaped by land-use patterns, mobility systems, and individual capabilities.

Early conceptualizations of accessibility emphasized spatial separation and the potential for interaction between locations (Hansen, 1959). More recent approaches have expanded this view, incorporating temporal constraints, modal choice, and social conditions that influence everyday mobility (Geurs and van Wee, 2004). A key distinction in this literature is between mobility and accessibility. While mobility refers to the capacity to move or travel, accessibility focuses on the ability to reach desired destinations. High levels of mobility do not necessarily imply high accessibility, particularly in cities where long travel distances and centralized land-use patterns require extensive travel to meet basic needs.

Mobility is nonetheless fundamental to accessibility, as it enables residents to participate in urban life and access essential services. Mobility is closely linked to distance and time: distance influences transport mode choice, while time can be understood as a limited and unevenly distributed resource. Variations in travel time, transport availability, and network efficiency generate inequalities among residents depending on their place of residence and socioeconomic conditions. In this sense, accessibility can be considered a scarce resource, conditioned by spatial configuration, transport systems, and individual constraints (Cerda, 2010).

Importantly, accessibility should not be reduced to the degree of physical connectivity provided by transport networks. A well-connected system does not guarantee equitable access if destinations are unevenly distributed or if certain populations face barriers to travel. Accessibility also depends on the willingness and ability of individuals to move, which are shaped by income, age, physical ability, and access to transport modes. Within this broader framework, accessibility has been conceptualized as a key component of the “right to the city,” understood as the capacity of residents to fully participate in urban life (Miralles and Cebollada, 2003).

Accessibility inequalities have become increasingly pronounced in Latin American cities due to rapid urban expansion, spatial segregation, and rising motorization. In Chile, sustained demographic growth and changes in land-use patterns have led to the emergence of large urban units and metropolitan configurations, often formed through the functional integration of intermediate cities (Orellana, 2020). These cities have experienced significant economic and demographic dynamism, acting as regional service centers while undergoing profound spatial transformations (Maturana and Rojas, 2015). However, processes of metropolization remain only partially consolidated, giving rise to hybrid urban forms described as urban complexes (Hidalgo et al., 2009).

A defining characteristic of many Chilean intermediate cities is a development pattern centered on a consolidated civic core that concentrates employment, services, and commercial activities, surrounded by expanding residential peripheries. This growth model often exacerbates accessibility inequalities, as increasing distances between residential areas and key destinations result in

longer travel times and greater dependence on motorized transport. In many cases, residential expansion has not been accompanied by a corresponding decentralization of services or improvements in public transport provision, reinforcing daily commuting flows toward central areas.

The city of Los Ángeles exemplifies these dynamics. As an important intermediate city in south-central Chile, Los Ángeles concentrates a wide range of administrative, commercial, educational, and healthcare functions in its civic centre, while residential neighbourhoods have expanded outward, particularly toward the south-eastern and western sectors. This spatial configuration poses significant challenges for urban accessibility, especially for residents of peripheral areas who must travel longer distances to meet daily needs. Rising levels of motorization and increasing congestion further intensify these challenges, affecting travel times, transport costs, and overall quality of life.

Within this context, the present study analyses spatial accessibility in the city of Los Ángeles using a travel-time–based approach that considers multiple transportation modes and types of urban facilities. By employing route-planning software and open-access geospatial data, the study addresses limitations associated with outdated or incomplete official mobility datasets. The research seeks to contribute to the understanding of accessibility inequalities in intermediate cities and to provide evidence that can inform urban planning and policy discussions aimed at promoting more equitable and sustainable urban development.

This study aims to analyse spatial accessibility inequalities in the city of Los Ángeles by comparing travel times across multiple transport modes and facility types, with particular attention to the relationship between urban structure and access to opportunities.

2. Study site

Los Ángeles, located in south-central Chile, is the capital of the Bío-Bío Province, Figure 1. It is the region’s second most populous city. The commune covers an area of approximately 29,973 km² and has a total population of 187,000 inhabitants, of whom around 140,000 (approximately 75%) reside within the urban area (Instituto Nacional de Estadísticas, 2017). Furthermore, Los Ángeles plays a key administrative, commercial, and service-provision role for surrounding rural and semi-urban territories, reinforcing its functional centrality at a provincial scale.

