ScienceDirect

Journal of Urban Mobility
Volume 5, June 2024, 100077

# Walk further and access more! Exploring the 15-minute city concept in Oslo, Norway

Mahsa Akrami [a], Marcin Wojciech Sliwa [a c], Maja Karoline Rynning [b]

[a] University of Oslo, Department of Sociology and Human Geography, Moltke Moes vei 30, 0851 Oslo, Norway
[b] The Institute of Transport Economics, Gaustadalléen 21, 0349 Oslo, Norway
[c] Agency for Planning and Building Services, City of Oslo

Received 23 September 2023, Revised 26 February 2024, Accepted 19 March 2024, Available online 27 March 2024, Version of Record 27 March 2024.

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https://doi.org/10.1016/j.urbmob.2024.100077
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## Abstract

The 15-minute city theory has recently become a popular paradigm in urban development. It claims that everyone should have access to the essential services, facilities and green spaces within a 15-minute walk. This article tests this concept in Oslo, Norway using a mixed-methods approach, based on a Geographical Information Systems (GIS) analysis of accessibility, review of relevant plans, interviews with planners and a case study of the Hovinbyen area. The objective was to find out to what extent Oslo is a 15-minute city, and discuss how this concept can be integrated in urban planning strategies more generally. The study shows that the central part of Oslo is already a 15-minute city, and that several areas are transforming in this direction. However, many suburban neighborhoods have low accessibility scores, and, according to the plans, will likely not change much in the future. This article argues that the 15-minute city concept cannot serve as the main development strategy, but such an analysis can be useful as a diagnostic study or to assist planning in rapidly changing areas or city extensions. The concept can therefore be considered as a flexible tool to support other planning strategies that share the same goals and ambitions. Any interventions that such accessibility analyses suggest should be contextualized and developed in combination with other qualitative assessments and in partnership with local communities.

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## Keywords

15-minute city; Urban planning; GIS-analysis; Accessibility; Proximity; Oslo

## 1. Introduction

Cities play a central role in achieving sustainable development goals. As a result, a large spectrum of planning principles has been proposed and adopted to redesign and redevelop them in order to face the ongoing social, economic and environmental challenges, e.g.: livable,

inclusive, sustainable, resilient, smart, compact, transit-oriented, walkable, or car-free cities. Common features among these concepts relate to accessibility and active mobility. Indeed, within urban planning, there is a somewhat shared vision of the ideal neighborhood being a densely built area where a variety of services are provided within the residential vicinity and could be easily accessible by foot (Gehl 2010; Hagen et al., 2019; Pinto & Akhavan, 2022; Pozoukidou & Chatziyiannaki, 2021; Speck, 2012; Zhang et al., 2018; Zhao & Wan, 2020).

The 15-minute city (as defined by Carlos Moreno) is another planning concept that has gained a great momentum in recent years. At its core is the principle that urban dwellers should be able to meet basic daily needs within a 15-minute walk or bicycle ride from home. Its popularity increased significantly during the Covid-19 pandemic and the resulting lockdown restrictions imposed to restrict mobility, particularly for public transportation. This increased public attention to the substantial need for easy access to everyday facilities and essential services around places of residence, in particular by foot or bicycle (Guzman et al., 2021; Moreno et al., 2021; Pozoukidou & Chatziyiannaki, 2021; Pinto & Akhavan, 2022).

Considering that the 15-minute city idea has gained a lot of popularity in a relatively short time, we believe there is a need for testing its applicability and compatibility with ongoing planning processes in order to link theory and practice. The aim of this study is to test the 15-minute city concept as defined by Moreno et al. (2021) on the city of Oslo, Norway, a mid-size capital city with a population of 709 thousand people (SSB, 2023). Our research questions are:

- To what extent is today's Oslo already a 15-minute city?
- Should the 15-minute city concept be integrated into existing urban planning strategies?

To answer these questions, we applied a mixed-methods approach consisting of a Geographical Information Systems (GIS) analysis of accessibility to different types of facilities, a review of official planning documents, interviews with planners from Oslo municipality and a more in-depth study of an area of Oslo currently under development.

This study was motivated by the need for better GIS-based methodologies that can be applied directly in city planning, as well as the lack of similar studies from the Oslo area or elsewhere in the Nordic countries. Our ambition is to contribute to the debate about the opportunities and limitations of the 15-minute city concept in planning practice and theory by exploring the concept's applicability to an existing city and its current planning strategies. For research, we believe our article can contribute methodologically through its innovative GIS analysis that might serve as inspiration for similar studies. For planning practice, our research may help clarify when the 15-minute city approach can be useful in planning, but also its limitations and operative challenges.

Oslo is an interesting case to study, as it is among the fastest growing urban areas in Europe and has ambitious sustainability and climate goals (Oslo municipality, 2013; 2017a). Its targets of halving CO2 emissions and reducing car traffic by one third before 2030 are to be achieved using planning strategies that are, in principle, aligned with the 15-minute city concept. Our study centers on walking because it is central to all kinds of mobility. In 2022, 32 % of daily trips in Oslo were made by foot, compared to 6 % by bicycle (Oslo municipality, no date).

We first present a literature review focusing on the key principles of the 15-minute city concept and its main critiques. Second, we describe our methodology and research design, with the main focus on the GIS analysis. Third, we present the results of our analysis of Oslo, followed by an overview of how the 15-minute city ideas are integrated in the planning strategies in Oslo as a whole and in our case area Hovinbyen. Finally, we conclude with a discussion about the validity of the 15-minute city concept in Oslo and reflect upon how it relates to other urban planning strategies.

## 2. The 15-minutes city concept

Distance and time are the key indicators in the contemporary understanding of the 15-minute city concept (*ville du quart d'heure*) as defined by Carlos Moreno in 2016 (Moreno et al., 2021). Inspired by chrono-urbanism as a process of decentralization of urban areas, 15-minute cities are to consist of self-sufficient neighborhoods where every day needs are available by up to 15 min walking or cycling (Allam et al., 2022a; Moreno et al., 2021; Manifesty & Park, 2022; Pinto & Akhavan, 2022). These needs are categorized into six essential urban functions: living, working, healthcare, commerce, education, and entertainment (Moreno et al., 2021).

The typical 'urban' characteristics of neighborhoods that meet the 15-minute criteria are high built density, proximity, as well as diversity and flexibility of uses (Moreno et al., 2021; Mocák et al., 2022; Pinto & Akhavan, 2022). The concept differs from other neighborhood centered concepts in its aim of accessibility by proximity rather than transportation (Ferrer-Ortiz et al., 2022). The goal is to bring facilities and workplaces closer to the places of residence rather than people closer to the facilities and offices or places of work (Pozoukidou & Chatziyiannaki, 2021). Graells-Garrido et al. (2021) write that ensuring access to all basic facilities within a limited time of walking (or cycling) from home represents a shift from monocentric city configurations to polycentric structures. The 15-minute city model can therefore be referred to as proximity-centered accessibility, offering a kind of distributed model or a polycentric pattern to ensure all neighborhoods have equal access to different amenities. Such cities can be organized as interconnected, but self-sufficient and resilient neighborhood modules

(Khavarian-Garmsir et al., 2023). According to Papas et al. (2023), the advantage of the 15-minute city model is that it allows bottom-up planning at a local scale, where citizens can actively engage in the reconfiguration of their neighborhoods.

According to Moreno et al. (2021), a 15-minute city serves as a regeneration model to promote a healthy lifestyle. The concept strongly focuses on human-oriented urban planning, as advocated by Jane Jacobs (1961), who argued for neighborhoods in which people could access necessary services within walking distance without any limitations, regardless of the time of the day. She highlighted the social and economic elements of urban planning and the importance of mutual support of both to make cities more livable and healthier. The 15-minutes city concept reflects this through its aim of improved access to quality affordable housing and transportation options, employment and education opportunities, as well as the right to lead a healthy life for all age groups and abilities, irrespective of place of residence or socioeconomic status (Gaglione et al., 2022; Moreno et al., 2021; Noworól et al., 2022; Pozoukidou & Chatziyiannaki, 2021; Weng et al., 2019).

