Regional Science Policy & Practice 18 (2026) 100283

Contents lists available at ScienceDirect

Regional Science Policy & Practice

journal homepage: www.sciencedirect.com/journal/regional-science-policy-and-practice

Adapting the '15-minute city' concept to medium-sized urban contexts: A case study in Desio, Italy

Manuel Garramone [1,*], Marco Scaioni [2]

Dept. of Architecture, Built Environment and Construction Engineering, Politecnico di, Milano, via Ponzio 31, Milano 20133, Italy

ARTICLE INFO

Keywords:
15-Minute City
Chrono-Urbanism
Medium-Sized Cities
Regional Governance
Spatial Accessibility

ABSTRACT

As global concerns about public health and environmental sustainability continue to grow, urban planners are developing strategies to promote active and public transportation as alternatives to private car use. Reducing car dependency can offer significant benefits, including lower carbon emissions and less traffic congestion. In this context, the '15-minute city' is gaining momentum as an urban planning concept designed to optimise the population's daily mobility: the model aims to ensure that essential urban functions and facilities are reachable within a 15-minute walk or cycling. Starting with a bibliometric analysis and a literature overview about the '15-minute city' topic, the paper applies this framework to Desio, a medium-sized municipality in the Milan metropolitan area, Italy. Most analysed studies focused on large metropolitan cities, while this research wants to investigate how the paradigm can be adapted in a commuter-oriented urban context, where local accessibility and regional mobility coexist. A network-based accessibility analysis was used to assess the spatial relationships between the distribution of population, split by age groups, and essential services (educational, health, and social facilities). Results reveal spatial mismatches between demographic concentrations and service accessibility, particularly in peripheral and edge neighbourhoods and among elderly residents. This study expands on how the '15-minute city' framework could work in medium-sized towns, and stresses the need for multi-scalar governance, social equity, and inclusive planning strategies to achieve human-centred urban environments.

1. Introduction

Urban planning has increasingly moved from traditional car-oriented development models towards more sustainable, inclusive, and human-centred approaches (Pozoukidou and Chatziyiannaki, 2021). Among the most significant frameworks emerging from this transition is the '15-minute city,' which promotes an urban environment where essential services (healthcare, education, employment, leisure, and retail) are reachable within a 15-minute walk or bicycle ride from home (Moreno et al., 2021). This paradigm handles urban challenges, including traffic congestion, air pollution, spatial inequality, and the erosion of personal time, often described as 'time poverty' (Tiznado Aitken et al., 2024), and through the strengthening of local living, it aims to reduce the dependence on private vehicles and lower greenhouse gas emissions (Giuffrida et al., 2024). Moreover, the promotion of mixed-use urban development enables the '15-minute city' to improve liveability and ensure equitable access to services for all citizens (Logan et al., 2022).

Complementing this spatial perspective, *chrono-urbanism* introduces a temporal dimension to urban planning: it focuses on how time is used inside the city, aiming to minimise temporal mismatches between people's needs and the availability of the urban services (Liu et al., 2024). Synchronising residents' daily routines with service operating hours and commuting patterns is the main challenge of chrono-urbanism (Willberg et al., 2023), which aims to eliminate temporal inequality and improve urban efficiency and quality of life.

Chrono-urbanism and '15-minute city' paradigm share the goal of creating more equitable and efficient cities that respond to global challenges such as climate change and social fragmentation (Rojas-Rueda et al., 2024). Together, they promote a holistic rethinking of spatial and temporal urban dynamics, challenging paradigms that prioritised vehicular mobility and economic productivity over ecological sustainability and citizen well-being (Khavarian-Garmsir et al., 2023).

While the '15-minute city' has been discussed for large metropolitan

* Corresponding author.
E-mail addresses: manuel.garramone@polimi.it (M. Garramone), marco.scaioni@polimi.it (M. Scaioni).
1 [0000–0003–3170–2411]
2 [0000–0003–4058–6176]

https://doi.org/10.1016/j.rspp.2026.100283
Received 26 June 2025; Received in revised form 20 January 2026; Accepted 21 January 2026
Available online 22 January 2026

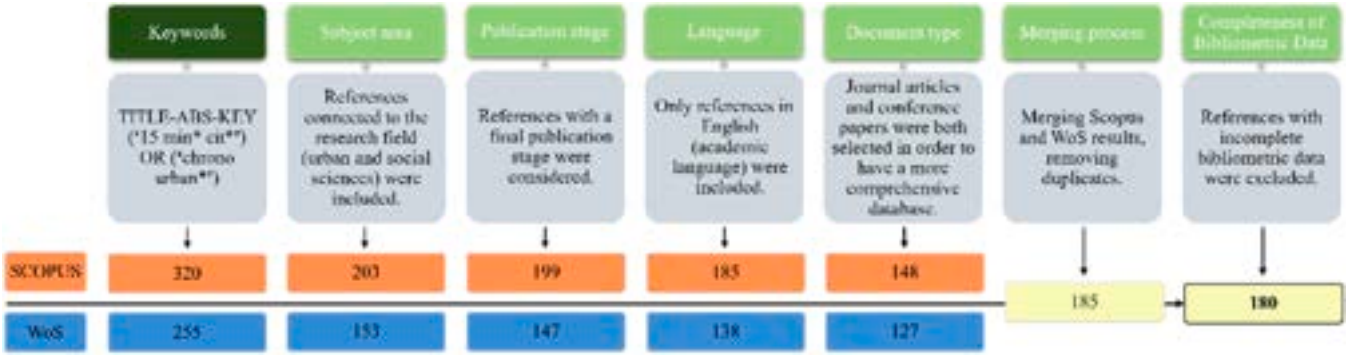


Fig. 1. Research process for the literature overview. The research was conducted at the end of December 2024. The early months of 2025 were excluded to avoid misrepresenting the annual growth rate.

areas (Allam et al., 2024), limited attention has been paid to how its principles can be used in small and medium-sized cities (Elldér, 2025). This study, applying the '15-minute city' and chrono-urbanism frameworks to Desio (a mid-sized town in the Milan metropolitan area, Italy), addresses this gap. The demonstration of how proximity-based urban models can support planning in commuter-oriented contexts is the novelty of this research: the integration of georeferenced demographic data and network analysis provides new evidence on spatial and age-related inequalities in access to essential urban services. Finally, it extends the discussion on spatial justice and temporal equity from global metropolitan areas to medium-sized urban settings that are increasingly central to the regional sustainability.

The paper is structured as follows. Section 2 shows a bibliometric analysis of the main topic. Section 3 describes the case study. Section 4 presents the main findings, followed by Section 5, which concludes the paper, highlighting limitations and future work.

2. Bibliometric analysis

A comprehensive literature overview was conducted to analyse scientific publications related to the '15-minute city' and chrono-urbanism concepts. This analysis provides valuable insights into the evolution and dynamics of this specific knowledge domain, enabling the identification of prevailing research trends, existing gaps, and potential directions for future studies.

2.1. Method

As a first step, specific keywords related to the research topic were used to query Scopus and Web of Science (WoS) databases. Fig. 1 shows the research process, starting from the search code to the filtering phases (by subject area, publication stage, language and document type). This results in 148 (Scopus) and 127 (WoS) references. The samples were then merged using RStudio (Bhat et al., 2023), and duplicates were removed. At the end, references with incomplete bibliometric data were excluded, giving a final number of 180 documents. The bibliometric analysis was carried out using the web-based data analysis framework Biblioshiny for Bibliometrix (Aria and Cuccurullo, 2017).

2.2. Results

The final selection of 180 documents was published by 535 authors; 8.89 % (#16) of those publications were single-authored. The authors provided a total of 611 keywords, while the keywords 'Plus' (words and phrases that appear in an article's references but not in the article itself) were 484.

The publication timespan (2015–2024) highlights that the research topic is analysed over a few years. The annual production shows a consistently growing trend in the last four years, with a significant increase in the number of publications from 2021 and a peak in 2024, when 74 references were published. The annual growth rate of 61.32 % confirms the growing interest in this topic.

Besides the temporal trend, the spatial trend reveals the geographic locations where the topic is more developed, based on the authors' affiliations: France received 651 citations, followed by Italy (#593) and Greece (#273). The most-cited papers originate from the European countries, where the city's structure, history, and population distribution resulted in the development of alternative urban strategies (Teixeira et al., 2024).

Table 1
Ten most popular Authors' keywords and keywords plus.

Authors' keywords	Occurrences	Keyword Plus	Occurrences
15-minute city	135	Accessibility	29
Accessibility	35	City	24
Walkability	33	Walkability	21
Urban Planning	31	15-minute city	18
Proximity	22	Transport	15
GIS	19	Land-use	13
Sustainability	17	Mobility	13
Covid-19	12	Travel	13
Chrono-Urbanism	11	Urban Planning	13
Sustainable Mobility	11	Proximity	12

2.2.1. Words analysis

Text mining, the process of obtaining meaningful information, patterns, or knowledge from textual data (Shamshiri et al., 2024), transforms text into structured data. Table 1 lists the ten most popular keywords, either decided by the authors or established by the Bibliometrix algorithm. Before starting with the analysis, similar keywords have been reviewed and aggregated to improve the method (e.g., '15-minute city' matches '15-min city', '15-minute cities', '15 min cities', etc.).

These keywords provide a comprehensive understanding of the reference content and broader trends within the specific study field. Since the primary keyword in the search query was '15-minute city', it ranks at the top among the authors' keywords, followed by 'accessibility' and 'walkability'; 'sustainability', 'proximity', and 'sustainable mobility' indicate significant focus on these themes in the 'urban planning' and 'GIS' fields. A special mention must be made of 'Covid-19', which has been a source of significant reflection about the distribution of the population and urban management and policies. This is strongly supported by the keywords 'Plus', where 'accessibility' appears first alongside the previously mentioned keywords, highlighting the importance of the human dimension.

To complete the keywords analysis, a co-occurrence network was implemented to highlight connections and elements of the '15-minute city' concept.

Fig. 2. Keywords co-occurrence network (conceptual network), setting the minimum number of edges at two.

The network was generated by conducting density-based spatial clustering using the full counting method (Kriegel et al., 2011), resulting in four clusters (see Fig. 2). The term '15-minute city' appears as the most prominent element, indicating its role as the primary concept. Various related terms radiate from the central node, with different sizes and colours, reflecting their frequency and association strength. The clusters are:

- red: represents key aspects of 'urban mobility', 'accessibility', 'sustainability', and 'spatial planning' (e.g., walkability, public space, urban planning). The high number of connections suggests that mobility and accessibility are central to the '15-minute city' model;
- green: is associated with sustainable urban development and chrono-urbanism (e.g., sustainable development, composite index, chrono-urbanism). The presence of '20-minute city' in this cluster suggests that the '15-minute city' is part of a broader trend in chrono-urbanism, where cities are planned around efficient time-use;
- blue: is related to travel behaviour and time-based urban models (e.g., travel behaviour, travel time, '30-minute city'). The connections indicate that the '15-minute city' is analysed in relation to commuting patterns, transport policies, and behavioural aspects of urban living; and
- purple: is focused on urban configuration, spatial analysis, and post-pandemic city planning (e.g., place syntax, space syntax, configuration). The links to urban form and configuration suggest a focus on how physical space may influence accessibility and liveability in a post-pandemic urban landscape.

Beyond the quantitative trends identified through bibliometric clustering, the conceptual and policy understanding of the '15-minute city' framework (Hunter, 2021) was deepened by recent research.