The urban structure of Los Ángeles reflects a marked centre–periphery configuration. The civic and commercial centre concentrates a large share of public services, retail activity, administrative functions, and employment opportunities, while residential neighbourhoods have expanded outward through predominantly low- to medium-density developments. This pattern is consistent with the typical growth model of Chilean intermediate cities, where urban expansion has occurred faster than the decentralization of services and facilities (Orellana, 2020). As a result, daily mobility flows are strongly oriented toward the central area, generating spatial imbalances in access to urban opportunities.

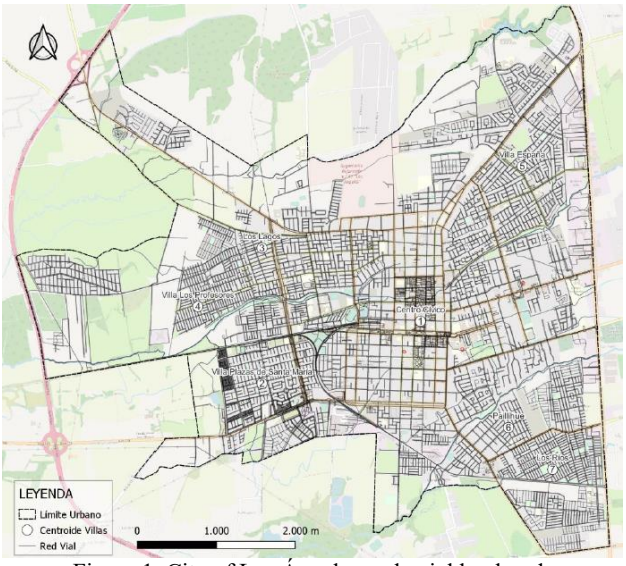

Figure 1. City of Los Ángeles and neighbouhoods

Population density patterns further illustrate this imbalance. While the civic centre has relatively low residential density—partly due to the conversion of housing into commercial and service uses—higher population densities are observed in south-eastern and western neighbourhoods. These peripheral sectors accommodate a significant proportion of the city’s population but are characterized by a more limited supply of services and facilities. This spatial mismatch between residential location and activity concentration has direct implications for accessibility and travel behavior, particularly for residents who depend on non-motorized or public transport modes.

From a socioeconomic perspective, Los Ángeles exhibits notable levels of social vulnerability. According to data from the Ministry of Social Development and Family (Ministerio de Desarrollo Social y Familia, 2017), approximately 17.4% of the population lives in poverty. Economic activity in the city is largely based on forestry, industry, services, and commerce, reflecting its integration into national and international production networks (Azócar et al., 2008). These economic dynamics have contributed to urban growth and spatial transformation, while also intensifying demand for daily travel across the urban area.

Mobility patterns in Los Ángeles highlight the relevance of accessibility analysis. The 2004 Origin–Destination Survey recorded approximately 278,025 trips on a typical weekday, with walking accounting for 35.7% of trips, followed by public transport (28.9%), private vehicles (21.2%), and bicycles (4.2%). Although this survey is now outdated, it provides important insight into the historically significant role of non-motorized and public transport. More recent trends suggest increasing motorization, with registered vehicles rising from 53,946 in 2012 to 62,471 in 2023 (Instituto Nacional de Estadísticas, 2017). This growth has contributed to congestion, longer travel times, and declining accessibility, particularly in peripheral areas.

These demographic, spatial, and mobility characteristics make Los Ángeles a relevant case for examining accessibility inequalities in intermediate cities. The coexistence of a highly concentrated civic centre and expanding residential peripheries provides an appropriate context for analysing how urban structure influences residents access to services and daily opportunities.

3. Methodology

This study adopts a travel-time–based approach to analyse spatial accessibility in the city of Los Ángeles, focusing on residents' ability to reach key urban services under different transportation modes. Given the limited availability and outdated nature of official mobility data at the municipal level, the methodology relies on route-planning software and open-access geospatial datasets to generate approximate but realistic travel-time estimates.

3.1 Data sources and spatial units

The primary spatial unit of analysis is the census block, defined as the smallest official statistical unit used by the Chilean National Institute of Statistics. Census blocks are delineated by physical, cultural, or natural boundaries and provide a high level of spatial detail suitable for urban accessibility analysis. The geometric centroids of each residential census block were used as trip origins, representing the approximate location of residents within each block.