Another intended consequence of the planning concept is a reduction in local car traffic in order to significantly reduce greenhouse gas emissions (ibid.). Di Marino et al. (2023) (the only other academic publication we know of where the concept of 15-minute cities was applied to Oslo), concludes that the 15-minute city model is also well suited to urban areas where people increasingly work from home or different kinds of new workplaces (e.g., public libraries or coworking spaces), as it allows for the arrangement of working and living routines within areas that are accessible by foot (or bicycle). This is further supported by the opportunities presented by digitalization and the constantly enhanced information and communication technology (Khavarian-Garmsir et al., 2023; Moreno et al., 2021).

The concept of the 15-minute city has recently been overtaken by the concept of the 'x-minute city' (Logan et al., 2022; Lu & Diab, 2023). A different definition of time can allow for adaptation to cities of different sizes and travel patterns or include public transportation trips in accessibility analysys. Some examples include 5- or 10-minute accessibility thresholds in Turin, Italy (Staricco, 2022), 20-minute city studies of Tempe, Arizona (Capasso Da Silva et al., 2019), 30-minute travel time in Montréal, Canada (Birkenfeld et al., 2023), and a 45-minute city of Singapore (Manifesty & Park, 2022., 2022).

While the 15-minute city model has developed its unique characteristics and criteria, it is important to underline that it is not an entirely new concept, and is, in many ways, compatible and overlapping with other planning ideas, such as New Urbanism, Transit-oriented development (TOD), as well as compact cities and mixed-use development. According to Manifesty and Park (2022), the 15-minute city is in many ways an updated version of earlier paradigms such as the 'garden city' by Ebenezer Howard (1989), the 'livable neighborhood unit' by Clarence Perry (1929) and the 'city within the city' by Leon Krier (1984). One distinction from these similar concepts, however, is the 15-minute city's focus on proximity-centered accessibility as explained above.

The 15-minute cities idea is not without criticisms. The most common drawback often pointed out is how it cannot serve as a 'one-size-fits-all'-model as it is difficult or even impossible and/or feasible to implement it on existing cities (see Capasso Da Silva et al., 2019; Pozoukidou & Chatziyiannaki, 2021; Allam et al., 2022b; Ferrer-Ortiz et al., 2022; Marchigiani & Bonfantini, 2022; Noworól et al., 2022; Staricco, 2022; Zhang et al., 2022; Birkenfeld et al., 2023; Khavarian-Garmsir et al., 2023; Limerick et al., 2023; Olivari et al., 2023; Wilberg, 2023). Birkenfeld et al. (2023) underlines the complexity of achieving the x-minute city ideal in large North American cities, with limited households able to complete all daily travel near their homes. Staricco (2022) and Vale and Lopes (2023) similarly highlights how the model is not feasible in European cities, where densities within the same urban areas vary a lot. Khavarian-Garmsir et al. (2023) criticized the concept for its physical determinism, as it overlooks the needs of diverse social groups, as well as the considerations related to biodiversity, energy efficiency, culture and heritage. In line with this, Wilberg (2023) writes that the 15-minute city by definition underestimates how much the ability to walk certain distances depends on the characteristics and physical form of each individual.

Despite disagreements regarding the 15-minute city concept application and benefit for city planning, it has nevertheless attracted a lot of attention within research as well as practice, making this concept among the most debated in contemporary planning studies. We here attempt to contribute to this discussion by presenting the Oslo-perspective and suggesting a different approach to analyze it.

## 3. Methodology and research design

As explained, we employed a mixed-methods approach consisting of quantitative and qualitative methods at the city level and for one district. We first explored the accessibility to different facilities within a 15-minute walk from all places of residence using GIS analysis tools. Second, we reviewed relevant planning documents and interviewed planners at Oslo municipality to understand the extent to which the 15-minute concept is applied in the city's development strategy. As part of this, we looked further into the currently redeveloping district of Hovinbyen as it is the largest redevelopment area in the city. Through a GIS-analysis, combined with the document studies and interviews we sought to explore what the 15-minutes city might look like at the neighborhood level in Oslo, and how the concept might apply to a district redevelopment project.

### 3.1. Case description: Oslo and Hovinbyen

Oslo is the capital of Norway and has a population of 709 thousand people (SSB, 2023). It is situated in the Greater Oslo region with more than 1.5 million inhabitants. A considerable population growth in the later years have led to densification and transformation of central areas with workplaces and housing in the inner city and around public transport nodes in the region. The city of Oslo is largely structured by three ring roads, and is organized into 15 boroughs with local administrations (see Fig. 1). The area within Ring 1 is the city center with the main business district, harbor, central railway station and main shopping areas, but few residents. The area extending just a little outside Ring 2 is the inner city. Like many European cities, the boroughs of the inner city have local centralities and many everyday facilities in walkable distance. The rest of Oslo, largely outside Ring 3, is the outer city with a more 'suburban' and car-oriented character (Nenseth & Røe, 2023). Here too, we find local centers with everyday facilities, but conditions are generally less favorable for easily reaching these by foot. In addition to neighboring municipalities, Oslo's development is restricted by its natural surroundings. To the North and Southeast the built area is bordered a forested 'greenbelt' called Marka, where urban development is strictly prohibited. To the South, the built area is naturally limited by the fiord of Oslo.

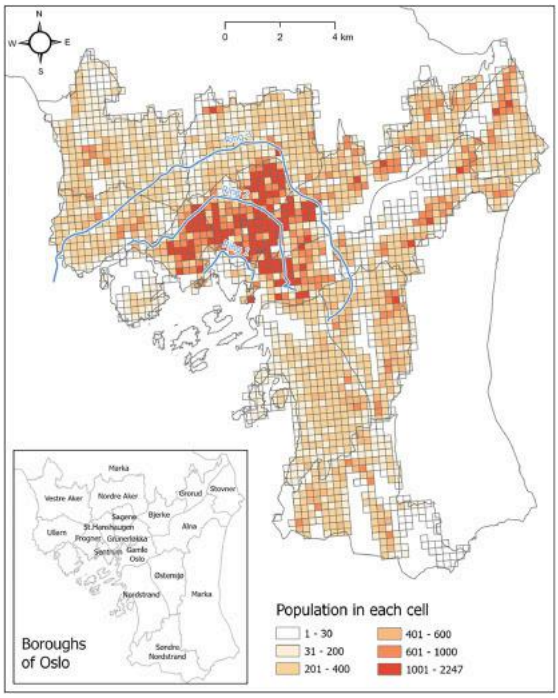


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Fig. 1. Maps of population density and boroughs of Oslo. Population in each cell measuring 250m*250m. The blue lines are the Ring roads 1, 2 and 3. Data source: SSB.

Hovinbyen, the area we explore further in-depth, is located a few kilometers northeast of the city center, at the intersection of boroughs Gamle Oslo, Grunerløkka, Bjerke and Alna (Fig. 9) on both side of the Ring 3. Most of the area is undergoing rapid transformation from industrial to residential and mixed residential, commercial and office uses (Fig. 10). Hovinbyen was also identified as one of three future innovation districts in the city, which would bring together companies and entrepreneurs working with circular economy activities and ideas (Oslo municipality, 2019b). The most intense development is concentrated especially around the neighborhoods of Økern, Ulven, Løren, Hasle, Helsfyr, Ensjø, Bryn and Vollebekk, which are at different stages of redevelopment. To coordinate these projects, the municipality of Oslo prepared the Strategic Plan for Hovinbyen (Oslo municipality, 2018b).

The general urban strategies of Oslo in the past decades have been urban densification and reduction of car use (Hagen & Tennøy, 2021 and Næss, 2022). Meanwhile, since the 1980s, the housing market in Norway has been deregulating and privatizing. The combination of these factors resulted in growing housing unaffordability (Turner & Wessel, 2019; Cavicchia, 2021). Prioritizing environmental stability and urban growth within the already built area led to increasing inequalities, gentrification pressures and the weakening of social sustainability (Cavicchia, 2023; Kjærås, 2023), while at the same time rising concerns about environmental justice (Venter et al., 2023). Lunke (2022) highlights that inequality in Oslo is also evident in mobility and access to public transportation. He uses the concept "suburbanization of poverty" and shows how "less affluent neighbourhoods suffer from low accessibility and poor time competitiveness of public transport" (p. 1).