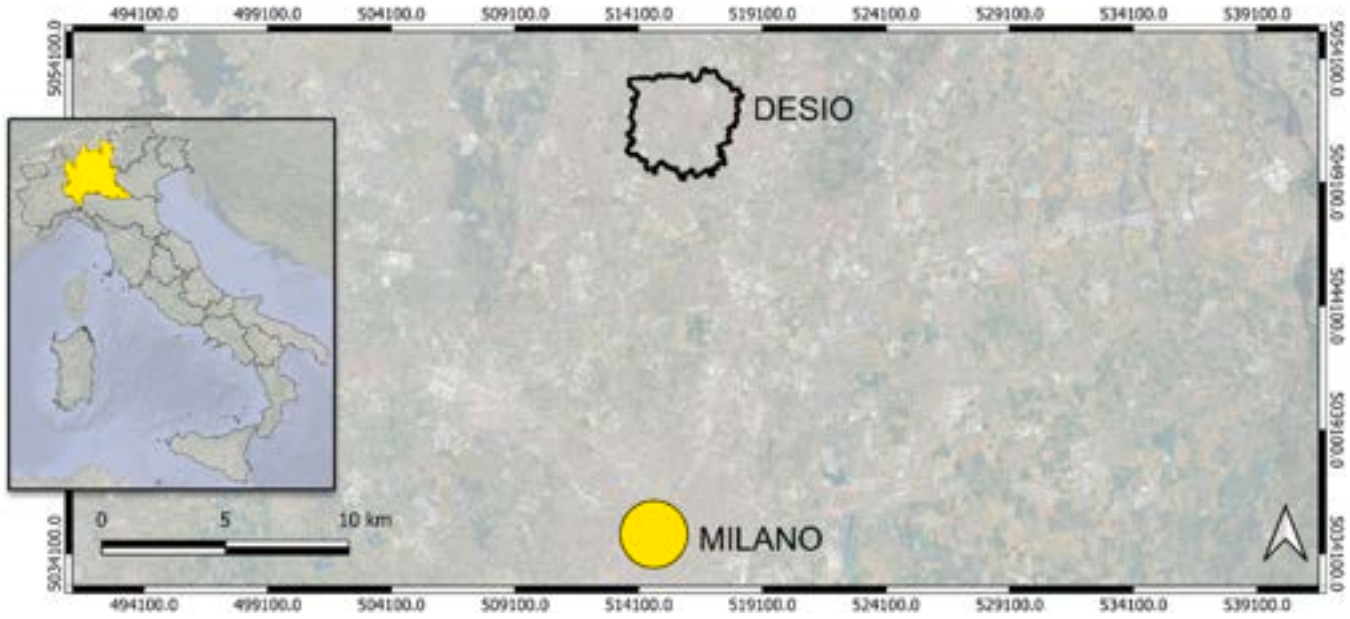


Fig. 3. Location of the study area (Desio municipality), with respect to the capital of Lombardy, Milan. On the left, the position of the Italian region of Lombardy (background map from Google Maps®).

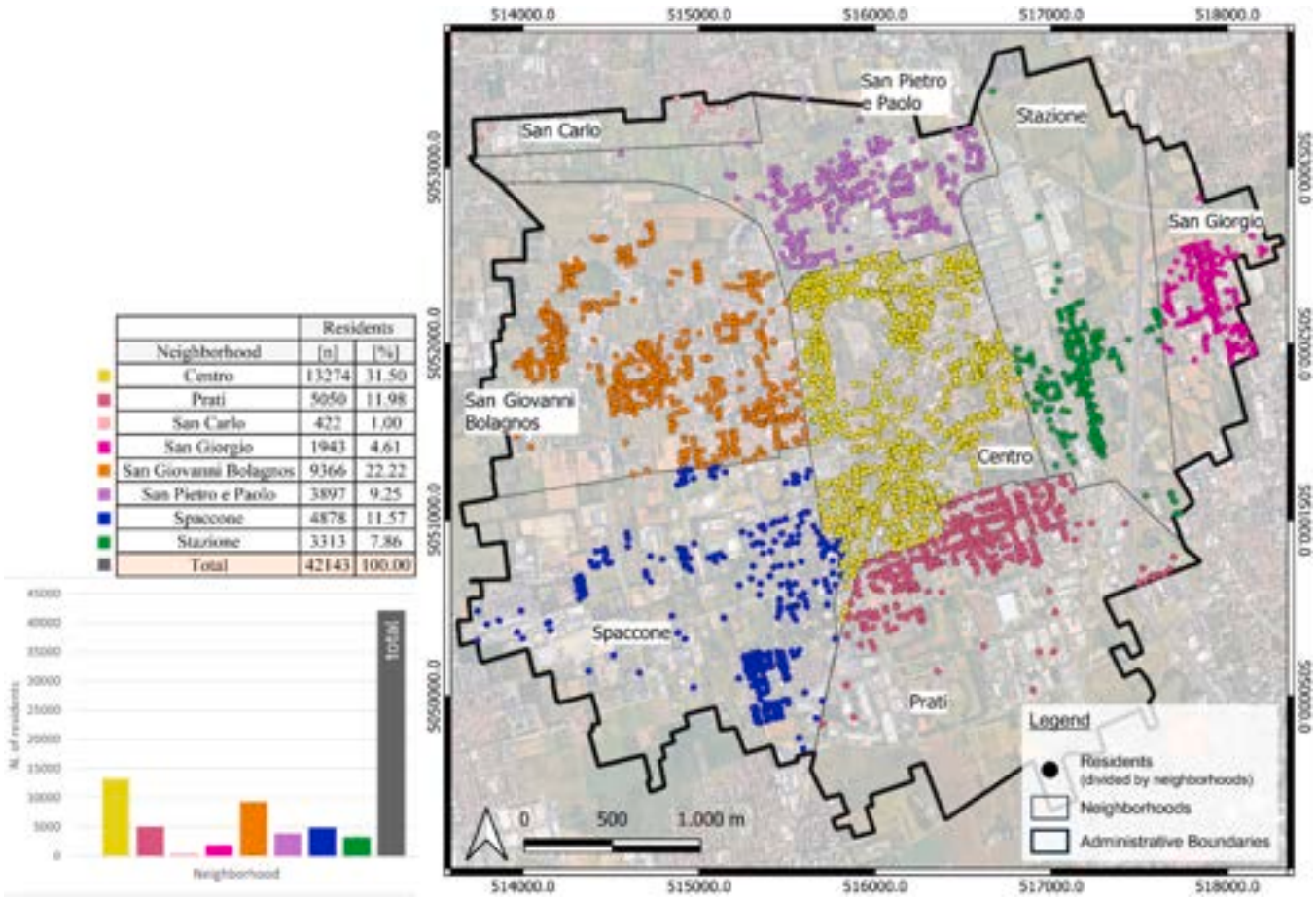


Fig. 4. Distribution of the resident population in the town of Desio. (CRS: EPSG 7791 – RDN2008 / UTM zone 32 N - background map from Google Maps®).

Following the COVID-19 pandemic, the discussion has focused on how proximity-based urban models can enhance resilience and inclusivity in both metropolitan and non-metropolitan contexts (Afrin et al., 2021). The pandemic resulted as a catalyst for rethinking the relationship between urban form, accessibility, and temporal equity (Jang and Park, 2025).

This evolving discussion has shifted attention from morphological and transport-oriented approaches towards a broader focus on spatial justice and neighbourhood-scale well-being (Rao et al., 2024). This transformed the idea of the '15-minute city' from a static design model into a dynamic chrono-urban framework that balances accessibility and daily habits to create equitable opportunities for all citizens (Nijkamp et al., 2024): its implementation needs sensitivity to the socio-economic diversity of urban populations, including residents of peripheral or commuter towns (Mercier et al., 2021; Oh et al., 2024).

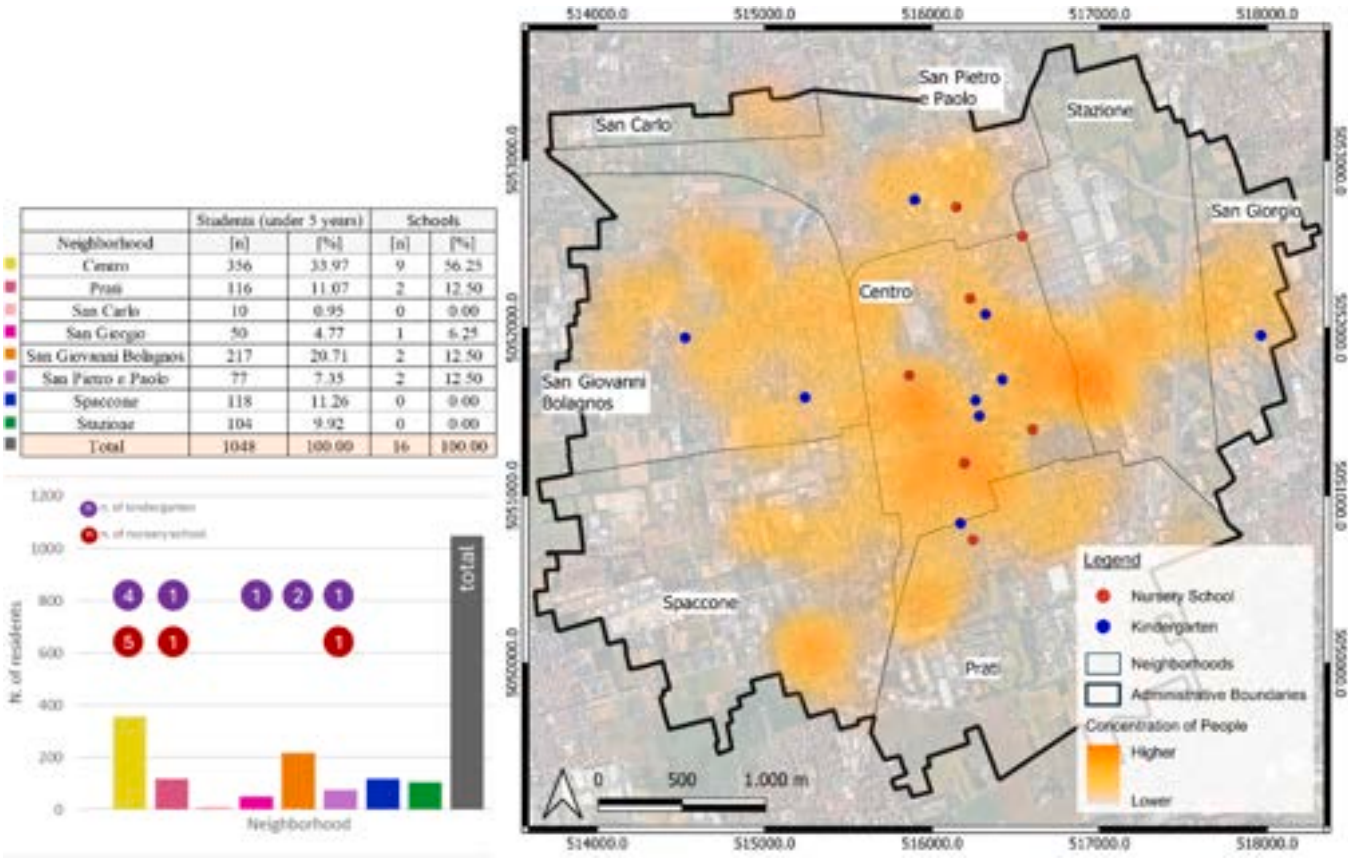
Moreover, risks and opportunities of applying the '15-minute city' model across urban scales, especially in transport investment and integrated planning strategies, are highlighted (Lowe et al., 2022). While big cities experiment with decentralisation, medium-sized cities face distinct challenges in service provision and regional connectivity. Recent studies argue for a multi-scalar interpretation of the concept, combining neighbourhood-level accessibility with metropolitan governance frameworks (Alotaibi et al., 2025): multi-level governance and spatial equity are essential for embedding proximity-based urban models into regional development strategies (Nijkamp et al., 2025). These perspectives underscore the growing convergence between urban design and regional science, leading to policies that address both social inclusion and infrastructure evolution, aligned to demographic change (Gaxiola-Beltrán et al., 2021).

Building on these insights, the present study examines how the '15-minute city' paradigm can be adapted to a medium-sized municipality inside a metropolitan region, where the combination of local accessibility and regional mobility is strong.

3. The case study

The empirical analysis operationalises the '15-minute city' framework by measuring neighbourhood-level walkable accessibility to key services and public transport, highlighting spatial mismatches relevant for equity-oriented planning. To better understand how proximity-based principles may be applied in real-world settings, the town of Desio was tested. The municipality of Desio, covering approx. 14 km^2 and hosting nearly 40,000 inhabitants, is located in the northern part of the Milan metropolitan area, inside the Lombardy Region, Italy (see Fig. 3). It is a medium-sized city with an urban structure composed of a historical centre and peripheral neighbourhoods characterised by a mix of residential and industrial uses. The proximity to Milan (about 20 km away) creates daily commuting flows, as many residents travel for work, education, or leisure: these dynamics make Desio an appropriate context for testing the '15-minute city' concept in a commuter-oriented setting.

The workflow for data collection and preprocessing follows the methodology detailed in a previous work (Garramone and Scaioni, 2025). That study described the integration of municipal databases, building footprint and infrastructure data, and urban service location records into a geospatial network model using the open-source desktop GIS software QGIS version 3.34 (QGIS Association, 2024). This article focuses on the analytical results derived from that framework and their implications for accessibility, equity, and spatial planning.



	Students (under 5 years)		Schools	
Neighborhood	[n]	[%]	[n]	[%]
Centro	356	33.97	9	56.25
Prati	116	11.07	2	12.50
San Carlo	10	0.95	0	0.00
San Giorgio	50	4.77	1	6.25
San Giovanni Bolagnos	217	20.71	2	12.50
San Pietro e Paolo	77	7.35	2	12.50
Spaccone	118	11.26	0	0.00
Stazione	104	9.92	0	0.00
Total	1048	100.00	16	100.00

Fig. 5. Number of the resident population (under-5 years) in relation to nursery schools and kindergarten. (CRS: EPSG 7791 – RDN2008 / UTM zone 32 N - background map from Google Maps®).