Geospatial data for the road network, administrative boundaries, and residential areas were obtained from open-access platforms, including the Geospatial Data Infrastructure of Chile (IDE Chile) and the Library of Congress map collections. OpenStreetMap data were incorporated to provide a detailed and up-to-date cartographic base, particularly for the street network and pedestrian infrastructure. Information on commercial establishments was supplied by the Municipality of Los Ángeles, while locations of educational and healthcare facilities were compiled from public institutional records and georeferenced for spatial analysis.

3.2 Accessibility indicators and facility selection

Accessibility was evaluated for three types of urban facilities: commercial establishments, educational institutions, and healthcare services. These categories were selected due to their relevance for daily life and their differing spatial distribution patterns within the city. Accessibility was operationalized using two complementary indicators: (1) travel time to selected facilities and (2) the number of opportunities reachable within predefined travel-time thresholds.

Travel time was chosen as the main indicator rather than distance, as it better captures the lived experience of mobility and reflects the influence of transport mode, network structure, and operational constraints. This approach aligns with contemporary accessibility research that emphasizes time as a critical and finite resource for urban residents.

3.3 Route calculation and travel-time estimation

Travel times were calculated using the TravelTime API, a route-planning tool that estimates optimal paths based on mode-specific travel speeds, network connectivity, and typical traffic conditions. For educational and healthcare facilities, point-to-point routing was applied to calculate the minimum travel time from each residential centroid to the nearest facility under three transportation modes: walking, public transport, and private vehicle.

For commercial accessibility, an opportunity-based approach was employed using a time-filtering tool within the same API. This method identifies all commercial establishments reachable from a given origin within a specified travel-time threshold, allowing for an assessment of the variety and quantity of opportunities accessible to residents. This approach is particularly suitable for analyzing everyday activities, such as shopping, where multiple destination choices exist.

Although the API does not provide real-time travel conditions, it incorporates historical traffic patterns and network characteristics, producing representative travel-time estimates for typical weekday conditions. This makes it a practical alternative for accessibility studies in data-scarce urban contexts.

Travel times were estimated for three representative weekday time periods (07:00, 13:00, and 17:00) to capture peak and off-peak conditions. For comparative purposes, average travel times across these time periods were calculated and used in the analysis.

3.4 Transportation modes and assumptions

Three transportation modes were considered: walking, public transport, and private vehicle. Walking accessibility reflects the potential for non-motorized mobility and is especially relevant in central areas. Public transport accessibility accounts for bus routes and transfers, while private vehicle accessibility reflects motorized travel along the road network.

Several assumptions were necessary for the analysis. Walking speeds and vehicle travel times are standardized within the API, and all origins are assumed to have equal access to transport modes. While these assumptions simplify complex mobility behaviors, they allow for consistent comparison across space and modes.

3.5 Limitations

This study presents several methodological limitations that should be considered when interpreting the results. Accessibility was estimated using neighbourhood centroids, which may overlook intra-neighbourhood variability and local differences in access conditions. In addition, the use of route-planning APIs relies on generalized assumptions regarding traffic conditions, travel speeds, and route selection, while the use of historical traffic data limits sensitivity to short-term congestion or service disruptions. The analysis is further constrained by the use of discrete time snapshots (07:00, 13:00, and 17:00), which capture key daily variations but do not fully represent temporal dynamics throughout the day. Finally, minor routing inconsistencies were observed for very short distances or closely spaced origins and destinations.
Despite these limitations, the approach provides a robust and replicable framework for identifying spatial patterns of accessibility and inequality in data-scarce contexts, offering valuable insights for urban planning in intermediate cities.

4. Results

The accessibility analysis reveals clear spatial differences across the urban area of Los Ángeles, closely associated with the city's centre–periphery structure and the distribution of urban facilities. Accessibility patterns are presented according to facility type and transportation mode, highlighting variations in travel time and opportunity availability across residential areas. The analysis is aggregated at the neighbourhood level for interpretation. Figure 2 shows the spatial distribution of urban facilities across neighbourhoods, highlighting their strong concentration in the civic centre.