## 3.2. GIS analysis

### 3.2.1. Overall method description

To assess the extent to which Oslo is currently a 15-minute city, we undertook a GIS analysis to explore the accessibility to different facilities within a 15-minute walk from all places of residence. As mentioned before, our focus is on walking, as it is over five times more common to walk in Oslo than to cycle. We considered the 15-minute time limit, because we wanted to stay as close as possible to the core ideas of Carlos Moreno.

In short, the process consisted of plotting areas accessible within 15-minutes' walk from places of residence followed by counting how many facilities in different categories are located in these areas. The aim is to measure accessibility to different types of facilities and services within a 15-minute walk and to identify spatial patterns considering walkability and population density in relation to the distribution of facilities. We base our GIS-analysis on accessibility to basic daily needs.

Accessibility is here understood as the assessment of the availability of facilities that are easily reachable for all groups of people (Graells-Garrido et al., 2021). From the social sustainability perspective, accessibility is often used as a parameter to measure social equity (Capasso Da Silva et al., 2019). Contemporary research indicates that high accessibility in combination with efficient transportation systems create more liveable cities, enable access to ever distant opportunities and ultimately eliminate car dependency (Ibraeva et al., 2020; Graells-Garrido et al., 2021; Lunke, 2022; Silva & Altieri, 2022).

Silva and Altieri (2022) defined two perspectives in reaching accessibility: proximity- and mobility-centered. The former has been introduced before and is related to the neighborhood unit model as proposed by Clarence Perry (1929), who used a quarter-mile walk as the best radius where residents can access basic facilities. This definition has also been adopted by the advocates of the New Urbanism movement as the 'basic unit of planning' (Kunstler, 1998, 155; see also Katz, 1994 and Steuteville, 2023). Mobility-centered accessibility focuses on the many variations of active mobility including, but not limited to, walking and cycling. Investment in active mobility can contribute to improved health and traffic safety (Zander et al., 2014; Wang & Yang, 2019; Alves et al., 2020; Ferretto et al., 2021), in addition to other positive social, environmental and economic impacts (Rabl & de Nazelle, 2012; Rojas López & Wong, 2017; Pajares et al., 2021; Pisoni et al., 2022). By studying both the location of facilities and the extent of areas covered by walking within 15 min, our analysis combines both the proximity and mobility-centered accessibility.

### 3.2.2. Data collection

To access population information, we used primarily publicly available data from Statistics Norway (Statistisk Sentralbyrå, SSB). The dataset is a grid with cells measuring 250 m × 250 m with aggregated population information from 2019. For the analysis of access to kindergartens and schools, we used population information for age groups 0–5 and 6–19 respectively, retrieved from Oslo municipality Statistics Bank (Statistikkbanken). Universities are not included, because we do not consider them as essential facilities that everyone needs to have within a short walking distance.

The location of facilities was collected from the Geonorge database (Kartkatalogen) and OpenStreetMap (OSM). The former includes the building (N50), land use (FKB) and land cover (AR5) datasets generated by the Norwegian Mapping Authority (Kartverket), Geovekst and the Norwegian Institute of Bioeconomy Research (NIBIO) respectively. OSM is an open-source collaborative world map created by volunteers with detailed and relatively updated information for Norway.

After combining the datasets, we came up with a list of facilities and categories that resemble, though are not exact the same, those proposed by Moreno et al. (2021). He defined six essential urban functions, including living, working, healthcare, commerce, education, and entertainment. Since service areas were selected based on the population data, this study considered residential areas (or living parameter) as points of origin. Four of the Moreno's other main facilities were programmed as destinations: education, entertainment, healthcare, and commerce. To this, we added green spaces and kindergartens as two separate categories, or destinations. While the accessibility to all job locations, or Moreno's working parameter, has not been considered directly as a specific category, we believe that our facility categories represent a good approximation of the distribution of job locations throughout the city. The six facility categories and their total counts for Oslo used in our analysis are summarized in Table 1.

Table 1. List of different groups of each facility.

| Facilities | Sub-group | Count | Sum |
|---|---|---|---|
| Education | School | 202 | 225 |
| | Library | 23 | |
| Kindergarten | | 476 | 476 |
| Entertainment | Playground | 439 | 711 |

| Facilities | Sub-group | Count | Sum |
|---|---|---|---|
| | Museum, Art gallery | 121 | |
| | Sports hall | 74 | |
| | Indoor ice rink | 4 | |
| | Swimming pool | 13 | |
| | Gym | 5 | |
| | Cinema / Theatre / Opera / Concert Hall | 55 | |
| Green space | | 2174 | 2174 |
| Healthcare | Hospital | 30 | 565 |
| | Clinic, Doctor's office / medical center / emergency / Animal hospital | 181 | |
| | Health center, Health station | 14 | |
| | Dental clinic | 212 | |
| | Pharmacy | 128 | |
| Commercial | Bank building, Post office | 130 | 2166 |
| | Shopping center | 82 | |
| | Shop, Commercial building | 316 | |
| | Restaurant, Fast food, Food court | 672 | |
| | Bakery | 55 | |
| | Café | 327 | |
| | Supermarkets, Convenience stores, Kiosk | 584 | |

The network of walkable streets and paths applied in the analyses was downloaded from OpenStreetMap and prepared using the R and ESRI ArcGIS Pro software. The walking speed was set to 5km/h.

### 3.2.3. Step by step description of the analysis

The first step was to calculate the accessibility to main facilities within the 15-minute walking distance with different residential areas of Oslo as starting points. To do this, different network and spatial analysis tools in the software ESRI ArcGIS Pro were used.

As the basis for analysis, we used the statistical SSB 250m*250m grid with population information covering Oslo municipality. To identify residential areas, we eliminated all cells with less than 30 inhabitants. This means that we only took into consideration areas with minimum population density of 480 inhabitants per $km^2$, while the average population density for the city proper is around 1,500 inhabitants per $km^2$. The result was 1874 cells with a population between 30 and 2325 inhabitants (see Fig. 1).

Next, we created points in the centers of all the 1874 cells as origins for network analysis. The points are 250m apart and approximate places of residence for most of the residents of Oslo. Then, we added the network of walking and used the Service Area tool to generate polygons representing areas that can be reached by walking within 15 min from all points of origin. For further analysis, we added point layers representing the locations of different facilities.

Fig. 2 presents an example of three random overlapped 15-minute service areas, estimated from the center points of the marked cells that represent places of residence. In the background of the picture, street networks and other grid cells are shown. The colored points are various facilities located within the 15-minute walking distance. As this visualization demonstrates, most points (facilities) can be accessed by people in different 15-minute areas. Therefore, they have been counted multiple times, once for each population cell.

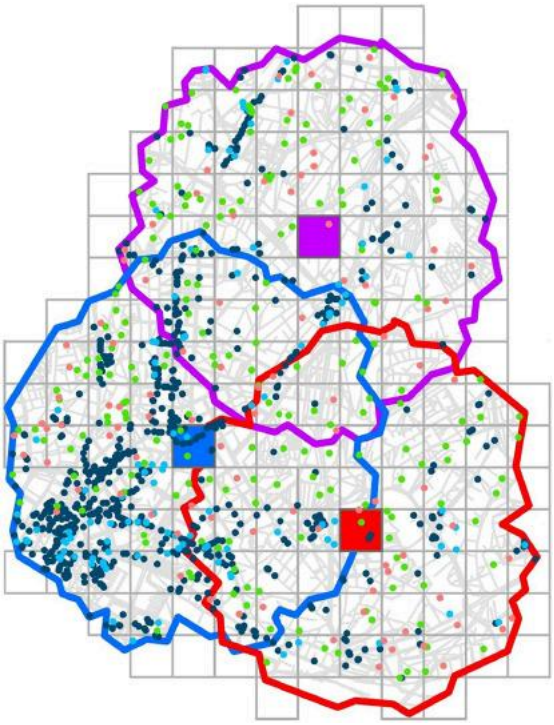

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Fig. 2. Sample of three 15-minute service areas.