3.1. Quantitative data and demographic characteristics of the population

3.1.1. Data

Population analysis provides an essential overview for understanding the composition and structure of a society. The initial data, some of which required preliminary processing, were sourced and organised as follows:

- population extraction from the Municipal Registry: the primary data source was the population register (Municipality of Desio, 2024), which was queried on June 30, 2023. This dataset included demographic information such as the date of birth and residential address of each individual (anonymised), specified by street name and house identifier;
- georeferenced mapping of house identifiers: to achieve spatial precision in the analysis, house numbers were georeferenced and stored in a SHP file (Shapefile format) that contained point elements representing each address. This step allowed for the accurate spatial mapping of the population, facilitating analyses related to population density, spatial distribution, and proximity to various public services and infrastructures; and
- age group classification based on ISTAT (ISTAT, 2024b) criteria: the population was categorised into age groups, covering from early childhood (up to 5 years) to the elderly population (over 75 years), according to the classification used by ISTAT (Italian National Institute of Statistics) for its official demographic analyses (ISTAT, 2024a). These categories allow targeted analyses and provide insights into specific age groups.

3.1.2. Methodology

Each resident was georeferenced based on their home address, using the Municipal Registry data and house numbers. This process required manual intervention to complete the mapping of house numbers: about 25 % of the population was not associated with a geographic location, due to the lack of mapping for some house numbers, the non-uniqueness of street names, and the incompleteness of the street directory. In order to georeference the entire population, preliminary steps were taken to solve these issues. In particular, a point was inserted to represent missing house numbers, located at a central position relative to the street's geometry. This solution allowed for mapping the entire population, except for ten people, some of whom were classified as homeless (see Fig. 4).

The results indicate that 'Centro' and 'San Giovanni Bolagnos' are the most populated neighbourhoods in Desio town, followed by 'Prati' and 'Spaccone.' Each of the other four neighbourhoods ('San Carlo,' 'San Giorgio,' 'San Pietro e Paolo,' and 'Stazione') have a population of less than 10 % of the total inhabitants of the town.

Thanks to this georeferencing process, population density maps were created based on current and projected age groups over the next 10 years. Two different population categories were analysed:

- the spatial distribution of three young-people groups (under-5 years, in the age 5–9, and 10–14) to evaluate the alignment between population density and the location of corresponding educational facilities; and
- the spatial distribution of the elderly population (over 75 years, existing and projected over the next 10 years) and the location of some useful facilities (categorised as services, free-time and health).

This approach allows for comparing the spatial needs of age groups at the opposite ends of the demographic spectrum, providing insights for age-inclusive urban policy design. The spatial configuration of basic urban services mainly affects these groups, whose mobility is limited to

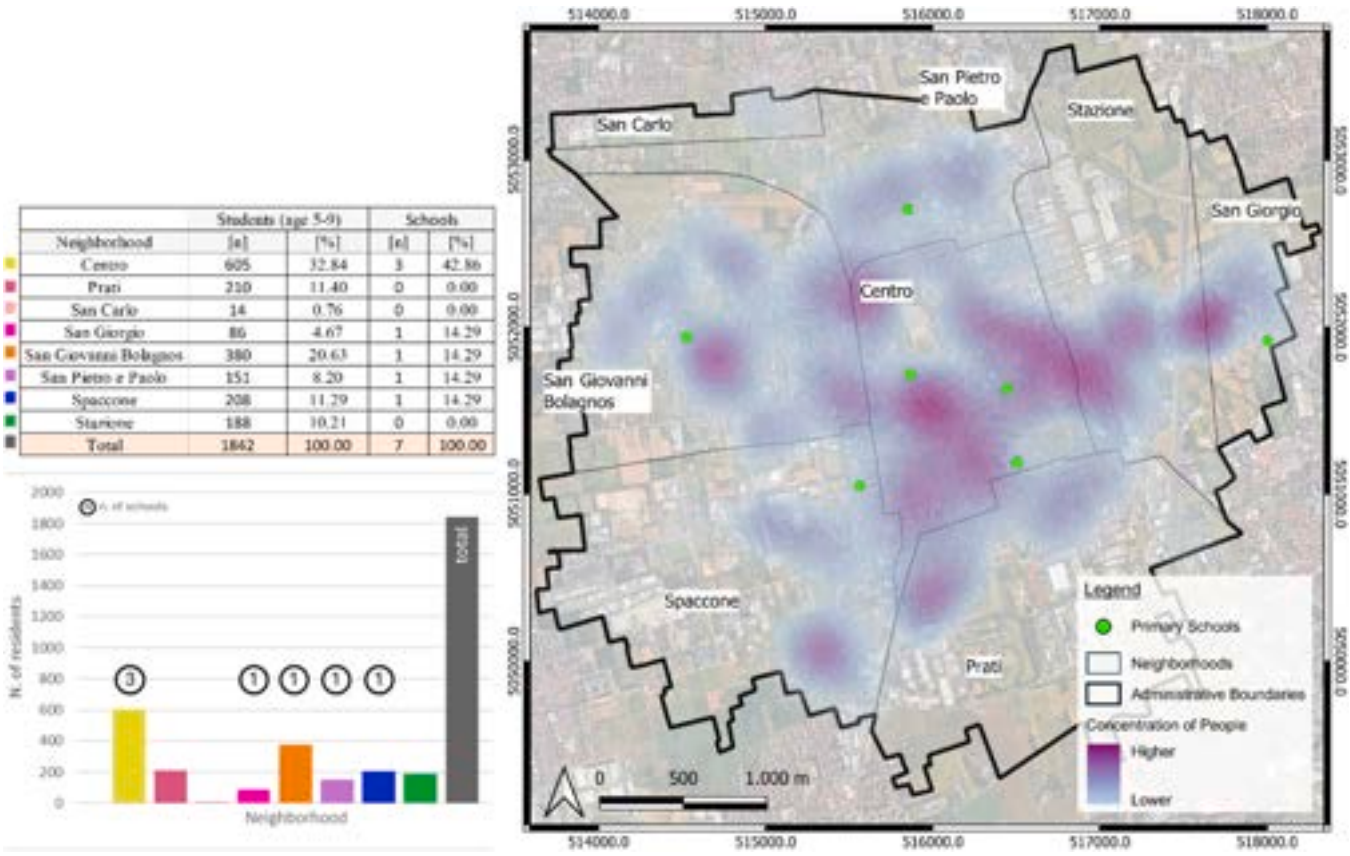


Fig. 6. Number of the resident population (age 5 – 9) in relation to the primary schools. (CRS: EPSG 7791 – RDN2008 / UTM zone 32 N - (background map from Google Maps®).

the local scale; other population segments (employed adults and university students), instead, tend to accomplish daily activities outside the municipal boundaries, commuting to larger urban centres.

3.1.3. *Analysis of young-people distribution*

Fig. 5 shows the heatmap and the distribution of the resident population (under-5 years) and related services (nursery schools and kindergartens). This map allows to evaluate the spatial distribution of early-childhood educational services in relation to the density of young children: darker orange areas indicate higher concentrations of under-5 years of age population, while lighter yellow areas indicate lower concentrations; red and blue dots represent nursery schools and kindergartens. The analysis indicates 1048 children under-5 years of age residing across eight neighbourhoods, served by 16 early-childhood educational facilities, resulting in an average of 66 students per school.

The neighbourhood of 'Centro' accounts for the highest proportion of the under-5 population (about 34 %) and hosts the largest educational facilities (n = 9, about 56 %). 'San Giovanni Bolagnos' follows, with about 21 % of the under-5 population and two schools. Other neighbourhoods, such as 'Prati' and 'San Pietro e Paolo', host two facilities each despite having smaller populations, while 'San Giorgio' neighbourhood has minimal under-5 population but includes one kindergarten.

The remaining three neighbourhoods have neither nursery schools nor kindergartens. The results suggest a partial but inconsistent alignment between the spatial distribution of the early-childhood services and the actual demographic demand.

While 'Centro' and 'San Giovanni Bolagnos' neighbourhoods exhibit relatively proportional service provision, others such as 'Spaccone' and 'Stazione' appear underserved relative to their under-5 year population. Conversely, 'San Giorgio' neighbourhood hosts a kindergarten despite its small number of residents in the target age group, indicating possible inefficiencies in the allocation of resources.

Fig. 6 shows the spatial distribution of primary schools (green dots - 7 facilities) and a heatmap representing the residential concentration of children aged 5–9 years (darker purple areas indicate higher concentrations, while lighter purple areas indicate lower concentrations). The east-west axis (including 'Centro', 'San Giovanni Bolagnos', and 'Stazione' neighbourhoods) contains the maximum density of this age group: although primary schools are generally well distributed, with at least one facility located in or near most residential clusters, some dense areas in the southern part ('Spaccone' and 'Prati' neighbourhoods) appear underserved.

Compared to the early childhood education services, the spatial alignment between primary schools and the 5–9 age population seems more balanced (7 secondary schools and a citywide average of 263 students per school). However, the local ratios vary greatly: the central area remains the best served (3 secondary schools, with an average ratio of 201 students), while the peripheral neighbourhoods show higher concentrations of children with fewer nearby school facilities (e.g., 'San Giovanni Bolagnos' has one secondary school and a ratio of 308 students) and about 22 % of the total students of this age-group live in a neighbourhood without a primary school. This spatial mismatch could lead to increased student travel distances and potential overcrowding in centrally located schools.

The last analysis about students considers the heatmap of the 10–14 age population and related services (secondary schools), with a red gradient indicating areas of higher population density, see Fig. 7.

The population distribution is concentrated in the central and southern parts of the municipality, and the four existing secondary schools are spread along its central axis. However, peripheral neighbourhoods such as 'San Carlo', 'San Giorgio', and 'Prati' lack a school,

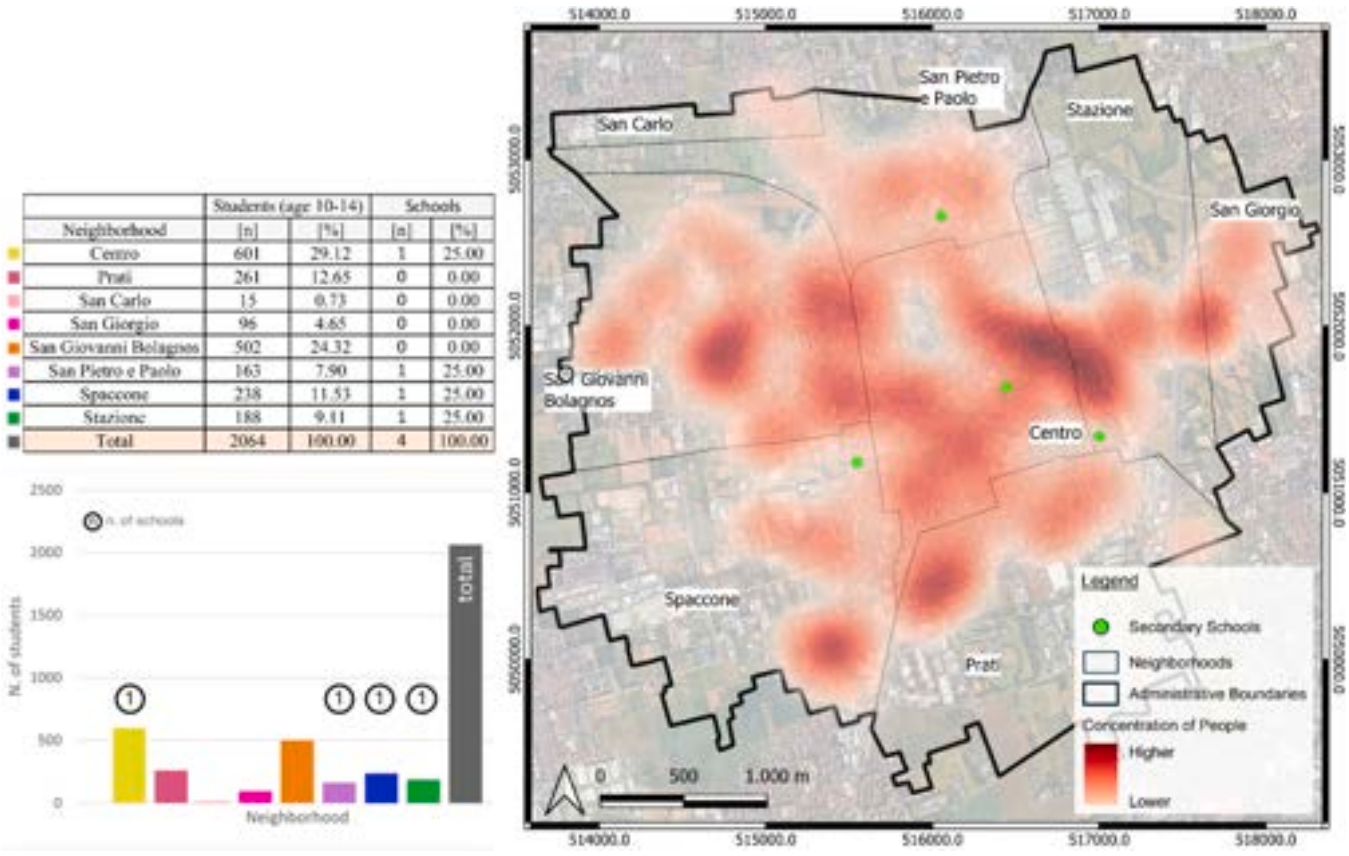


Fig. 7. Number of the resident population (age 10 – 14) in relation to the first-grade secondary schools. (CRS: EPSG 7791 – RDN2008 / UTM zone 32 N - (background map from Google Maps®).

despite they host a non-negligible number of students.