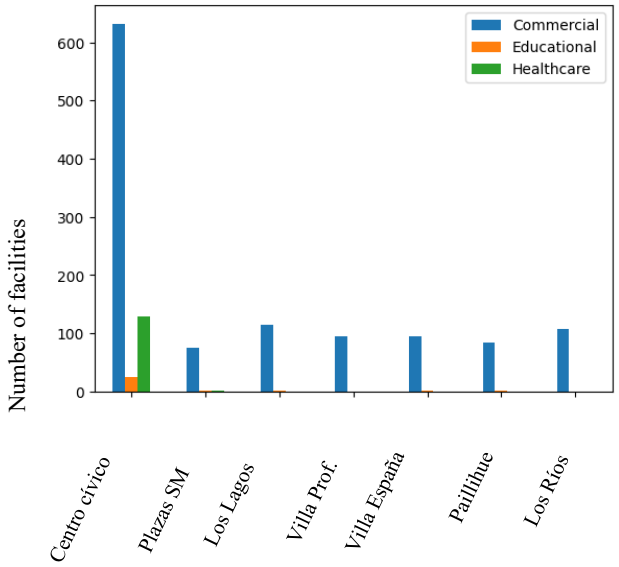

Figure 2. Distribution of urban facilities by function across neighbourhoods

4.1 Accessibility to commercial facilities

Commercial accessibility is highest in the civic centre and its immediately surrounding neighbourhoods. This area concentrates the widest variety of commercial establishments, including retail, services, food outlets, and specialized businesses. Residential census blocks located near the centre can access a large number of commercial opportunities within short travel-time thresholds, particularly by walking. Walking emerges as the most efficient mode in these areas, as short distances and dense street connectivity allow residents to reach multiple destinations without being affected by traffic congestion or signalized intersections.

In contrast, peripheral neighbourhoods display significantly lower commercial accessibility. Although small-scale establishments such as minimarkets and local grocery stores are present, the range of available opportunities is limited. As distance from the city centre increases, the number of commercial establishments reachable within short travel-time thresholds declines sharply. In these areas, accessibility becomes increasingly dependent on motorized transport, especially private vehicles, which offer greater spatial reach despite longer absolute distances.

4.2 Accessibility to educational facilities

Accessibility to educational facilities exhibits a more centralized pattern. Most primary, secondary, and higher education institutions are located in central and intermediate zones, resulting in relatively short travel times for residents living near the city centre. For these areas, walking and public transport provide reasonable access, with walking being viable for short-distance trips and public transport extending accessibility to adjacent neighbourhoods.

Peripheral sectors, however, face longer travel times to educational facilities, particularly when relying on walking. In many cases, walking times exceed commonly accepted thresholds for daily travel, making this mode impractical. Public transport and private vehicles significantly reduce travel times, although accessibility remains uneven due to variations in route coverage and network connectivity. These results suggest that educational accessibility is strongly influenced by facility location and transport availability rather than residential density alone.

4.3 Accessibility to healthcare facilities

Healthcare accessibility shows the most pronounced spatial disparities. Within a 20-minute walking threshold, only a limited number of outpatient healthcare centres are accessible, and none provide emergency services. This indicates a clear disadvantage for non-motorized accessibility, particularly for residents in peripheral areas. Walking accessibility to healthcare is largely restricted to central and nearby intermediate zones.

Motorized modes substantially improve healthcare accessibility. Both public transport and private vehicles allow residents to reach a broader range of healthcare facilities within shorter travel times, including those offering specialized or emergency services. Nevertheless, residents in peripheral neighbourhoods still experience longer travel times compared to those living near the centre, reflecting the concentrated spatial distribution of healthcare infrastructure.

4.4 Modal differences and population distribution

Across all facility types, differences between transportation modes are evident. Walking is highly effective in central areas where distances are short and facilities are densely clustered, while its effectiveness declines rapidly with distance from the centre. Public transport offers intermediate accessibility levels, extending reach beyond walking but remaining constrained by route availability and service frequency. Private vehicles consistently provide the shortest travel times over longer distances, reinforcing their role as the dominant mode for accessing centrally located services from peripheral areas.