In the next step we used the Summarize Within analysis tool to transfer information about the number of facilities within all the created 15-minute polygons. Since most of the generated 1874 polygons overlap, the generated maps were illegible. Therefore, all the data (number of facilities within each 15-minute service area) was transferred from polygons to their respective 250m*250m grid cells which the service area polygons correspond to. In other words, grid cells shown in the final maps symbolize their own 15-minute walking extents (see Fig. 2).

The final maps symbolize the approximated number of different facilities accessible within 15 min' walk for people living within the grid cell areas. All the maps are classified into six classes based on the natural breaks (Jenks) in the value ranges. The darker color represents more facilities and higher accessibility. In addition, areas where no facilities of a certain type can be accessed within a 15-minute walk were marked in grey.

Additional analysis was done using Kernel Density Estimation (KDE) and spatial correlation Moran's I index methods to understand the spatial patterns of different facilities throughout the entire city. We used the KDE tool to aggregate the number of facilities into geographic clusters. 'High-value clusters' represent a greater number of facilities, and 'low-value kernel groups' contain areas with a smaller number of facilities. Similarly, Moran's I analysis identified hot spot neighborhoods (red color squares) where multiple adjacent cells have high accessibility to facilities, and cold spots (blue color squares) which are clusters with areas with lower accessibility. We have also examined accessibility correlation patterns based on the population data in each grid cell.

### 3.2.4. Assumptions and limitations of the GIS-analysis

The GIS-analysis required making certain assumptions and simplifications, which in turn led to limitations we reflect upon here. As mentioned, spatial distribution data have been combined from different datasets (accessible via Geonorge and OSM) to increase validity and reliability. However, this led to some limitations on the outcome. For example, some of the same facilities have been shown multiple times with little distance from each other; while the same facility (such as a school) could be marked by different buildings that belong to the same complex. This necessitated simplification and manual manipulation of the data. For some educational and entertainment facilities, which appeared as multiple points in a very close proximity, we created 50-meter dissolved buffers and selected only one point in the middle. For larger institutions, such as hospitals, we considered one point in each corner of the property, rather than only one point in the center. During simplifications, most of the data were compared with satellite images to make sure that the facilities are part of the same complex and to avoid removing features by mistake. It is, however, possible that some facilities have been missed and others counted more than once. We also did not take into consideration the capacity of different facilities and whether or not there is actual demand to expand schools, kindergartens and health centers in areas where these are already located.

Significant simplifications were also done to measure access to green spaces, which are normally represented as polygons. In the first step, we divided green space polygons into three area categories: less than 100 $m^2$, 100–300 $m^2$, and over 300 $m^2$. For the forested area (Marka), which surrounds the city, we only considered the zone that lays within 150 m from the built area as a recreational area. This was done by generating a buffer, which was then added to the green space layer. We concluded that green spaces smaller than 100 $m^2$ were too small to be considered recreational areas and were therefore removed. This assumption is based on our observation that such spaces, if they are used at all, do not attract activity over longer periods of time. Green spaces between 100 and 300 $m^2$ were represented as one point in the middle. For the largest green space category (including the forested buffer), we used the Grid Index Features tool to divide them into squares sized 250m*250m. After removing the polygons that were too small (usually along the edges), we created center points for all the remaining green space cells. In other words, by converting green spaces into grid points, larger green areas were considered as multiple facilities and smaller ones were counted as fewer, or in some cases one facility. This conversion is visualized on Fig. 3.

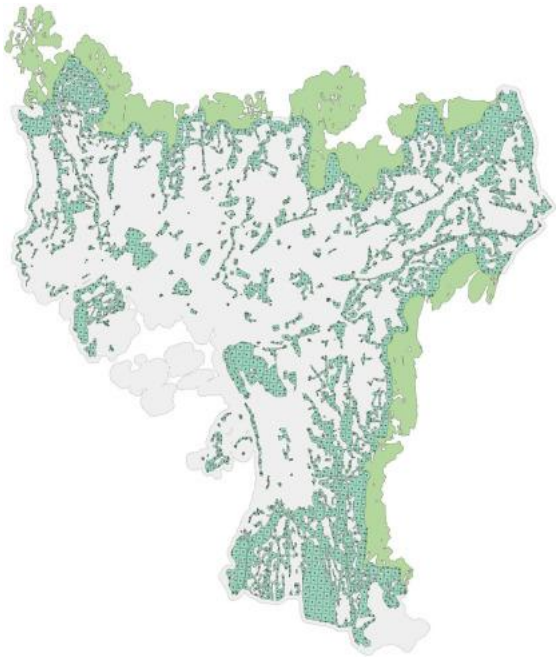

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Fig. 3. Simplifications of green space areas.

In terms of the walkable network, we identified three types of limitations. First, there is uncertainty related to the possibly outdated, incomplete or missing paths and intersections that were not properly connected. Second, slopes are not taken into consideration, meaning that the network is entirely flat. This implies that in reality some paths are longer than they appear in the program and assumes that people are willing to traverse steep and flat paths equally. Third, a walking speed of 5 km/h might assumedly be too fast for certain groups such as seniors, children, and people with physical disabilities, a concern that was also raised by Wilberg et al. (2023).

Our accessibility analysis for Hovinbyen is limited, because at the time the population data was collected (2019), many of the housing projects have not yet been finished or did not start, which means that large sectors of Hovinbyen did not qualify for accessibility analysis (Fig. 9). There has also been a significant number of new facilities, especially within the green spaces, education and commercial categories. When it comes to the analysis of how far can residents in Hovinbyen walk within 15-minutes, there are also certain limitations, because at the time of writing this, many of the roads and paths are being redeveloped.

### 3.2.5. Review of similar GIS studies

After reviewing relevant literature on the use of GIS to study accessibility within x-minutes, two studies stand out as particularly relevant for this paper.

A similar method of analyzing and visualizing accessibility to different facilities and jobs, though then for cyclists, was done in Utrecht, the Netherlands, by Knap et al. (2022) using grid cells of 500m*500m. Although methodologically strong, we believe that this grid density is too coarse to perform a detailed geographic analysis. Independently of us, a Norwegian consulting company Asplan Viak developed an accessibility study of different types of facilities in Oslo within 5-, 10- and 15-minute walking distances, combined with a detailed connectivity study (Berglund, 2022). Their methods are more robust compared to ours regarding connectivity, as they take into consideration street and

block lengths and crossing densities. This is something we did not investigate directly. Regarding accessibility, however, we consider our analysis of to be more accurate, as we set the starting points in the actual places of residence. For this, Asplan Viak used evenly spaced points across the entire built-up area of Oslo, regardless of use or density. Beyond this, our results are relatively similar and show the same areas as being highly or less accessible.

Other recent studies which use GIS methods to study the x-minute city concept, see e.g., Caselli et al. (2022), Gorrini et al. (2023), Kesarovski & Hernández-Palacio (2023), Jiang et al. (2024), Rhoads et al. (2023), Yang et al. (2023) and Zhang et al. (2023), apply very different approaches and are therefore not further discussed here.

## 3.3. Interviews and document studies

In addition to the GIS analysis, our study delved comprehensively into the underlying principles of the 15-minute city concept through a particular document analysis and a series of semi-structured interviews with key urban planners in the Oslo municipality. The document analysis involved a systematic review of official planning documents, urban development strategies, and relevant policy frameworks. This approach enabled us to gain a deeper understanding of how the 15-minute concept has been conceptualized, and integrated into the city development framework. The aim was to explore similarities and differences between the current planning schemes and principles of Oslo, and the ideas of the 15-miunte city (or a similar concept). Moreover, we wanted to explore what a local understanding of the 15-minute idea might look like in a city like Oslo.

### 3.3.1. Document analysis

In regards to planning documents, we used both legally binding and non-binding plans at city and neighborhood scales from 2012 onwards. By scrutinizing these documents, we aimed to uncover the intended goals, priorities, and challenges associated with implementing the 15-minute city paradigm in Oslo. For the in-depth exploration of Hovinbyen we focused primarily on the *Strategic Plan for Hovinbyen* from 2018. We have also studied a handbook on public spaces by the Department for Planning at the Ministry of Local Government and Modernization, which introduced a 10-minute city concept as a good practice (Kommunal- og moderniseringsdepartementet, 2016). The documents included in the analysis are listed in Table 2.