Only four of eight neighbourhoods are covered by secondary schools: 'Centro' alone accounts for a third of the total student population (about 29 %) and it hosts only one secondary school; 'San Giovanni Bolagnos' ranks second in student numbers (about 24 %), yet it lacks any local secondary school facilities; 'Spaccone' (about 11 %), 'Stazione' (about 9 %), and 'San Pietro e Paolo' (about 8 %) show a modest student presence and they are served by a single school each. About 42 % of total students live in a neighbourhood without a secondary school, located in 'Prati', 'San Carlo', 'San Giorgio', and 'San Giovanni Bolagnos'. The central location of schools may reflect a strategy to optimise the accessibility for the majority, but it risks missing the needs of the edge communities.

The three spatial distributions indicate a critical imbalance between demographic needs and the spatial allocation of the educational services: while early-childhood education (under-5 years) appears moderately well-distributed, the decrease in the available schools for older age groups (age 5–9 and 10–14) raises: the constant under-servicing of neighbourhoods as 'San Giovanni Bolagnos' and 'Prati' across multiple age groups suggests a systemic oversight in educational planning. Conversely, 'Centro' neighbourhood shows the maximum number of students and schools in all three age groups.

3.1.4. *Analysis of elderly distribution*

In parallel, the other side of the demographic spectrum was analysed, considering the elderly population (over 75 years, existing and projected over the next 10 years) and the location of some useful facilities. Facilities were categorised as follows: (i) services (e.g., police station, city hall, post offices, etc.), (ii) free time (e.g., community centres, civic hall, etc.), and (iii) health (e.g., hospitals, pharmacies, etc.).

Fig. 8 illustrates the spatial distribution of the over-75 population in relation to key urban services, including healthcare (blue), general services (red), and recreational or free-time facilities (yellow).

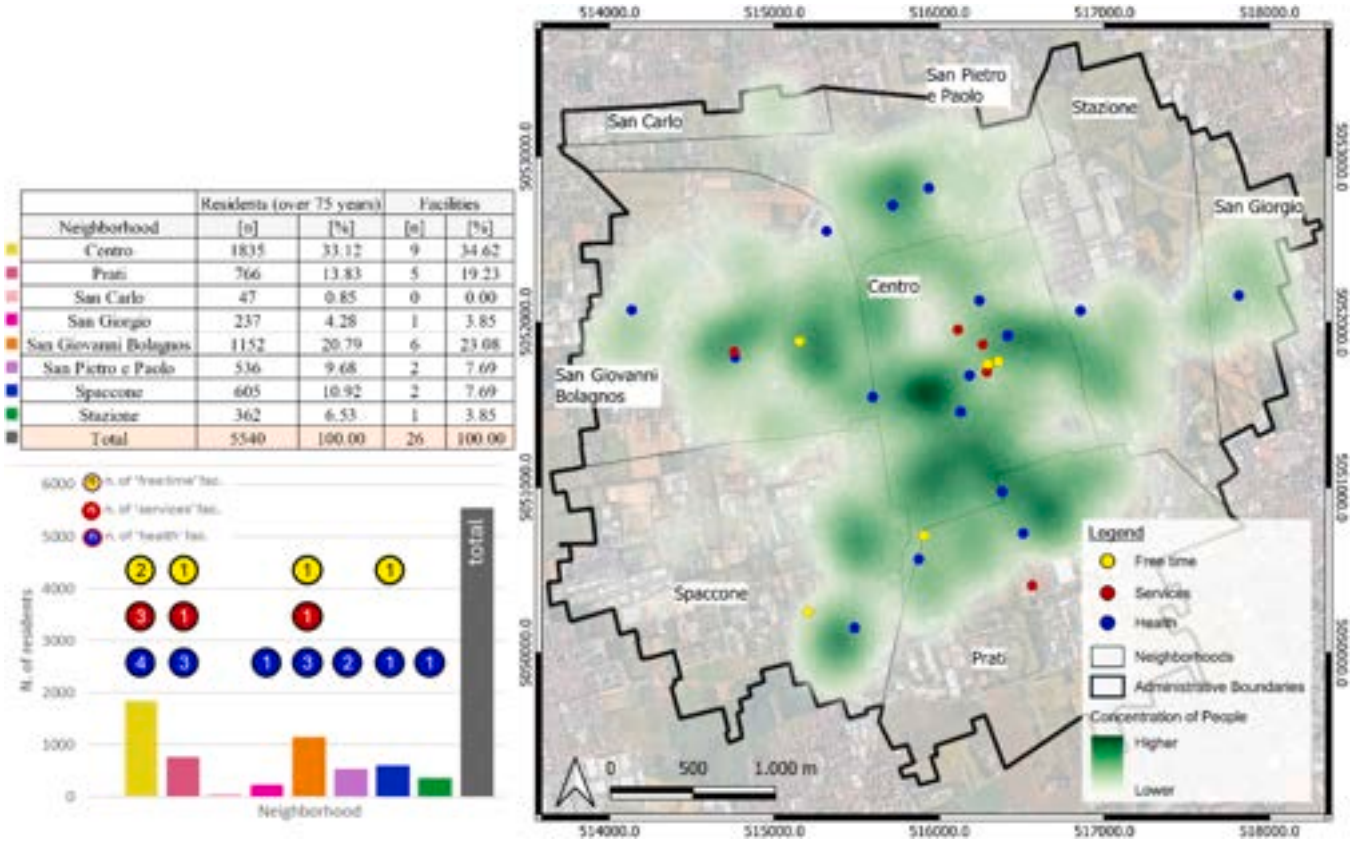
The central zone shows a strong co-location between this age-group population and the availability of services, particularly healthcare and social infrastructure. Peripheral neighbourhoods such as 'San Carlo', 'Stazione', and 'San Giorgio', display relatively-high concentrations of elderly residents, but they are underserved in terms of proximity to the essential services. A critical issue for urban accessibility and ageing in place may arise from this spatial discrepancy, as older residents in these areas may face increased physical barriers to daily activities and community participation. The remaining neighbourhoods are between these extremes.

3.1.5. *Analysis of elderly distribution in ten-year projection*

Eventually, a ten-year projection of the over-75 population has been undertaken to anticipate the future service demands and to inform long-term urban planning. The ten-year projection was developed by identifying individuals aged 65 and over, assuming that most of this cohort will transition into the over-75 age group within the next decade. This prospective analysis allows for the identification of emerging demographic pressures and spatial shifts in ageing patterns across neighbourhoods.

The ten-year projection of the over-75 population reveals some spatial redistribution of ageing, with a pronounced increase in population density across several peripheral neighbourhoods (see Fig. 9). The interpolated density surface highlights emerging hotspots in 'San Giovanni Bolagnos' and 'Spaccone,' neighbourhoods that are currently underserved in terms of essential services.

In contrast, while the 'Centro' neighbourhood remains a key-concentration node, its relative prominence diminishes in the projected scenario. In particular, almost all the peripheral neighbourhoods



	Residents (over 75 years)		Facilities	
Neighborhood	[n]	[%]	[n]	[%]
Centro	1835	33.12	9	34.62
Prati	766	13.83	5	19.23
San Carlo	47	0.85	0	0.00
San Giorgio	237	4.28	1	3.85
San Giovanni Bolagnos	1152	20.79	6	23.08
San Pietro e Paolo	536	9.68	2	7.69
Spaccone	605	10.92	2	7.69
Stazione	362	6.53	1	3.85
Total	5540	100.00	26	100.00

Fig. 8. Number of the resident population (over 75 years) in relation to basic urban services. (CRS: EPSG 7791 – RDN2008 / UTM zone 32 N - (background map from Google Maps®).

present a predominance of health-related infrastructure over recreational or general services.

Analysing the current and ten-year projected distribution of the over-75 population, there is an overall decline from 5540 to 4722 elderly residents (14.8 % decrease). This reduction is not uniform across neighbourhoods: 'Centro' (about −7 %) and 'Prati' (about −4 %) show the largest decrease, while the remaining districts show a lower value (minor or slightly greater than −1 %). Despite these changes, the number of available services remains insufficient, suggesting that peripheral neighbourhoods may require greater attention in planning basic urban services.

3.2. Network analysis

Starting from the previously explained georeferencing of residents, the '15-minute city' concept was applied to evaluate the accessibility of services located within a 15-minute walking distance. This temporal proximity is particularly relevant in the context of ageing populations, for whom walkable access to basic services is critical in maintaining independence and social inclusion (Lin and Cui, 2021). This study adopted a 1-km buffer as a proxy for a 15-minute walking radius based on the commonly used estimate of an average walking speed of 4 km/h (Duffy and Crawford, 2013). This distance reflects a level of physical effort generally feasible across a broad spectrum of age groups and is frequently employed in urban mobility and accessibility studies (Marquet et al., 2025). The road network was derived from the regional geospatial database, which can be retrieved from the Geoportal of Lombardia Region (Regione Lombardia, 2025). Near the residents' georeferencing, the municipal road network, which spans a total length of 160.3 km, was intersected to carry out the analysis. However, in order to represent walkable routes more realistically, the statal road 'SS36' (commonly referred to as 'Valassina') - a high-speed arterial corridor that crosses the eastern part of the municipality - was excluded from the analysis. This refinement reduced the effective walkable network to 143.9 km, thus providing a more accurate foundation for evaluating service accessibility in everyday urban conditions. In particular, public transport nodes (Metrotranvia, railway station, and bus stops) were selected for this analysis.