Figure 3 illustrates the variation in average travel times across transportation modes, showing a consistent advantage for private vehicles in all neighbourhoods. Walking travel times increase significantly with distance from the civic centre, while public transport provides intermediate levels of accessibility. Figure 4 further highlights these disparities by showing the travel time gap between walking and private transport. This gap is particularly pronounced in peripheral neighbourhoods, indicating a strong dependence on motorized mobility and reinforcing spatial inequalities in access to urban opportunities.

When accessibility patterns are compared with population distribution, a notable mismatch emerges. Peripheral neighbourhoods tend to have higher population densities than the civic centre, yet they exhibit lower accessibility to most facility types. This suggests that a large share of the population must travel longer distances to access essential services, increasing dependence on motorized transport and exacerbating spatial inequalities.

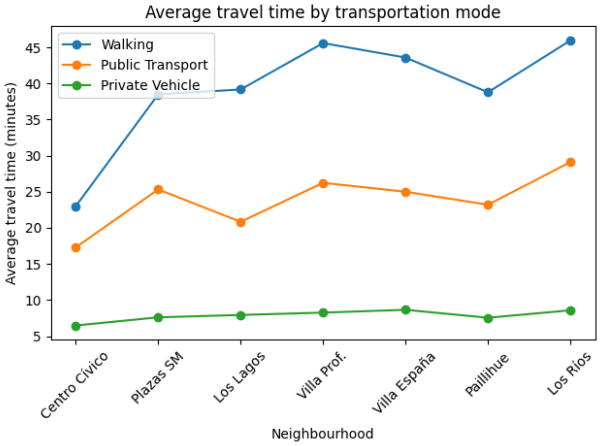

Figure 3. Average travel times by transportation mode across neighbourhoods.

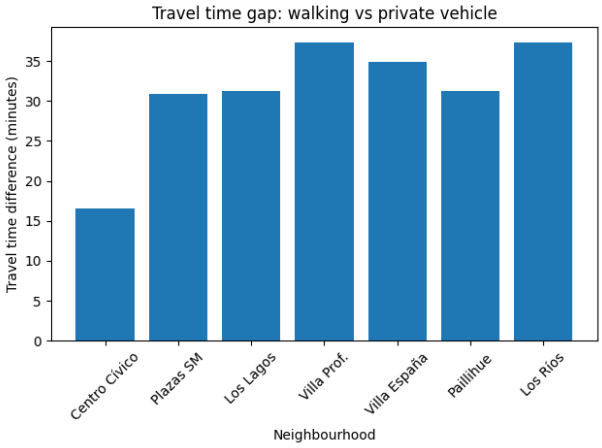

Figure 4. Travel time gap between walking and private vehicle by neighbourhood.

Overall, the results demonstrate that accessibility in Los Ángeles is shaped less by optimal routing to individual destinations and more by the spatial concentration and diversity of opportunities within defined travel-time limits. Areas with a greater variety of facilities achieve higher accessibility even when distances are relatively short, while areas with limited facility diversity remain disadvantaged regardless of transport mode. This pattern is consistent with the facility distribution shown in Figure 2.

5. Policy and Planning Implications

The accessibility patterns identified in Los Ángeles highlight the need for urban planning strategies that move beyond transport infrastructure provision and address the spatial distribution of services and activities. The strong concentration of commercial, educational, and healthcare facilities in the civic centre suggests that accessibility inequalities are primarily land-use driven rather than solely the result of network deficiencies. Consequently, policies aimed exclusively at improving travel speeds or expanding road capacity are unlikely to resolve the underlying accessibility challenges faced by peripheral neighbourhoods.

One key implication is the importance of promoting mixed-use development in peripheral and intermediate areas. Encouraging the location of educational, healthcare, and commercial facilities closer to residential concentrations could significantly reduce travel times and dependence on private vehicles. This approach aligns with proximity-based planning principles, which emphasize access to essential services within short travel-time or walking thresholds as a foundation for urban equity.

Public transport planning also plays a critical role in addressing accessibility disparities. While motorized modes improve access from peripheral areas, reliance on private vehicles reinforces social and environmental costs, including congestion and emissions. Strengthening public transport coverage, frequency, and connectivity—particularly between peripheral neighbourhoods and intermediate service nodes—could improve accessibility while reducing car dependency. Integrating public transport planning with land-use decisions is essential to avoid reinforcing existing spatial inequalities.