Table 2. List of documents included in the analysis.

| **Legally binding planning documents (Oslo municipality)** | **Relevant sub-plans (Oslo municipality)** |
|---|---|
| Municipal plan - Oslo towards 2030 | Climate change adaptation strategy 2014–2030 |
| Municipal plan for Oslo 2018 - Vision, Goals, and Strategies Towards 2040 | Climate and energy strategy for Oslo, 2016 |
| Strategic plan for the municipality of Oslo 2020–2023 (revised version) | Action plans for age-friendly city, 2017 |
| Small house plan, 2023 | Oslo European green capital, 2019 |
| Proposal for a new high-rise strategy, 2023 | Car-free livability 2017–2019 |
| Proposal for a new Municipal Lan Use Plan - Oslo Towards 2030 (for public consultation, yet to be approved by the council) | The urban development of Oslo, 2017 |
| **Other planning documents** | |
| Strategic plan for Hovinbyen (Oslo municipality), 2018 | |
| Handbook on public spaces (Department for Planning at the Ministry of Local Government and Modernisation), 2016 | |

### 3.3.2. Interviews with municipal planners

Semi-structured interviews were conducted with four municipal planners working on land-use and transportation plans at the Oslo's Planning and Building Agency (PBE), which means that they were directly or indirectly involved in developing a 15-minute strategy in Oslo. This allowed us to capture both the theoretical and the practical understanding that underlie the city's efforts to embrace the 15-minute paradigm, offering a more holistic perspective on its feasibility, challenges, and potential benefits. The maps generated from the GIS analysis and the relevant aspects from the reviewed plans served as discussion points. We sought out the planners to explore their perspectives of the 15-minute city concept, the decision-making processes guiding its incorporation, and the adjustments to align the concept with the city's unique socio-economic and geographical characteristics. Some of the main questions concerned the awareness of 15-minute city idea, ongoing relevant strategies and policies in Oslo, the city's progress towards becoming a 15-minute city, planner's own perspectives on implementing the concept in Oslo and comparisons with TOD principles. See Appendix for the full interview guide.

The conversations concerned both the city in general, and Hovinbyen more specifically. We used content analysis and coding strategies to structure and categorize the recorded information (Bengtsson, 2016).

For a more detailed description of our methods, see Akrami (2022).

## 4. Findings

### 4.1. GIS-analysis and map results

#### 4.1.1. Area of the 15-minute service areas

Fig. 4 shows that there are significant differences between the extent of areas that residents in different parts of the city can cover within a 15-minute walk. People living closer to the city center can walk further than those who live in suburban areas, which, as explained, are more car-oriented. This is not surprising, considering that most of the central areas were developed before cars became a widely accessible mode of transportation. This shows how a well-connected street network based on a grid structure is a very important factor to achieve a 15-minute city. Walkability in most parts the outer areas is limited not only due to car domination, but also hilly topography, which enlarges distances between different destinations.

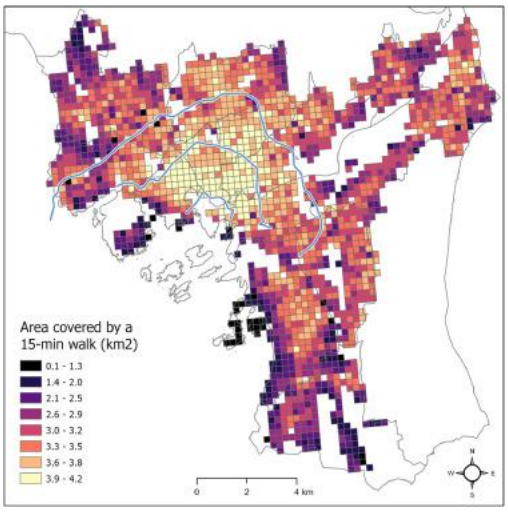


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Fig. 4. Area coverage of 15-minutes walking service area from residential areas and the Ring roads 1, 2 and 3.

#### 4.1.2. Accessibility to facilities within 15-minute walking distance

The maps in Fig. 5 demonstrate the spatial distribution pattern of each facility in the city. Unsurprisingly, commercial, entertainment and healthcare facilities are concentrated in the city center, while educational facilities and kindergartens are more or less evenly distributed in residential areas.

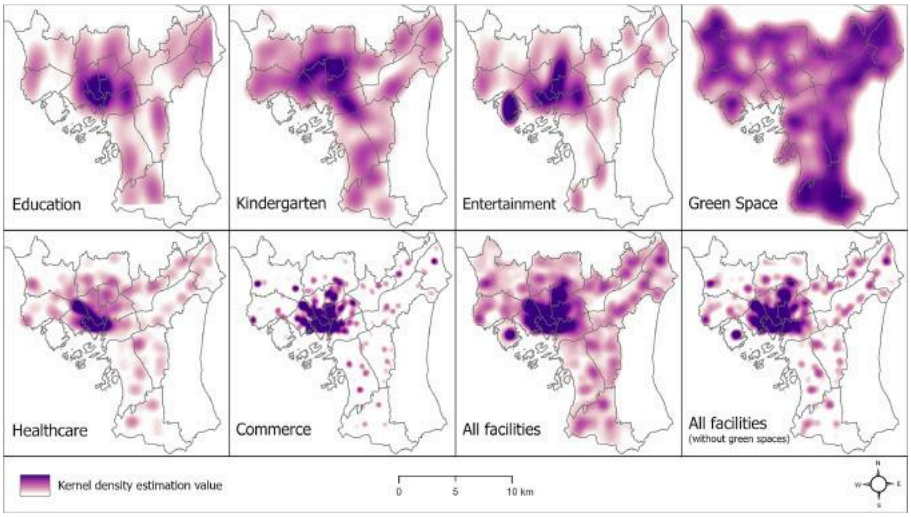


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Fig. 5. Spatial distribution of facilities based on the KDE analysis in Oslo.

Fig. 6 shows the main result of our study: the number of facilities in each category accessible within a 15-minute walk for people living in different parts of the city.

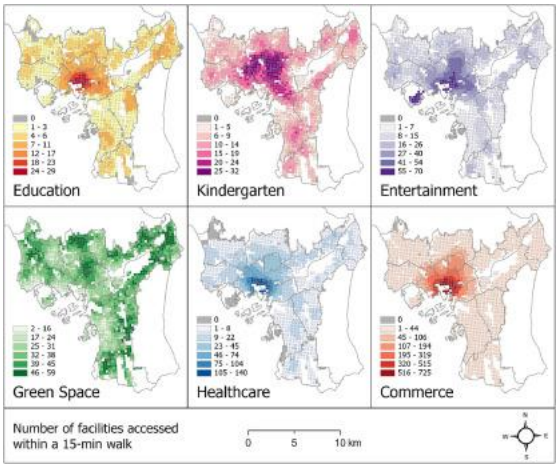


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Fig. 6. . Access to different types of facilities within a 15-minute walk.

Fig. 7 shows spatial distribution patterns for all types of facilities. Spatial correlation analysis shows that generally, the distribution pattern of all facilities in Oslo is positive and greater than the significance level test. The Moran's I value for total facilities with and without green space are 0.940674 and 0.939918 respectively. This confirms that there is a high clustering pattern in all facilities in the inner parts of the city. The clustered pattern can also be seen in commercial, healthcare and entertainment facilities (Moran's I score of 0.937286, 0.926985 and 0.901312 respectively). Green spaces have the lowest clustering rate of all facility categories.