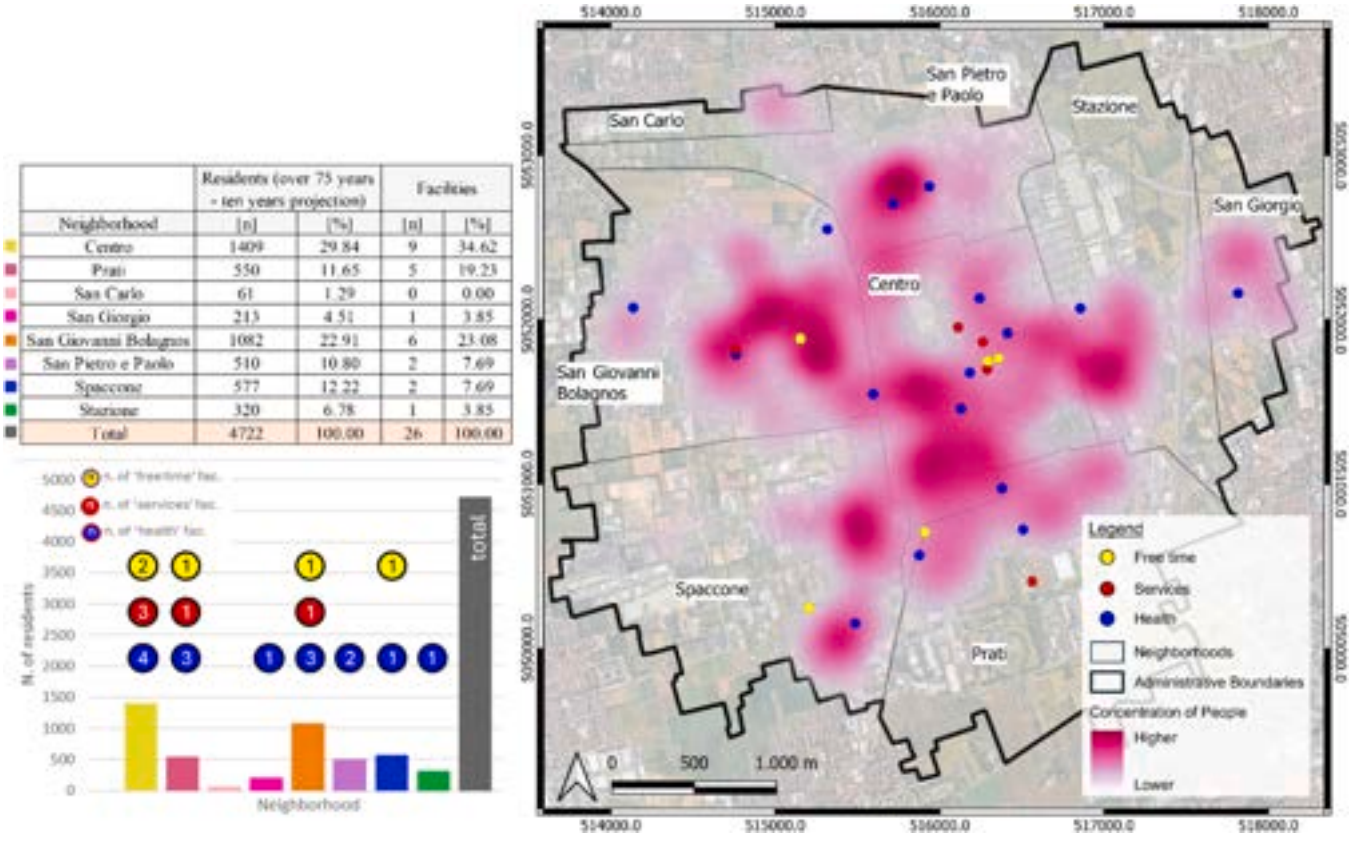
3.2.1. Metrotranvia

Metrotranvia is a light-rail system, currently under construction, with a total length of 14.3 km that will connect the northern periphery of the Milan metropolitan area to Seregno via Desio. The planned alignment retraces the historic route of the former Milan – Carate/Giussano tramway, which operated until 2011. The project of reusing this historical axis in a contemporary form has the aim to address current deficiencies in public transportation provision, mitigate car traffic congestion, and encourage a modal shift. Considering the location of the Metrotranvia and its seven stations inside the Desio municipality, the number of people located within a 15-minute walking distance was analysed (see Fig. 10).

The area of influence covers 53.7 % of the street network and 65.3 % of the total population: those living along the north-south axis benefit more from the Metrotranvia's location, while the outer areas are at a disadvantage due to greater distances.

The accessibility analysis shows marked disparities among neighbourhoods: 'Spaccone' and 'Centro' neighbourhoods have the highest accessibility (94.3 % and 82.0 %); similarly, 'San Pietro e Paolo' and 'San Giovanni Bolagnos' achieve relatively high coverage, exceeding 67 %; in contrast, 'San Giorgio' and 'Stazione' are completely unserved; 'San Carlo' has a very low accessibility rate (3.1 %), despite having a small population.

Due to the Desio commuter-oriented nature, detailed origin-destination (OD) results describing inter-municipal commuting



Neighborhood	Residents (over 75 years - ten years projection) [n]	[%]	Facilities [n]	[%]
Centro	1409	29.84	9	34.62
Prati	550	11.65	5	19.23
San Carlo	61	1.29	0	0.00
San Giorgio	213	4.51	1	3.85
San Giovanni Bolagnos	1082	22.91	6	23.08
San Pietro e Paolo	510	10.80	2	7.69
Spaccone	577	12.22	2	7.69
Stazione	320	6.78	1	3.85
Total	4722	100.00	26	100.00

Fig. 9. Number of the resident population (over 75 years – ten-year projection) in relation to basic urban services. (CRS: EPSG 7791 – RDN2008 / UTM zone 32 N - (background map from Google Maps®).

patterns are reported in Appendix A, as they provide additional context for interpreting proximity-based accessibility.

3.2.2. *Railway station*

Desio railway station is situated on the Milan – Chiasso railway main line and lies in the 'Stazione' neighbourhood, in the eastern part of the municipality (see Fig. 11). It has four platforms: two main lines (one is reserved for trains to Milan, the other for transit and stopping of trains to Saronno or Chiasso) and two passing tracks (primarily used for shunting operations and managing traffic priorities).

The railway station is served by lines S9 (Saronno – Milan – Albairate) and S11 (Chiasso – Milan Porta Garibaldi) of the Milan Suburban Railway Service, running approximately every 15 min. The analysis of the population's spatial proximity to Desio railway station highlights a significant accessibility gap across the municipality: only 20.3 % of the total population lives within a 15-minute walking distance from the station, and they are concentrated in the 'Centro' (10.1 %) and 'Stazione' (7.7 %) neighbourhoods. Peripheral areas such as 'San Carlo,' 'San Pietro e Paolo,' 'Spaccone', and 'San Giovanni Bolagnos' neighbourhoods remain almost completely excluded from effective pedestrian access despite containing substantial amounts of the overall population. Although the railway line provides quick connections to Milan and other major urban centres, its location may restrict its usefulness to a limited segment of the population.

3.2.3. *Bus lines*

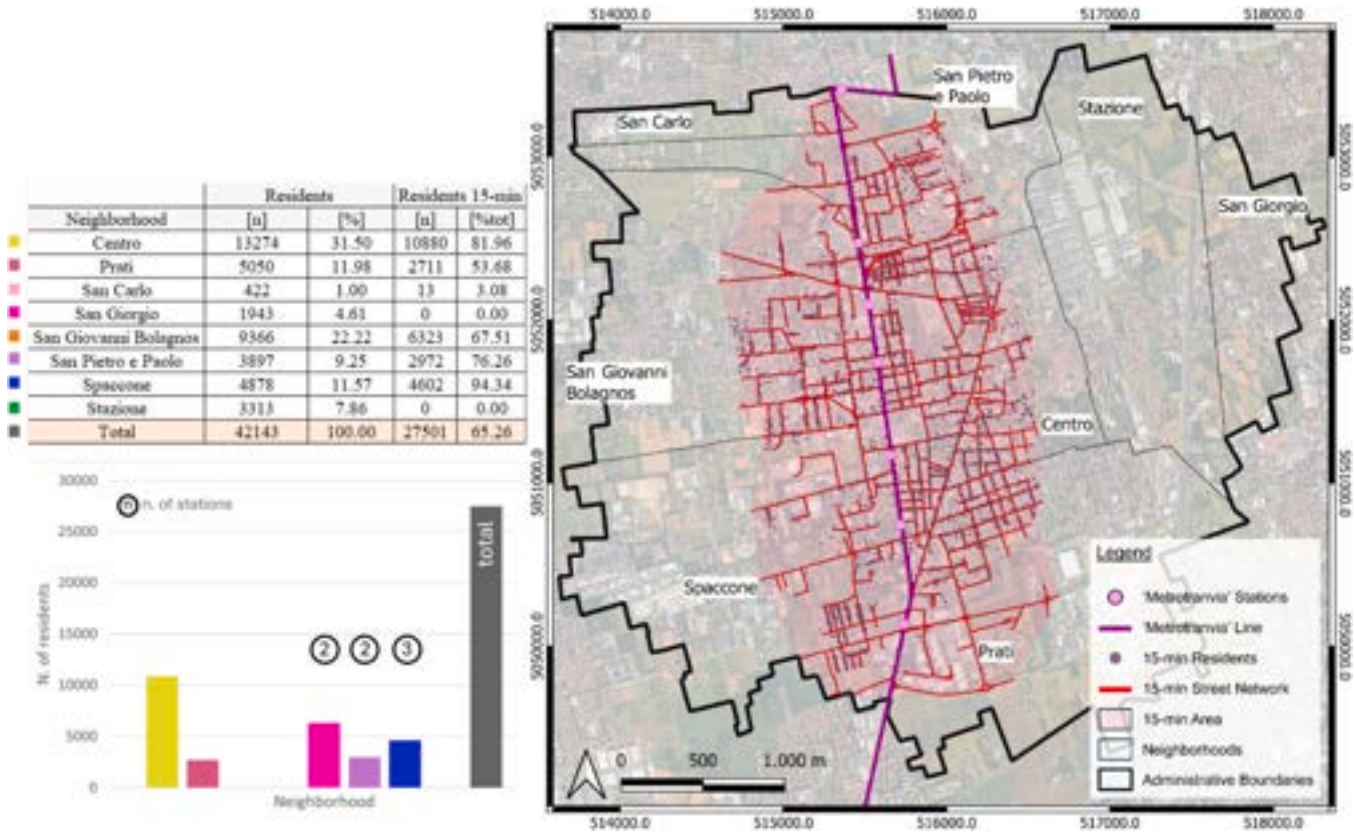
Desio town is served by ten different bus lines, as listed below:

- Z111: Saronno FN – Solaro – Limbiate – Varedo FN – Bovisio – Desio;
- Z209: Monza (FS) – Muggiò - Desio – Bovisio M. – Cesano M. (FNM);
- Z231: Carate B. – Giussano (Robbiano) – Seregno – Desio;
- Z232: Desio – Seregno – Carate B. – Renate/Besana B. (FS);
- Z242: Desio – Seregno – Carate B. – Renate;
- Z250: Desio (FS) – Cesano M. (FNM) – Limbiate;
- Z251: Desio (FS) – Bovisio M. – Varedo – Senago – Limbiate – Cesano M. (FNM);
- 166: Milan – Desio;
- 3: Urbano Seregno - Linea 3; and
- C80: Cantu – Meda – Monza.

Each bus line was analysed considering stop locations and the line routes. For the previous local public transport (LPT), the spatial distribution of the 15-minute pedestrian catchment area around bus stops was investigated. Fig. 12 shows the example of line Z250. The map highlights the 15-minute walkable network (in red), with the area indicating regions accessible within this timeframe. A notable concentration of bus stops is evident in the central urban core, while peripheral neighbourhoods are only partially served or entirely excluded from the 15-minute isochrone, pointing to potential gaps in transit accessibility.

The dataset shows that approx. 72.2 % of the total population lives within a 15-minute walking distance from at least one bus stop. This suggests a high level of bus accessibility in the municipality, although the distribution across neighbourhoods is unbalanced: the 'Centro' neighbourhood has the highest share of accessible residents (31.5 %); 'San Giovanni Bolagnos' also shows substantial accessibility (16.8 %); 'San Pietro e Paolo', 'Spaccone', 'Prati' and 'Stazione' each contribute between 3.3 % and 7.2 % of residents; peripheral neighbourhoods, 'San Carlo' and 'San Giorgio', show values close to zero.

The ten bus lines reveal significant differences in how the public transport network serves the population (see Fig. 13): line Z250 is the most effective in terms of spatial accessibility (72.2 % of the population living within a 15-minute walk of a stop on the line) and this indicates that it is a key vector of the urban mobility system, probably due to a combination of route centrality and a higher density of stops. In



Neighborhood	Residents [n]	Residents [%]	Residents 15-min [n]	Residents 15-min [%tot]
Centro	13274	31.50	10880	81.96
Prati	5050	11.98	2711	53.68
San Carlo	422	1.00	13	3.08
San Giorgio	1943	4.61	0	0.00
San Giovanni Bolagnos	9366	22.22	6323	67.51
San Pietro e Paolo	3897	9.25	2972	76.26
Spaccone	4878	11.57	4602	94.34
Stazione	3313	7.86	0	0.00
Total	42143	100.00	27501	65.26

Fig. 10. Network analysis: analysis of 15-minute walking distance from the new 'Metrotranvia' stations. From north to south, the stations are: 'San Carlo', 'Ospedale', 'Gabellini', 'Diaz', 'Stadio', 'Pietro da Desio', and 'Desio Togliatti'. (CRS: EPSG 7791 – RDN2008 / UTM zone 32 N - background map from Google Maps®).

contrast, bus lines such as Z111 and 3 show lower coverage, with only 16.0 % and 17.6 %. The other bus lines display average coverage levels (43.4–63.8 %), with lines Z209, Z232, and 166 performing well (over 63 %), suggesting an alignment between their routes and residential areas.

The network-level assessment becomes even clearer when viewed considering individual neighbourhoods: 'Centro' district benefits from the highest number of bus stops and the widest coverage; peripheral neighbourhoods such as 'San Giorgio' and 'San Carlo' experience lower service levels, either in terms of accessible bus stops and the total residents reached within 15 min. Neighbourhoods such as 'San Giovanni Bolagnos' and 'San Pietro e Paolo' fall into an intermediate category: although not as extensively covered as the central zone, they still have access to several bus lines and a moderate share of reachable residents.

4. Discussions

In the '15-minute city' paradigm, a comprehensive evaluation of the population spatial distribution is essential for assessing infrastructure strengths/weaknesses and planning future policies. The case study of Desio town shows how age-specific population clusters intersect with service availability.