The findings also underscore the need to consider walking accessibility as a key indicator in urban planning. In central areas, walking provides highly efficient access due to compact urban form and facility clustering. Replicating these conditions elsewhere requires not only pedestrian infrastructure but also the strategic location of services within walkable distances. Without such spatial reconfiguration, investments in pedestrian infrastructure alone may have limited impact.

From a governance perspective, intermediate cities such as Los Ángeles often face institutional and financial constraints that limit long-term planning capacity. In this context, accessibility-based analyses using open data and routing tools can support evidence-based decision-making, enabling local governments to identify priority areas for intervention and to evaluate alternative planning scenarios. Incorporating accessibility metrics into municipal planning instruments could help align urban growth with social equity objectives.

Overall, addressing accessibility inequalities in Los Ángeles requires coordinated land-use, transport, and social policies that prioritize proximity, diversity of opportunities, and inclusive mobility. Without such an integrated approach, current patterns of spatial inequality are likely to persist as the city continues to expand.

6. Discussion

The results highlight pronounced spatial inequalities in accessibility within the city of Los Ángeles, reflecting broader patterns observed in intermediate cities in Chile and Latin America. These inequalities are closely linked to the city’s centre–periphery structure, where economic activities, services, and institutional facilities remain heavily concentrated in the civic centre while residential growth continues to expand outward. This spatial configuration reinforces uneven access to urban opportunities and places a disproportionate mobility burden on residents of peripheral neighbourhoods. These spatial disparities are clearly illustrated in Figure 2, which shows the strong concentration of facilities and accessibility advantages in the civic centre relative to peripheral neighbourhoods.

One of the most significant findings is the strong relationship between facility concentration and accessibility outcomes. Central areas benefit not only from shorter travel distances but also from a greater diversity of services within limited travel-time thresholds. This confirms that accessibility is influenced less by the optimization of individual routes and more by the spatial availability of opportunities, as emphasized in opportunity-based accessibility approaches (Cerda, 2010). In this context, walking

emerges as a highly effective mode in central areas, reinforcing its role as an equity-enhancing form of mobility when urban functions are spatially compact.

In contrast, peripheral neighbourhoods exhibit limited accessibility despite often having higher population densities. This mismatch underscores the consequences of residential expansion without corresponding decentralization of services. Residents in these areas are more dependent on motorized transport—particularly private vehicles—to access healthcare, education, and a broader range of commercial services. Such dependence exacerbates social inequalities, as access to private vehicles is unevenly distributed across socioeconomic groups. Public transport partially mitigates these disparities but remains constrained by route coverage, travel times, and service efficiency.

Healthcare accessibility illustrates these inequalities most clearly. The limited walking access to healthcare facilities, especially those offering emergency services, raises concerns regarding spatial justice and urban resilience. Reliance on motorized modes for essential services can create vulnerabilities for populations with limited mobility resources, including older adults, children, and low-income households. Similar patterns have been documented in other Chilean cities, where centralized healthcare infrastructure contributes to unequal access and increased travel times for peripheral residents.

The findings also reveal the complex relationship between density and accessibility. While higher densities are often associated with improved accessibility, the case of Los Ángeles demonstrates that density alone is insufficient if it is not accompanied by a diverse mix of land uses and services. The relatively low residential density of the civic centre, driven in part by the conversion of housing into commercial and service functions, further complicates this relationship. Although this centralization improves accessibility for surrounding areas, it simultaneously displaces residential populations toward the periphery, reinforcing long-distance travel patterns.

From a methodological perspective, the use of route-planning APIs proves effective in capturing spatial accessibility patterns in data-scarce contexts. Travel-time–based measures provide a more realistic representation of everyday mobility than distance-based indicators, particularly when comparing different transportation modes. While methodological constraints should be acknowledged, the results provide consistent evidence of spatial accessibility inequalities. Despite these constraints, the approach offers a valuable tool for exploratory accessibility analysis and for informing planning discussions in intermediate cities.

Overall, the discussion underscores the importance of integrating accessibility considerations into urban planning and transport policy. Addressing accessibility inequalities in Los Ángeles requires not only improvements in transport infrastructure but also strategic land-use planning that promotes the decentralization of services and the development of mixed-use neighbourhoods. Without such interventions, existing patterns of spatial inequality are likely to persist and intensify as urban expansion and motorization continue.