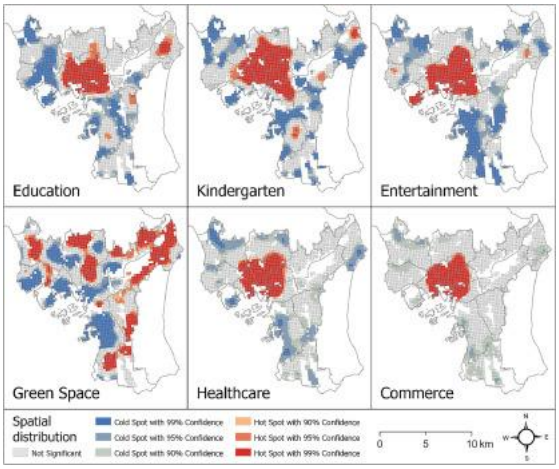


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Fig. 7. Spatial distribution patterns for access to different types of facilities

Fig. 8 shows the overall spatial distribution for all facilities combined. To enable comparison between different boroughs of the city (see Fig. 1), the general level of accessibility is further divided into three classes of high, medium, and low. 'High accessibility'-boroughs are those where all or most all of the 15-minute service areas have high accessibility to different facilities; 'low accessibility'-boroughs usually contain polygons with the lowest accessibility. This 'high-medium-low'-categorization was done by counting the number of cells from the spatial distribution analysis corresponding to hot spots and cold spots in each borough, arranging them from the most accessible (high coverage of hot spot cells) to least accessible (high coverage of cold spots) and finding 'natural breaks' between them. The accessibility scores in different districts of the city are summarized in Table 3.

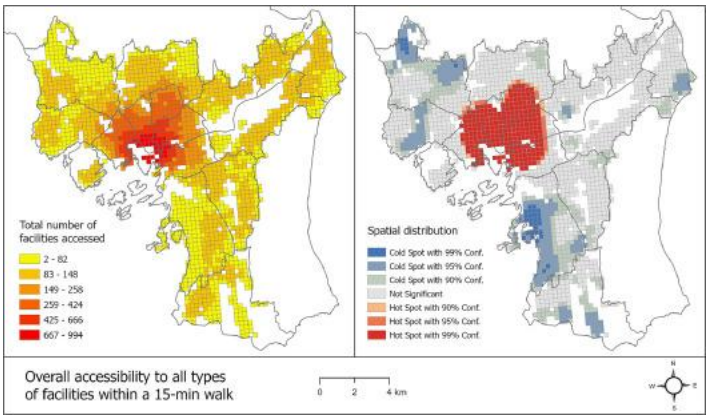


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Fig. 8. The total number of facilities accessed within a 15-min walk (left) and spatial distribution patterns (right). The borough limits are marked on the maps in dark grey.

Table 3. Accessibility scores (high/medium/low) to different kinds of facilities based on spatial distribution patterns. The list of boroughs is arranged from those whose central point lays closest from the city center (arbitrarily chosen as Oslo S train station) on top to those furthest away on the bottom.

| Borough | Education | Kindergarten | Entertainment | Green space | Healthcare | Commercial | Overall facilities |
|---|---|---|---|---|---|---|---|
| Sentrum | **High** | **Medium** | **High** | **Low** | **High** | **High** | **High** |
| Gamle Oslo | **High** | **High** | **High** | **Low** | **High** | **High** | **High** |
| St. Hanshaugen | **High** | **High** | **High** | **Medium** | **High** | **High** | **High** |
| Grünerløkka | **High** | **High** | **High** | **High** | **High** | **High** | **High** |

| Borough | Education | Kindergarten | Entertainment | Green space | Healthcare | Commercial | Overall facilities |
|---|---|---|---|---|---|---|---|
| Frogner | **Medium** | **High** | **High** | **Medium** | **High** | **High** | **High** |
| Sagene | **High** | **High** | **High** | **High** | **High** | **High** | **High** |
| Nordstrand | **Medium** | **Low** | **Low** | **Low** | **Low** | **Medium** | **Low** |
| Nordre Aker | **Medium** | **High** | **Medium** | **High** | **Medium** | **Medium** | **Medium** |
| Bjerke | **Medium** | **Medium** | **Medium** | **Medium** | **Medium** | **Medium** | **Medium** |
| Østensjø | **Low** | **Medium** | **Low** | **High** | **Medium** | **Medium** | **Medium** |
| Ullern | **Low** | **Medium** | **Medium** | **Medium** | **Medium** | **Medium** | **Medium** |
| Vestre Aker | **Low** | **Low** | **Low** | **Medium** | **Low** | **Medium** | **Low** |
| Alna | **Medium** | **Medium** | **Medium** | **High** | **Medium** | **Medium** | **Medium** |
| Grorud | **Medium** | **Medium** | **Medium** | **High** | **Medium** | **Medium** | **Medium** |
| S. Nordstrand | **Medium** | **Medium** | **Low** | **High** | **Medium** | **Low** | **Medium** |
| Stovner | **Medium** | **Medium** | **Medium** | **High** | **Medium** | **Medium** | **Medium** |

We find a significant divide between access to the different kinds of facilities in the city center and the inner-city boroughs (the first six boroughs in Table 3) on the one side and boroughs outside Ring 3 in the more suburban areas (bottom ten) on the other. This mirrors and supports our findings related to areas covered by a 15-min walk.

When it comes to green spaces, almost all residents of Oslo have a choice of at least two green spaces within the 15-minute walking distance. Most of them are located outside of the center and follow rivers and streams, such as Akerselva, Alnaelva, Lysakerelva, Frognerelva, Ljanselva, Hovinbekken etc, or are part of the forests in Marka at the edge of the built area. The Nordstrand region is the only suburban location where residents have slightly fewer green spaces in their neighborhoods. This is a low-density area not bordering Marka. However, it consists of mainly single-family houses with private gardens, meaning that the demand for public green spaces may also be lower there. As private gardens were not considered in the green space dataset, this shows the limitation of ranking areas with different typology based on accessibility to green spaces.

Entertainment facilities are also highly concentrated in the city center, but there is also a cluster in the Frogner borough, which is due to the large number of museums located in the Bygdøy area.

### 4.1.3. Key findings

In sum, we find that the accessibility to all services in the inner city is remarkably higher than in the outer city. This is primarily related to inhabitants living there being able to walk further within 15-minutes, and because the concentration of different facilities is higher. Our findings indicate that approximately 35 % of the population lives in these highly accessible 15-minute service areas. Furthermore, about 50 % of Oslo's population lives in what we classify as districts with medium level of access to services. The remaining 15 % are those living in the suburban areas with lowest accessibility to different services, such as the north of Vestre Aker, west of Nordstrand, south of Søndre Nordstrand, and southeast of Stovner boroughs. These are also areas with low population density and high usage of cars. However, each of these districts do have local centers with higher concentration of facilities, which most inhabitants can access within reasonable walking distance. These are typically areas located around train, subway or tram stops and can therefore be considered TODs, or places with potential of becoming TODs.

## 4.2. Findings from document studies and interviews

### 4.2.1. Document analysis

According to the main municipal master plans, Oslo's urban development builds on two main strategies: 'Compact city' and 'Transit-oriented development' (Oslo municipality, 2015, 2018a, 2020). Both share the same goals of achieving long-term sustainability, equity, and inclusiveness.

Although our study focuses on walking, in many of the analyzed planning documents walking and cycling are frequently mentioned together or classified under the same mobility category. Where poignant, we therefore include cycling when referring to findings in these documents. In terms of prioritizing modes of transportation, the planning authorities in Oslo place pedestrians and cyclists (including users of electric bicycles) on top of the hierarchy, followed by public transportation. Individual motorized transportation is actively discouraged, though electric cars are preferred over petrol and diesel vehicles (Oslo municipality, 2019a).

Complementary strategies include development based on the ‘inside out’-approach, mixed-use buildings and a blue-green agenda (Oslo municipality, 2015, 2018a, 2020). The "inside out" approach aims at achieving a dense multifunctional structure in the already pedestrian friendly city center (covering Bjørvika, Ensjø, Majorstuen, St. Hanshaugen, and Grünerløkka neighborhoods) and around transportation hubs in other areas (such as Gaustad, Smestad, Vollebekk, Stovner, Furuset, and Mortensrud). This idea is further supported by the new ‘High-rise strategy’ (*høyhusstrategi*), which proposes increasing the permitted building height limits in selected areas (Oslo S, Majorstuen, Skøyen, Lysaker, Nydalen, Forskningsparken, Bryn and some parts of Hovinbyen) (Oslo municipality, 2023a). The overall goal is to further reduce car dependency and develop more walkable neighborhoods throughout the city (Oslo municipality, 2013, 2016, 2019a).