Most of the population is concentrated in 'Centro' (31.5 %) and 'San Giovanni Bolagnos' (22.2 %) neighbourhoods, with other districts such as 'Prati', 'Spaccone', and 'San Pietro e Paolo' also hosting about 10 % of residents each. The spatial distribution of the population was also classified considering age groups and related to basic urban services.

The youth population (age groups: under-5, 5 – 9, and 10 – 14 years) is more prevalent in 'Centro' (about 30 %) and 'San Giovanni Bolagnos' (about 20 %) neighbourhoods, indicating high demand for schools in these areas. While different grade schools in 'Centro' district are well distributed, 'San Giovanni Bolagnos' seems underserved compared to smaller districts (such as 'Prati' and 'San Pietro e Paolo'), where the ratio of students-to-services is more favourable. This is even more evident in the peripheral neighbourhoods. Turning to the elderly population (age groups: over 75 – current survey and ten-year projection), the distribution reflects the previous trend, with 'Centro' neighbourhood (about 30 %) at the top, followed by 'San Giovanni Bolagnos' (about 20 %). Twenty-six facilities dedicated to elderly care (services, free time and health) are spread across the town, yet these do not consistently reflect the spatial needs of older residents. Once again, there is a marked centralisation of services at the expense of peripheral neighbourhoods: the concentration of urban services in the central area (especially in 'Centro' neighbourhood) may create logistical challenges for both children and elderly individuals, thus reinforcing inequalities in spatial accessibility, a crucial factor for the population's quality of life.

Additionally, the analysis of three key mobility infrastructures (Metrotranvia, railway station, and bus lines) shows substantial variability in accessibility across neighbourhoods. About 65.3 % of Desio's total population live within 15 min on foot of a Metrotranvia stop: central districts such as 'Spaccone' (94.3 %), 'Centro' (82.0 %), 'San Pietro e Paolo' (76.3 %), and 'San Giovanni Bolagnos' (67.5 %) have the highest levels of accessibility; peripheral neighbourhoods such as 'San Giorgio' and 'Stazione' are outside the 15-minute catchment zone. Accessibility to the railway station is much more polarised: only 20.3 % of the population lives within a 15-minute walk of Desio's railway station ('Centro' and 'Stazione' neighbourhoods). The last analysed LTP service, the bus network, appears to be the most accessible service, with ten bus lines crossing the town in different ways. For example, while line Z250 reaches over 72 % of residents (the most extensive coverage among the analysed transport modes), others, such as Z11, do not exceed 16 %. Peripheral areas such as 'San Carlo' and 'San Giorgio' remain

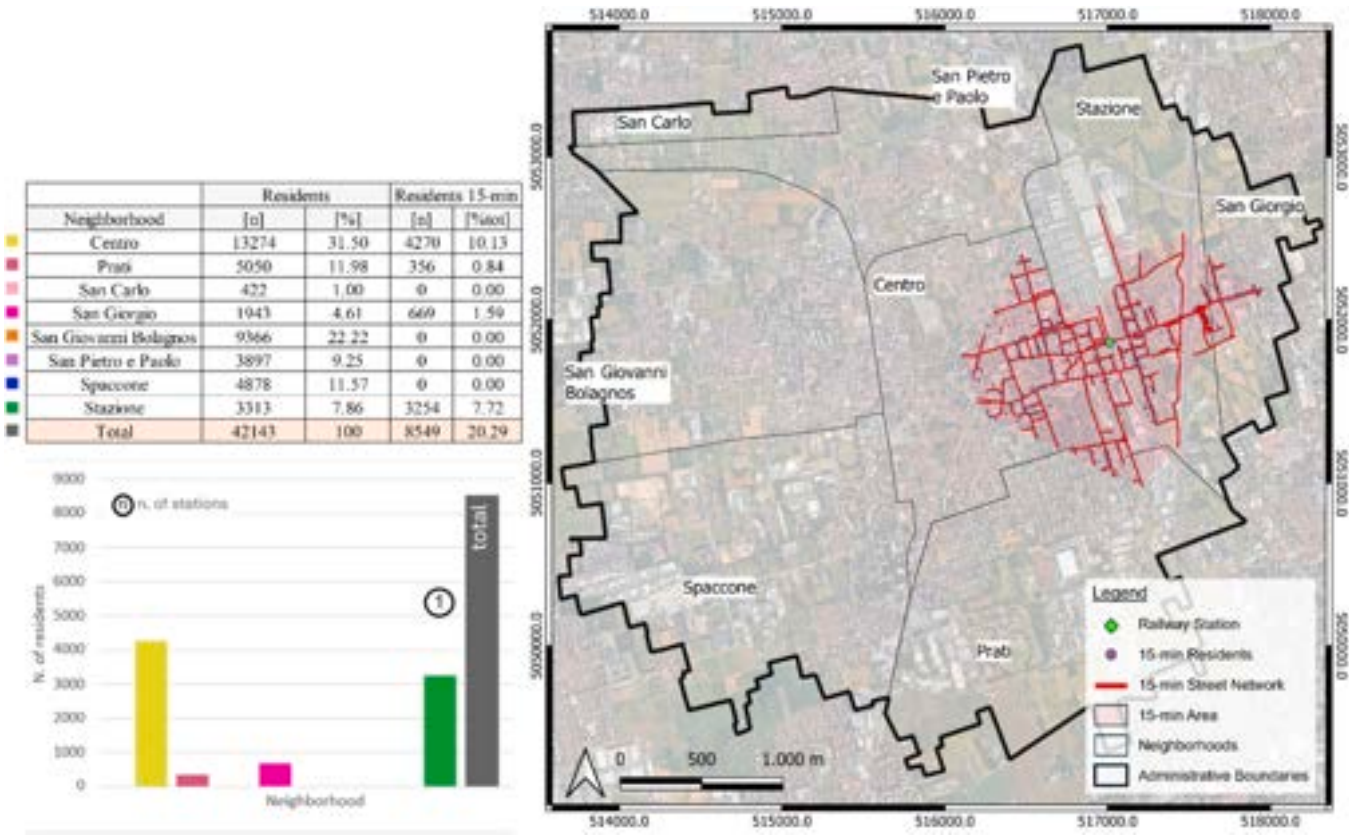


Fig. 11. Network analysis: analysis of 15-minute walking distance from the Railway Station. (CRS: EPSG 7791 – RDN2008 / UTM zone 32 N - background map from Google Maps®).

underserved.

As a whole, these three transport modes provide complementary coverage but also reveal essential gaps: the Metrotranvia offers extensive mid-range connectivity along the Seregno - Milan corridor (north-south axis), but does not reach east and west areas of the town; the railway station, essential for long-distance commuting inside the regional territory, is geographically decentralised in the east part of the town; the bus network offers the greatest coverage within the municipality boundaries, but its effectiveness relies on service and operational reliability.

4.1. Broader implications for urban equity and planning

The results show that spatial mismatches between population distribution and service locations raise concerns about planning equity and spatial justice: the centralisation of educational, health, and social facilities in a few neighbourhoods worsens disparities across all the analysed age groups. These findings underscore the importance of developing policies that promote an equitable distribution of daily urban services within walkable distances (including safe pedestrian pathways and barrier-free environments), especially in areas where reliance on private vehicles remains high. In this regard, the '15-minute city' framework offers a valuable perspective for age-inclusive urban planning, but its implementation must be tailored to smaller-scale and less densely connected contexts.

The case study of Desio indicates that the '15-minute city' concept can serve as a tool to identify and tackle intra-urban inequalities in medium-sized cities. Instead of striving for complete local self-sufficiency, small and intermediate towns can utilise the framework to encourage balanced access to essential daily services at the neighbourhood level: this redefinition expands the relevance of the '15-minute city' beyond metropolitan centres, demonstrating how proximity-based principles can enhance territorial cohesion and local well-being.

4.2. Regional context and policy implications

The position of Desio town inside the Milan metropolitan area adds an extra layer of complexity. The origin-destination (OD) matrix analysis shows that more than half of daily trips made by Desio residents (for work or study) are to other cities, particularly Milan, highlighting the city's strong functional dependence on other regional centres. The implementation of the '15-minute city' concept in such a context requires a multi-scale approach, where local and regional accessibility objectives support each other. The upcoming Metrotranvia offers a strategic opportunity to promote modal shift from private vehicles to public transport, although greater attention to peripheral neighbourhoods could increase its effectiveness.

On a wider scale, coordination among surrounding municipalities is necessary to align local service requirements with mobility schemas: on one hand, the '15-minute city' concept emphasises intra-urban proximity, and on the other hand, regional science perspectives underline that accessibility is also relational and depends on connections between territories.

Therefore, a hybrid planning approach that combines local walkability with metropolitan connectivity can guide more equitable spatial development strategies for mid-sized cities like Desio.

5. Conclusions

This paper presents a case study in Desio town (Italy) to assess the alignment between demographic concentrations and the availability of schools, care facilities, public services, and local public transport (LPT) access. The '15-minute city' concept was mainly adopted to analyse the quality of service/facility distribution with respect to the living location

Neighborhood	Residents [n]	Residents [%]	Residents 15-min [n]	Residents 15-min [%tot]
Centro	13274	31.50	13274	31.50
Prati	5050	11.98	1405	3.33
San Carlo	422	1.00	13	0.03
San Giorgio	1943	4.61	0	0.00
San Giovanni Bolagnos	9366	22.22	7089	16.82
San Pietro e Paolo	3897	9.25	3035	7.20
Spaccone	4878	11.57	2757	6.54
Stazione	3313	7.86	2839	6.74
Total	42143	100	30412	72.16

Fig. 12. Network analysis: analysis of 15-minute walking distance from the line Z250 bus stops. (CRS: EPSG 7791 – RDN2008 / UTM zone 32 N - background map from Google Maps®).

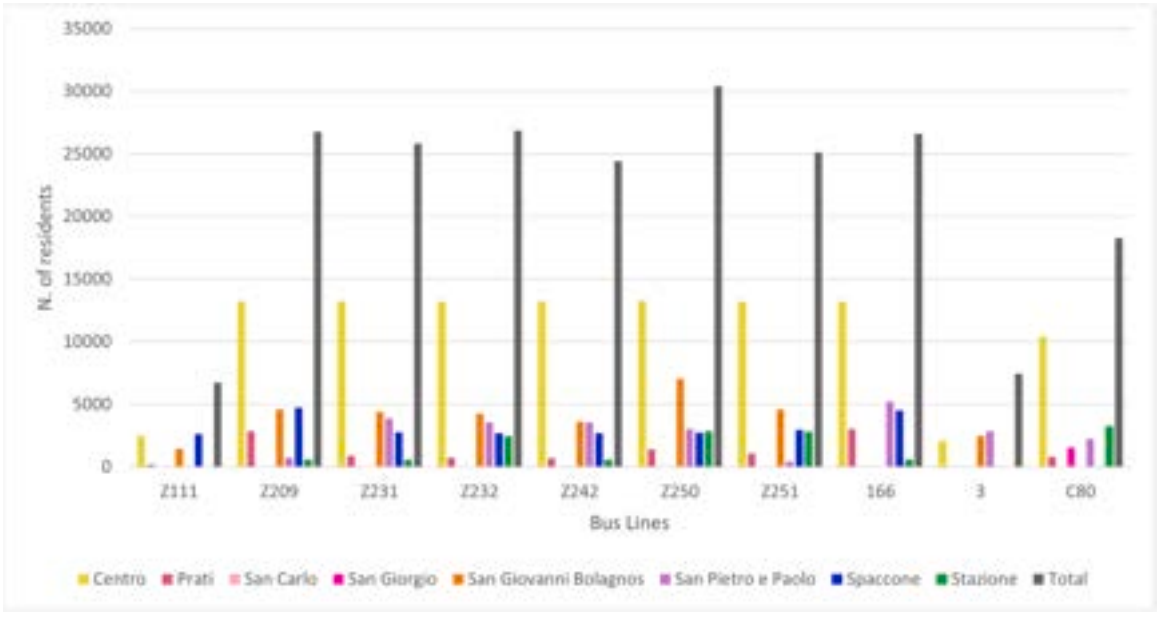


Fig. 13. Number of residents related to the bus lines in different neighbourhoods.

of residents.