7. Conclusions

This study analysed spatial accessibility in the city of Los Ángeles, Chile, using a travel-time–based approach that considers multiple transportation modes and types of urban facilities. The results reveal clear and persistent accessibility inequalities linked to the city’s centre–periphery structure, where the concentration of services and opportunities in the civic centre contrasts sharply with the predominantly residential character of peripheral neighbourhoods.

Central areas benefit from high accessibility due to the density and diversity of amenities, enabling short travel times and effective walking access. In contrast, peripheral sectors—despite accommodating a large share of the population—experience limited accessibility to healthcare and educational facilities and rely heavily on private vehicles to reach centrally located services. This dependence reinforces socioeconomic inequalities and increases vulnerability among groups with restricted access to motorized transport. The findings confirm that accessibility is shaped not only by transport networks and travel times but also, critically, by land-use patterns and the spatial distribution of opportunities.

The analysis also highlights the limitations of relying solely on population density or transport provision as indicators of accessibility. In Los Ángeles, higher densities in peripheral areas do not translate into improved access due to the lack of nearby services and facilities. Conversely, the low residential density of the civic centre, driven by functional specialization, contributes to residential displacement and longer daily travel distances. These dynamics underscore the need for integrated land-use and transport planning approaches that promote mixed-use development and service decentralization.

From a methodological perspective, the use of routing APIs demonstrates their potential as practical tools for accessibility analysis in contexts where official mobility data are outdated or incomplete. While the approach is subject to limitations related to data assumptions and routing accuracy, it provides a replicable and scalable framework for identifying spatial patterns of inequality.

This study demonstrates the value of travel-time–based accessibility analysis for understanding spatial inequalities in intermediate cities, highlighting the importance of integrating land-use and transport planning to promote equitable access.
Overall, the study contributes to the understanding of accessibility challenges in Chilean intermediate cities and offers evidence to support planning strategies aimed at reducing spatial inequities, improving proximity to essential services, and promoting more inclusive and sustainable urban development.

References

Azócar, G., Henríquez, C., Valenzuela, C., Romero, H., 2008. Tendencias sociodemográficas y segregación socioespacial en Los Ángeles, Chile. Revista de Geografía Norte Grande, (41), 103‑128.

Cerda, J., Marmolejo, C., 2010. De la accesibilidad a la funcionalidad del territorio: una nueva dimensión para entender la estructura urbano-residencial de las áreas metropolitanas de Santiago (Chile) y Barcelona (España). *Rev. geogr. Norte Gd.*, n.46, pp.5-27.

Geurs, K.T. and Van Wee, B., 2004. Accessibility Evaluation of Land-Use and Transport Strategies: Review and Research Directions. Journal of Transport Geography, 12, 127-140. https://doi.org/10.1016/j.jtrangeo.2003.10.005

Hansen, W.J., 1959. How Accessibility Shapes Land Use. Journal of the American Planning Association, 25, 73-76. https://doi.org/10.1080/01944365908978307

Hidalgo, R., Arenas, F., Aliaga, G., 2009. Ciudades medias en la macrozona central de Chile: transformaciones socio-espaciales en un contexto de metropolización. In Chile: del país urbano al país metropolitan, pp. 303–322.

Instituto Nacional de Estadísticas, 2017. Censo 2017: Resultados definitivos. Gobierno de Chile. https://www.censo2017.cl

Maturana, F., Rojas, A., 2015. Ciudades intermedias en Chile: territorios olvidados. Santiago de Chile: RIL Editores. ISBN: 978-956-01-0195-2.

Ministerio de Desarrollo Social y Familia., 2017. Encuesta de Caracterización Socioeconómica Nacional (CASEN) 2017. Gobierno de Chile. https://www.encas.enach.cl

Miralles, C., Cebollada, À., 2003. Movilidad y transporte: opciones políticas para la ciudad. (1 ed.) (Deumento de trabajo 256).

Orellana, A., 2020. Conformación metropolitana desde la fragmentación: El proceso de conurbación del Gran La Serena / Metropolitan formation from fragmentation. The conurbation process of Greater La Serena. Revista Urbano, 23(41), 58–83. DOI: 10.22320/07183607.2020.23.41.04.