From the social sustainability perspective, the revised city plans are highly concentrated on creating livable and self-sufficient neighborhoods where people can meet their necessities in their local areas and be involved in social and cultural activities, in line with previous findings by Næss (2014) and Lang et al. (2022). These goals and plans are defined by the municipality as ‘A city with space for everyone’ (*En by med plass til alle*), ‘Neighborhood values’ (*Nabolagsverdier*), and ‘Everyday city - neighborhood values and simpler life’ (*Hverdagsbyen – nabolagsverdier og enklere liv*) (Oslo municipality, 2018a, 2020)..

The blue-green agenda in Oslo focuses on healthy lifestyle, attractiveness and ecology through improving access to green spaces and opening up rivers and streams that have been channeled underground (Oslo municipality, 2015). By creating a network of linear parks, this strategy further promotes walking (and cycling).

In addition, the municipal plan from 2018 adds two fundamental principles, which are closely correlated with the 15-minute city concept: the ‘Zero-emission city’ and the ‘Everyday city’ (Oslo municipality, 2018a). The former focuses on energy use and measures to radically decrease greenhouse gas emissions from all sectors, including, but not limited to transportation. The Everyday city strategy intends to create safe and attractive neighborhoods for all age groups and ensure a high quality of life. The same principles have also been outlined in more detail in Oslo's climate strategy (Oslo municipality, 2013, 2016) and the 'Age-friendly city' plan (Oslo municipality, 2017b) respectively. Oslo's ambition to become climate neutral was further strengthened in 2019, when the city was appointed as the European green capital.

Although the plans outlined above do not mention the ‘15-minute city’ (or similar) concept explicitly, the formulations used in these plans indicate that the main development goals in Oslo are aligned with its main principles, as well as the 10-minute city principles defined by the Ministry of Local Government and Modernisation (Kommunal- og moderniseringsdepartementet, 2016). The guiding planning strategies in Oslo attempt to develop a dense and walkable city center and self-sufficient, mixed-use neighborhoods around transit stops, where people could live and work without the need of commuting by car. Accessibility to different facilities was an important principle of the new land use plan for Oslo, which is expected to be approved in 2024. The plan proposal (Oslo municipality, 2023c) does not make references to time-based access, but states as a goal that all residents should have all the basic amenities within a 500- or 1,000-meter distance from home, and recreational spaces, parks and/or playground within 200 m. Other principles mentioned in different planning documents that indirectly support these goals are strengthening local recreational and educational services, better integration of newcomers and minorities, addressing the needs of the elderly, improved participation processes, digitalization, and diversification of housing types (Oslo municipality, 2017a, 2017b, 2018a, 2020, 2023c).

An important constrain for achieving the 15-minute goal is also the recently adopted ‘Small house plan’ (*Småhusplanen*), which limits densification possibilities in existing neighborhoods with single family- and row-houses (Oslo municipality, 2023b). According to our study, these areas have the lowest accessibility to services within a 15-minute walk (see Fig. 8 and Table 3).

### 4.2.2. Interviews with municipal planners

In the next step in our research, we discussed the understanding of the 15-minute concept and its application in practice in Oslo with planners working for the municipal government.

Our interviewees had a good understanding of the 15-minute city concept and told us that the application of similar strategies, such as the 10- or 5-minute city and Everyday city have been debated in Oslo. The informants claimed that the priorities in Oslo's recent planning documents are aligned with the idea of creating a 15-minute city or neighborhood. One aspect that the planners are especially attracted to is how the 15-minute city idea can help Oslo achieve its ambitious climate goals through reducing energy use from cars and replacing car trips with walking and cycling. The interviewees explained that although the 15-minute city is not a deliberately stated goal for the whole city, the concept is considered for the development of new areas, such as Hovinbyen, which is the case area we analyze in detail in the next section:
The plans are not called the 15-minute city, but in smaller area plans, it is always a goal to increase walking and cycling; implicitly a 15-minute city. However, in municipal plans, at least there are some references to the 15-minute city concept. (Planner 2)

The results of our GIS analysis did not surprise the planners we talked to. They were aware of the fact that accessibility to services varied across the city. One of the main points that came up during the interviews was that the main strategies to get closer to achieving a 15-minute city are to continue improving walking and cycling connections and densify areas around transit stops in suburban areas:

Oslo is a relatively small city on an international scale. The city is almost a 15-minute city with some lacks in the outer areas (due to fewer facilities). But the inner parts are a 15-minute city, even a 5-minute city in the core parts. Establishing some urban spots in the suburbs or the city's fringe is required. However, some steep hills in the city make walking and cycling more difficult. (Planner 4)

Besides complicated topography, another challenge mentioned by the planners we talked to is that the average density in the outer city may not create enough demand for all kinds of jobs, retail or services, which means that some of these will continue to be concentrated in the city center, larger shopping malls or office parks.

Interestingly, one of the interviewees claimed that since the coverage and frequency of subways, trams and buses is relatively good, the accessibility measure should include public transit trips and if that is the case, then almost the entire city has achieved the concept of a 15-minute city. Another planner pointed out that making the entirety of Oslo a 15-minute city is neither possible nor desirable, because some people prefer to live close to the forest and places with lower population density and lower buildings. An example of such an area mentioned in one interview is Holmenkollen (Vestre Aker borough), where the redevelopment potential is limited to individual properties around transit stops. The fact that this neighborhood is dominated by single-family houses, is situated on steep hills and close to the forest makes it politically and practically impossible to implement the '15-minute city' concept there.

According to one of the planners, Oslo's development goes in the direction towards a 15-minute city, but it takes a long time to implement it. She explained that this delay has to do with the fact that most of the zoning plans and building applications favor concentrating development around several sites, rather than promoting a truly decentralized growth model. The planners agreed that a broader look and prioritization of areas with lower development potential is needed to make Oslo a 15-minute city. This means that the municipality must guide more development towards the accessible local centers on the city's outskirts, where mixed-use buildings and workplaces are strictly enforced. There is a need for coordinated plans to ensure that all facilities are accessible within walking and biking distance and that the infrastructure promotes non-motorized mobility. For example, one planner suggested that schools should be located in central areas of the neighborhoods, rather than on the edges.

## 4.3. Hovinbyen – ongoing urban redevelopment

Our analysis of Hovinbyen shows a significant east-west divide (Fig. 9). In general, people living on the western side (closer to the city center and its older neighborhoods) have better accessibility to all facilities, including green spaces. This area has better connectivity and walking infrastructure than the eastern part. Low connectivity and accessibility scores are especially evident for low-density neighborhoods such as of Risløkka and Teisen, located east of Ring road 3 (Fig. 10), which seems to work as a significant accessibility barrier. It is important to mention, however, that Hovinbyen is relatively well served by public transportation, with several subway and bus lines passing through its different parts. Most of the residents are able to reach the city center within 30-minutes by bike or public transport.

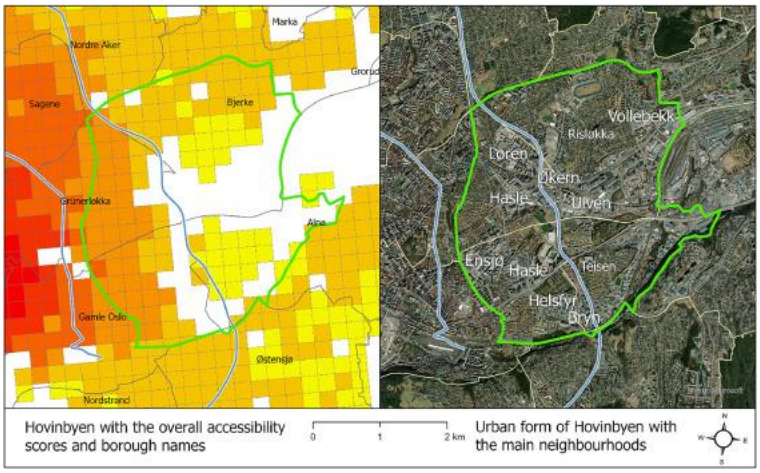


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Fig. 9. Location and context of Hovinbyen with Ring road 3 in the middle. Sources: ESRI / Maxar Technologies.