As a first step, the knowledge base was organised: (i) population data (including address and age) were georeferenced within the municipality boundaries to map the distribution of residents across neighbourhoods; (ii) services linked to specific population groups (such as nurseries, primary and secondary schools, and facilities for services, leisure, and health) were identified to analyse the equity of access; (iii) LPT nodes (Metrotranvia, railway station, and bus lines) were assessed through network analysis to determine their spatial distribution across the territory. Transport evaluation was also enhanced by the origin-destination (OD) matrix analysis: the results show imbalances between residents' locations, their service needs, and their accessibility. The central neighbourhood ('Centro') benefits from overlapping access to basic urban services, while peripheral areas (especially 'San Carlo' and 'San

Giorgio' neighbourhoods) remain underserved in either social infrastructure and basic transport access. The possibility to identify inequalities in the spatial distribution of urban services can support evidence-based policy recommendations for improvement strategies: for example, increasing the number of educational facilities and elderly care services in high-demand but low-coverage areas and aligning future transport planning with actual mobility patterns, as shown by the OD matrix.

This research also has some limitations: the 15-minute walking distance was estimated using a 1 km network buffer, assuming an average walking speed of 4 km/h; it is consistent with the established literature, but does not account for variations in pedestrian conditions or local topography. Furthermore, the current street network lacks detailed representations of pedestrian-only routes and green corridors, which can influence the real accessibility.

In order to further improve the understanding of the urban dynamics and service demand, future work will focus on integrating high-resolution datasets for pedestrians and cyclists, multimodal accessibility indicators, dynamic analyses based on travel behaviour, and temporal population projections.

The study provides a replicable methodological framework for evaluating spatial accessibility and equity in medium-sized, commuter-oriented cities. By adapting the '15-minute city' concept to such settings, it broadens the practical relevance of the paradigm and guides policies towards more balanced, sustainable, and inclusive urban areas.

CRediT authorship contribution statement

Manuel Garramone: Writing – original draft. **Marco Scaioni:** Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

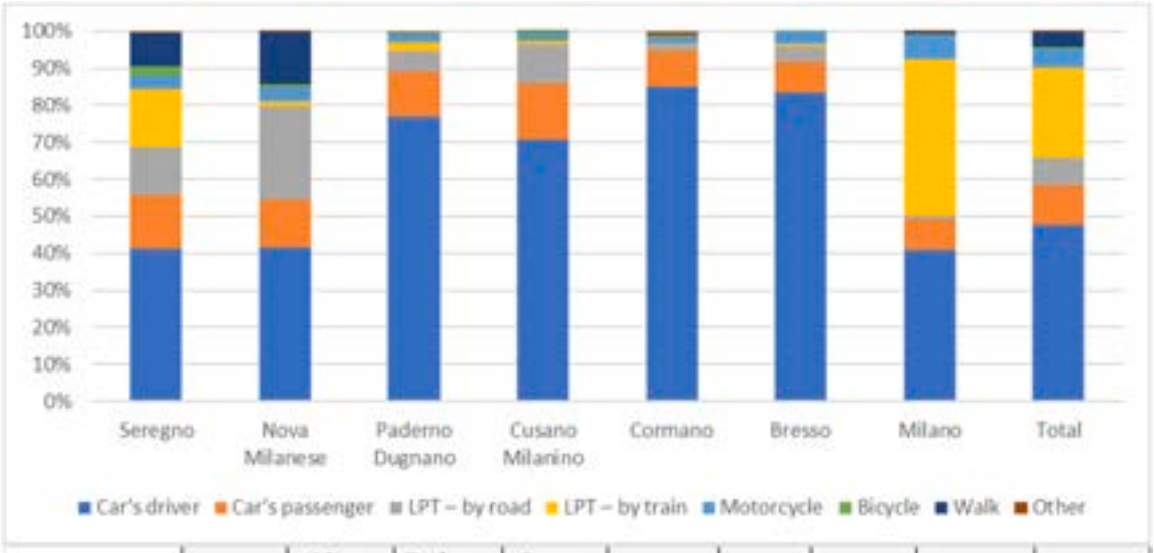
The authors want to thank the Municipality of Desio, Lombardy Region Geoportal and ISTAT for the data; QGIS Association for the open-source software it provides.

APPENDIX A

To further assess the strategic relevance of the Metrotranvia, an origin-destination (OD) matrix analysis (Barbosa et al., 2018) was conducted, focusing on flows between Desio and the other municipalities (Seregno, Nova Milanese, Paderno Dugnano, Cusano Milanino, Cormano, Bresso, and Milan) served by the planned infrastructure. The OD matrix includes eight modes of transport (car's driver, car's passenger, Local Public Transport – by road, LPT – by train, motorcycle, bicycle, walk, and other) and five travel purposes (work, study, occasional, business, and homecoming). The analysis considers both 2020 data and a 2030 projection (Regione Lombardia, 2019), enabling an assessment of future transport needs under evolving demographic and urban development scenarios.

The analysis of mobility from Desio in 2020 reveals a strong dependence on private motorised transport. As shown in both the bar chart and corresponding table (see Fig. A.1), the sum of 'car's driver', 'car's passenger' and 'motorcycle' always exceeds 50 % of all trips, with peaks surpassing 90 % in journeys towards Paderno Dugnano, Cormano, and Bresso. Considering LPT:

- rail-based transport plays a significant role in trips to Milan (approx. 42 %) and Seregno (approx. 16 %), mainly due to the availability of the Trenord Suburban Railway Lines 'S9' (Saronno – Seregno – Milan – Albairate) and 'S11' (Chiasso – Como – Milao – Rho). For all other municipalities, the proportion of rail usage does not exceed 3 %; and
- bus-based services are most utilised for journeys to Nova Milanese (approx. 25 %), Seregno (approx. 13 %), and Cusano Milanino (approx. 10 %). These movements are supported by the ATM Line 166 (Milan – Desio), Line Z209 (Monza FS – Muggiò – Desio – Bovisio Masciago – Cesano Maderno FNM), Line Z232 (Desio – Seregno – Carate – Besana FS), and Line Z229 (Paderno ITC – Cusano Milanino – Cinisello). Usage levels for other destinations remain between 1 % and 5 %.

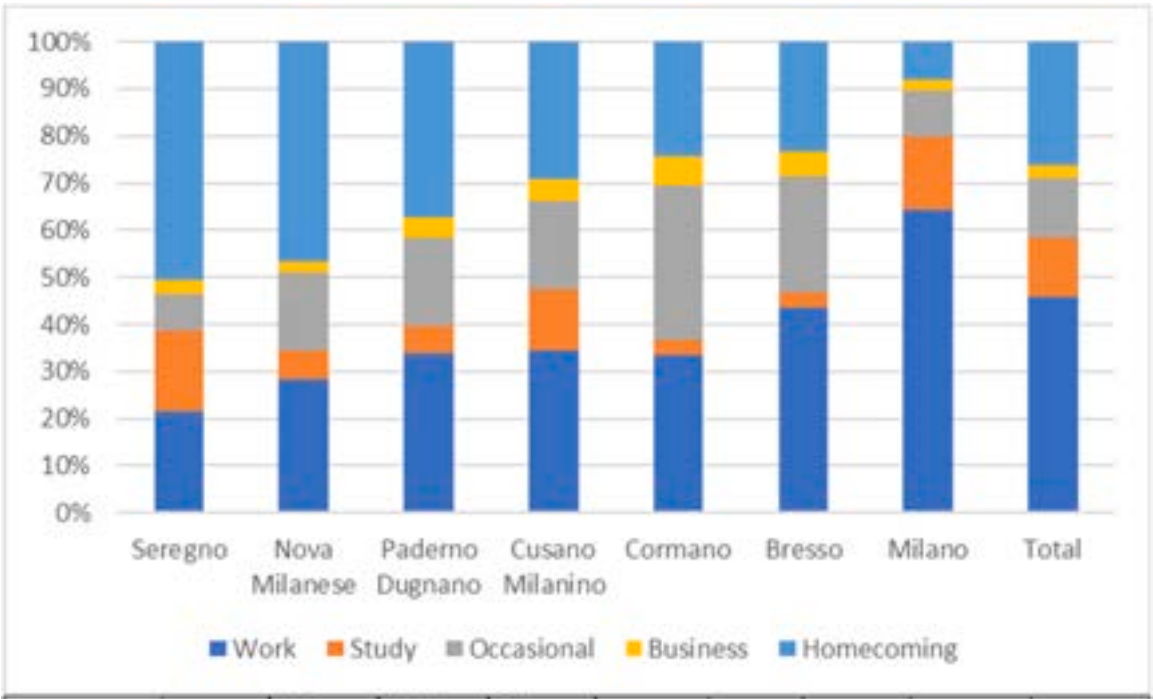


	Seregno	Nova Milanese	Paderno Dugnano	Cusano Milanino	Cormano	Bresso	Milano	Total	Total [%]
Car's driver	922.02	553.94	733.38	266.8	222.13	258.02	2102.79	5059.08	47.63
Car's passenger	328.4	172.54	119.61	58.46	25.01	25.8	427.15	1156.97	10.89
LPT – by road	290.83	336.26	51.02	38.6	4.64	12.5	52.75	786.6	7.41
LPT – by train	352.84	15.81	23.97	4.49	0.54	2.36	2181.88	2581.89	24.31
Motorcycle	81.16	45.68	19.75	5.98	4.94	9.64	330.65	497.8	4.69
Bicycle	55.39	15.76	5.1	2.98	0.66	0.61	18.17	98.67	0.93
Walk	209.03	187.7	0	0.57	0.57	0	28.3	426.17	4.01
Other	5.62	1.79	2.38	0	2.38	0	2.09	14.26	0.13
Total	2245.29	1329.48	955.21	377.88	260.87	308.93	5143.78	10621.44	100.00

Fig. A.1. Number of movements from Desio to other municipalities considering the mode of transport (year 2020)

Active modes, including walking (4.01 %) and cycling (0.93 %), represent a small fraction of overall mobility and are only relevant in the two neighbouring municipalities: Seregno to the north (2.5 % by bicycle and 9.3 % on foot) and Nova Milanese to the south (1.2 % by bicycle and 14.1 % on foot).

As for trip purposes (see Fig. A.2), nearly half of the trips (about 48 %) are work-related (including business), while around a quarter (26 %) are for returning home. Educational and occasional journeys account for about 13 % and 12 %, respectively.



	Seregno	Nova Milanese	Paderno Dugnano	Cusano Milanino	Cormano	Bresso	Milano	Total	Total [%]
Work	482.85	377.8	322.89	130.12	87.03	134.11	3316.97	4851.77	45.68
Study	382.91	78.41	55.38	48.97	9.03	10.51	791.88	1377.09	12.97
Occasional	178.69	223.26	180.15	70.75	85.34	76.07	497.99	1312.25	12.35
Business	62.63	29.25	39.59	17.65	15.72	16.21	121.12	302.17	2.84
Homecoming	1138.21	620.76	357.2	110.39	63.75	72.03	415.82	2778.16	26.16
Total	2245.29	1329.48	955.21	377.88	260.87	308.93	5143.78	10621.44	100.00

Fig. A.2. Number of movements from Desio to other municipalities considering the reason of transport (year 2020)

Analysing inbound flows from neighbouring municipalities to Desio, the modal distribution remains mainly unchanged. Private transport (including car's driver, car's passenger, and motorcycle) accounts for more than 50 % of total trips. Rail transport is relevant only for movements from Milan and Seregno, while bus services are mainly used for travelling from Nova Milanese and Seregno. These two municipalities also represent the only cases in which a small share of trips is made using active modes such as walking or cycling. What differs significantly, however, is the purpose of travel: about 66 % of trips are made for returning home, underscoring the municipality's strong role as a destination for commuters.

This is followed by work-related travel, representing roughly 20 % of the total. Educational trips and occasional journeys account for approx. 8 % and 6 %, respectively.

The 2030 projection reveals an overall decline of approx. −3.5 % in total movements, probably reflecting the global demographic decrease (ISTAT, 2023). On the other hand, a stability in the distribution of trip purposes can be observed: in both scenarios, work-related trips (including business) remain the primary driver of mobility, accounting for approx. 49 % of all journeys in 2020 and 48 % in 2030 (see Fig. A.3).

	Seregno	Nova Milanese	Paderno Dugnano	Cusano Milanino	Cormano	Bresso	Milano	Total	Total [%]
Work	414.43	380.71	323.95	69.48	45.23	138.09	3241.17	4613.06	45.01
Study	286.65	80.09	52.73	48.5	8.83	10.71	865.89	1353.4	13.21
Occasional	170.1	219.54	187.24	58.04	70.31	73.83	552.81	1331.87	13.00
Business	62.42	26.86	41.43	17.14	13.35	15.16	122.25	298.61	2.91
Homecoming	1127.36	595.93	293.24	98.61	53.77	74.35	407.93	2651.19	25.87
Total	2060.96	1303.13	898.59	291.77	191.49	312.14	5190.05	10248.13	100

	Seregno	Nova Milanese	Paderno Dugnano	Cusano Milanino	Cormano	Bresso	Milano	Total	Total [%]
Car's driver	848.99	538.95	686.91	184.04	154.06	262.79	2049.21	4724.95	46.11
Car's passenger	325.41	175.08	115.52	57.74	23.91	25.08	434.65	1157.39	11.29
LPT – by road	178.31	340.9	50.63	36.6	4.78	12.62	55.02	678.86	6.62
LPT – by train	363.71	10.95	19.57	4.59	0.59	2.58	2294.31	2696.3	26.31
Motorcycle	78.95	42.65	19.39	5.54	4.59	8.46	304.95	464.53	4.53
Bicycle	55.7	15.81	4.19	2.75	0.67	0.61	18.87	98.6	0.96
Walk	204.45	177	0	0.51	0.51	0	31.02	413.49	4.03
Other	5.44	1.79	2.38	0	2.38	0	2.02	14.01	0.14
Total	2060.96	1303.13	898.59	291.77	191.49	312.14	5190.05	10248.13	100

Fig. A.3. Number of movements from Desio to other municipalities considering the reason of transport, at the top, and the mode of transport, at the bottom (year 2030)

Although a slight decline is noticeable, the absolute number of trips for work and returning home remains high, reflecting Desio's continued role as a commuter hub; educational and occasional trips follow the same trend, with small proportional shifts across the two-time points.

Moreover, the modal split data is consistent, suggesting that the basic structure of mobility demand will remain constant: private motorised transport (cars and motorcycles) continues to dominate (63 % of trips in 2020 and 62 % in 2030). Even if this shows a modest decline, it could indicate a potential shift towards more sustainable modes, confirmed by the rail-based public transport, which increased by 2 %, driven by growth in train journeys to Milan. Active transport modes (walking and cycling) remain marginal but stable, together accounting for just under 5 % of all trips in both years. However, the strong prevalence of commuting flows allows the Metrotranvia to be well-positioned to support modal shift: by improving accessibility and increasing the attractiveness of public transport for inter-municipal journeys, the new infrastructure could contribute to a more sustainable regional mobility system.

References

Afrin, S., Chowdhury, F.J., Rahman, M.M., 2021. COVID-19 Pandemic: Rethinking Strategies for Resilient Urban Design, Perceptions, and Planning. Front. Sustain. Cities 3, 668263. https://doi.org/10.3389/FRSC.2021.668263/BIBTEX.

Allam, Z., Khavarian-Garmsir, A.R., Lassaube, U., Chabaud, D., Moreno, C., 2024. Mapping the Implementation Practices of the 15-Minute City. *2024, Vol. 7, Pages 2094-2109* Smart Cities 7 (4), 2094–2109. https://doi.org/10.3390/SMARTCITIES7040083.

Alotaibi, M., Malleson, N., Clarke, G., 2025. Location models to improve health and safety at a major temporary city: The case of the Hajj. Reg. Sci. Policy Pract. 17 (5), 100179. https://doi.org/10.1016/J.RSPP.2025.100179.

Aria, M., Cuccurullo, C., 2017. bibliometrix: An R-tool for comprehensive science mapping analysis. J. Informetr. 11 (4), 959–975. https://doi.org/10.1016/J.JOI.2017.08.007.

Barbosa, H., Barthelemy, M., Ghoshal, G., James, C.R., Lenormand, M., Louail, T., Menezes, R., Ramasco, J.J., Simini, F., Tomasini, M., 2018. Human mobility: Models and applications. Phys. Rep. 734, 1–74. https://doi.org/10.1016/J.PHYSREP.2018.01.001.

Bhat, W.A., Manzoor, A., Ahmad, Z., Qureshi, R., 2023. How to Conduct Bibliometric Analysis Using R- Studio: A Practical Guide. Eur. Econ. Lett. (EEL) 13 (3), 681–700. https://doi.org/10.52783/EEL.V13I3.350.

Duffy, A., Crawford, R., 2013. The effects of physical activity on greenhouse gas emissions for common transport modes in European countries. Transp. Res. Part D Transp. Environ. 19, 13–19. https://doi.org/10.1016/J.TRD.2012.09.005.

Elldér, E., 2025. Exploring socio-economic inequalities in access to the 15-minute city across 200 Swedish built-up areas. J. Transp. Geogr. 122, 104060. https://doi.org/10.1016/J.JTRANGEO.2024.104060.

Garramone, M., Scaioni, M., 2025. Dynamics Between Population Distribution and Location of Services: The Case Study of Desio Town, Italy. In: Borgogno-Mondino, E., Zamperlin, P. (Eds.), Geomatics for Green and Digital Transition. Springer Nature Switzerland, pp. 224–233. https://doi.org/10.1007/978-3-031-91141-5_16.

Gaxiola-Beltrán, A.L., Narezo-Balzaretti, J., Ramírez-Moreno, M.A., Pérez-Henríquez, B. L., Ramírez-Mendoza, R.A., Krajzewicz, D., Lozoya-Santos, J.D.J., 2021. Assessing Urban Accessibility in Monterrey, Mexico: A Transferable Approach to Evaluate Access to Main Destinations at the Metropolitan and Local Levels. *2021, Vol. 11, Page 7519* Appl. Sci. 11 (16), 7519. https://doi.org/10.3390/APP11167519.

Giuffrida, N., Mölter, A., Pilla, F., Carroll, P., Ottomanelli, M., 2024. On the equity of the x-minute city from the perspective of walkability. Transp. Eng. 16. https://doi.org/10.1016/j.treng.2024.100244.

Hunter, M., 2021. Resilience, Fragility, and Robustness: Cities and COVID-19. Urban Gov. 1 (2), 115–125. https://doi.org/10.1016/J.UGJ.2021.11.004.

ISTAT. (2023). *Previsioni della popolazione residente e delle famiglie.* ⟨https://www.istat.it/comunicato-stampa/previsioni-della-popolazione-residente-e-delle-famiglie-base-112022/⟩.

ISTAT. (2024a). *Indicatori demografici.* ⟨http://dati.istat.it/Index.aspx?DataSetCode=DCIS_INDDEMOG1⟩.

ISTAT. (2024b). *Istituto Nazionale di Statistica.* ⟨https://www.istat.it/⟩.

Jang, S., Park, H., 2025. Spatial equity in public rental housing based on commuting accessibility. Reg. Sci. Policy Pract. 17 (8), 100196. https://doi.org/10.1016/J.RSPP.2025.100196.

Khavarian-Garmsir, A.R., Sharifi, A., Sadeghi, A., 2023. The 15-minute city: Urban planning and design efforts toward creating sustainable neighborhoods. Cities 132, 104101. https://doi.org/10.1016/J.CITIES.2022.104101.

Kriegel, H.P., Kröger, P., Sander, J., Zimek, A., 2011. Density-based clustering. Wiley Interdiscip. Rev. Data Min. Knowl. Discov. 1 (3), 231–240. https://doi.org/10.1002/WIDM.30.

Lin, D., Cui, J., 2021. Transport and Mobility Needs for an Ageing Society from a Policy Perspective: Review and Implications. Int. J. Environ. Res. Public Health 18 (22), 11802. https://doi.org/10.3390/IJERPH182211802.

Liu, D., Kwan, M.P., Wang, L., Kan, Z., Wang, J., Huang, J., 2024. Development of a Chrono-Urbanism Status Composite Index under the 5/10/15-Minute City Concept Using Social Media Big Data. Tijdschr. Voor Econ. En. Soc. Geogr. 115 (4), 554–570. https://doi.org/10.1111/TESG.12613.

Logan, T.M., Hobbs, M.H., Conrow, L.C., Reid, N.L., Young, R.A., Anderson, M.J., 2022. The x-minute city: Measuring the 10, 15, 20-minute city and an evaluation of its use for sustainable urban design. Cities 131, 103924. https://doi.org/10.1016/J.CITIES.2022.103924.

Lowe, M., Adlakha, D., Sallis, J.F., Salvo, D., Cerin, E., Moudon, A.V., Higgs, C., Hinckson, E., Arundel, J., Boeing, G., Liu, S., Mansour, P., Gebel, K., Puig-Ribera, A., Mishra, P.B., Bozovic, T., Carson, J., Dygrýn, J., Florindo, A.A., Giles-Corti, B., 2022. City planning policies to support health and sustainability: an international comparison of policy indicators for 25 cities. Lancet Glob. Health 10 (6), e882–e894. https://doi.org/10.1016/S2214-109X(22)00069-9.

Marquet, O., Anguelovski, I., Nello-Deakin, S., Honey-Rosés, J., 2025. Decoding the 15-Minute City Debate: Conspiracies, Backlash, and Dissent in Planning for Proximity. J. Am. Plan. Assoc. 91 (1), 117–125. https://doi.org/10.1080/01944363.2024.2346596.

Mercier, A., Souche-Le Corvec, S., Ovtracht, N., 2021. Measure of accessibility to postal services in France: A potential spatial accessibility approach applied in an urban region. Pap. Reg. Sci. 100 (1), 227–250. https://doi.org/10.1111/PIRS.12564.

Moreno, C., Allam, Z., Chabaud, D., Gall, C., Pratlong, F., 2021. Introducing the "15-Minute City": Sustainability, Resilience and Place Identity in Future Post-Pandemic Cities. *2021, Vol. 4, Pages 93-111* Smart Cities 4 (1), 93–111. https://doi.org/10.3390/SMARTCITIES4010006.

Municipality of Desio. (2024). *Municipal Registry*.

Nijkamp, P., Kourtit, K., Krugman, P., Moreno, C., 2024. Old wisdom and the New Economic Geography: Managing uncertainty in 21st century regional and urban development. Reg. Sci. Policy Pract. 16 (10), 100124. https://doi.org/10.1016/J.RSPP.2024.100124.

Nijkamp, P., Kourtit, K., Haynes, K., & Elburz, Z. (2025). *Thematic Encyclopedia of Regional Science* (ElgarOnline, Ed.). ElgarOnline. https://doi.org/https://doi.org/10.4337/9781800379282.

Oh, S.E.S., Kwon, D., Kim, B.H.S., 2024. Neighborhood Food Accessibility and Health Disparity: Examining the Impact of COVID-19 Using Spatial Models. Int. Reg. Sci. Rev. 47 (4), 443–474. https://doi.org/10.1177/01600176231214205;JOURNAL:JOURNAL:IRXA;REQUESTEDJOURNAL:JOURNAL:IRXA;WGROUP:STRING:PUBLICATION.

Pozoukidou, G., Chatziyiannaki, Z., 2021. 15-Minute City: Decomposing the New Urban Planning Eutopia. *2021, Vol. 13, Page 928* Sustainability 13 (2), 928. https://doi.org/10.3390/SU13020928.

QGIS Association. (2024). *QGIS 3.34*. ⟨https://qgis.org/⟩.

Rao, F., Kong, Y., Ng, K.H., Xie, Q., Zhu, Y., 2024. Unravelling the Spatial Arrangement of the 15-Minute City: A Comparative Study of Shanghai, Melbourne, and Portland. Plan. Theory Pract. 25 (2), 184–206. https://doi.org/10.1080/14649357.2024.2350948;WEBSITE:WEBSITE:TFOPB;PAGEGROUP:STRING:PUBLICATION.

Regione Lombardia, 2019. Trasporti: Matrice Passeggeri. ⟨https://www.dati.lombardia.it/stories/s/5tsd-gjin⟩.

Regione Lombardia, 2025. Geoportale Regione Lombardia. ⟨https://www.geoportale.regione.lombardia.it/⟩.

Rojas-Rueda, D., Norberciak, M., Morales-Zamora, E., 2024. Advancing Health Equity through 15-min Cities and Chrono-urbanism. J. Urban Health. Bull. N. Y. Acad. Med. 101 (3), 483–496. https://doi.org/10.1007/S11524-024-00850-2.

Shamshiri, A., Ryu, K.R., Park, J.Y., 2024. Text mining and natural language processing in construction. Autom. Constr. 158, 105200. https://doi.org/10.1016/J.AUTCON.2023.105200.

Teixeira, J.F., Silva, C., Seisenberger, S., Büttner, B., McCormick, B., Papa, E., Cao, M., 2024. Classifying 15-minute Cities: A review of worldwide practices. Transp. Res. Part A Policy Pract. 189, 104234. https://doi.org/10.1016/J.TRA.2024.104234.

Tiznado Aitken, I., Palm, M., Farber, S., 2024. Exploring the interplay of transportation, time poverty, and activity participation. Transp. Res. Interdiscip. Perspect. 26, 101175. https://doi.org/10.1016/j.trip.2024.101175.

Willberg, E., Fink, C., Toivonen, T., 2023. The 15-minute city for all? – Measuring individual and temporal variations in walking accessibility. J. Transp. Geogr. 106, 103521. https://doi.org/10.1016/J.JTRANGEO.2022.103521.