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Fig. 10. View of the Ring road 3 in the Økern area (2023), which is the central part and largest concentration of redevelopment projects in Hovinbyen. Foto: Marcin Sliwa.

The Strategic Plan for Hovinbyen sets three fundamental goals for the future of the area. First, it will become a 'future-oriented' and 'climate-smart' urban extension. The second goal is to offer a diversity of attractive urban spaces that are closely intertwined with each other and the rest of the city. The third and final ambition is to make walking, cycling and public transport the easiest and most attractive ways to travel (Oslo municipality, 2018b). These goals are in line with the 15-minute concept, which was also confirmed by the planners we spoke to: Working on Hovinbyen project development will make a big part of Oslo a 15-minute city within the next years (Planner 1).

One of the goals of the strategic plan of Hovinbyen is to create 15-minute neighborhoods in this part of the city, aiming to extend the interest and improve the qualities of the outer part of the city center (Planner 2).

The plan includes multiple references to the principles of improved accessibility to diverse facilities and spaces, which would be achieved through a combination of different strategies, such as improving walkable network connectivity, raising density and encouraging mixed-use development (Fig. 11).

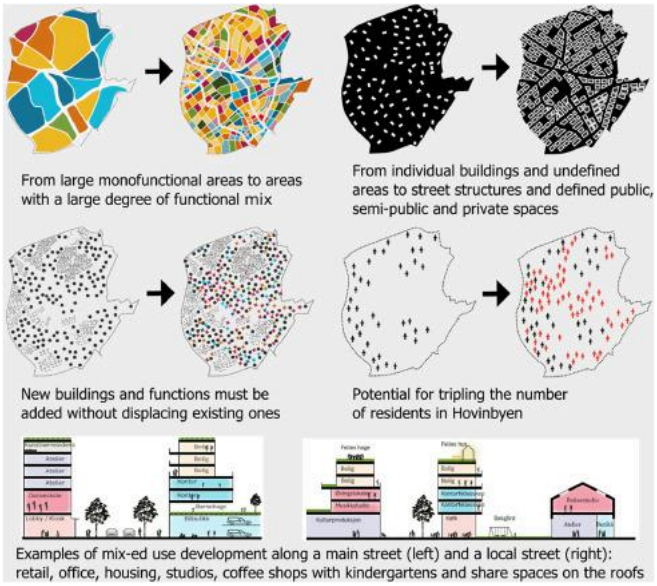


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Fig. 11. Visual representation of the different planning strategies in Hovinbyen to improve accessibility and develop a mixed-use, dense urban form. Source: Strategisk plan for Hovinbyen (Oslo municipality, 2018b).

The plan for Hovinbyen goes beyond the ambition of making the area a 15-minute city. It states that it should be developed as a '10-minute city', where distances between housing, workplaces and different services are even shorter and can easily be reached by foot:
In Hovinbyen, we make everyday life easier by ensuring proximity between housing and daily chores such as shopping, hiking areas, kindergarten, school services and leisure activities. Everyday functions are within walking distance from home. The inhabitants of Hovinbyen should have less than a 10-minute walk to the public transport stop. The 10-minute city contributes to a vibrant urban area, attractive urban environment, good public health, and less energy spent on transport. (Oslo municipality, 2018b, p. 80).

This 10-minute city goal is, once again, in line with the guidelines by the Ministry of Local Government and Regional Development (Kommunal- og moderniseringsdepartementet, 2016).

Accessibility to green spaces would be improved through the 'green belt' strategy, which assumes creating a 6 km long circular green trail for walking (and cycling) around Hovinbyen, linking existing and new parks as well as local streams and rivers (Oslo municipality, 2017a).

One of the planners we talked with emphasized that by developing Hovinbyen as a 10-minute city, it could serve as an example for other redevelopment projects of similar size. Considering the location and future ambitions for Hovinbyen, the redevelopment strategy of the area offers a possibility to extend the characteristics of the city center eastward. The plans show that those who prepared the strategy for future development of Hovinbyen acknowledge that the walkability and good accessibility to different facilities in older parts of Oslo deserve replication and that the 15-, or 10-minute concept can be a useful concept to argue for such a development model.

However, the strategic plan for Hovinbyen (Oslo municipality, 2018b) document does not include any analyses or simulations of accessibility within a 15- or 10-minute walk for the area such as the ones we present in this article. Such study, before and/or after redevelopment, could potentially identify areas where accessibility could be more limited, and then assess whether these challenges could be addressed through for example improvement of the road network or different configuration of desired land uses, including distribution of green spaces.

As Hovinbyen is a heterogeneous area with different typologies and priorities, its redevelopment will affect its neighborhoods unevenly. The strategy for Hovinbyen assumes most intense densification and mixed-use development around the already existing subway stations, which was also confirmed by a planner we talked to:
Thereby, it is more important to develop population density around public transport nodes and places where there is already a city center or established neighborhoods, such as Hovinbyen (Planner 2).

Another example for uneven development in Hovinbyen is that some parts have been identified as potential locations for new high-rise buildings (Oslo municipality, 2023a), while others are protected from densification by the 'Small house plan' (Oslo municipality, 2023b). After studying Hovinbyen, we are left with a question of whether or not it is desirable to develop such a large and diverse area according to the same development model, as assumed by the 15- or 10-minute city.

## 5. Discussion

In this section, we attempt to answer our research questions and connect our findings with relevant theory and studies from Oslo and other cities. To recall, our research questions ask about the extent of today's Oslo as a 15-minute city, and whether this concept ought to be integrated in urban planning strategies.

### 5.1. To what extent is today's Oslo a 15-minute city?

In short, we find that today's Oslo is, to a large extent, a 15-minute city. However, there is a significant disparity between the level of accessibility in the inner and outer parts of Oslo. Our analysis suggests that the inner city already fulfills the primary consideration of the concept, due to high concentration of facilities and good walking infrastructure. This aligns with previous research done in Oslo by Berglund (2022), Lang et al. (2022), Lunke↗(↗2022)↗ and Di Marino et al. (2023)↗. Moreover, our analysis of Oslo suggests that though a 15-minute city is not in itself a stated goal, several existing planning strategies holds similar elements and could guide the development in such a direction.

Not surprisingly, the level of accessibility decreases as we go further out from the city center. According to our study, the areas surrounding the city center have a medium level of accessibility to essential services within a 15-minute walking distance. Yet, as there are a lot of densification and redevelopment projects taking place in these areas, there are reasons to believe that the high level of accessibility typical to the center can extend outwards. This includes our case study area Hovinbyen, where improvements of the walking infrastructure and diversification of land uses may turn it not only into a 15, but even a 10-minute city. Furthermore, planning document review and interviews show how key planning strategies aim at improving walking accessibility in suburban areas, both in terms of facilitating multi-modal mobility and allocating more spaces for mixed-use and dense urban development.

However, as densification and mixed-use development is to be concentrated around existing transportation nodes, the low levels of accessibility in larger neighborhoods dominated by single-family houses will likely remain the same. This is mainly due to the strategy of strict limits on densification and redevelopment in these areas (Oslo municipality, 2023b). Hence, they might have good access to green spaces (both

private and public) and kindergartens, while other facilities, like certain types of retail, entertainment or health services, continue to be too far to walk to. These districts also have fewer well-connected street networks, which makes walking more difficult. Moreover, some areas are often perceived as having limited access to public transport, making them more car dependent (Næss, 2012; Lang et al., 2022; Lunke, 2022; Nenseth & Røe, 2023). This could be partly remedied with increased permeability and connectivity, e.g., by increasing number of pedestrian (and cyclist) shortcuts.

A potential consequence of Oslo's current development strategies of investments in parks and open spaces in selected areas, together with the densification and redevelopment projects around the city center, is rising real-estate prices (Haarstad et al., 2022; Lunke, 2022). This, in turn, can push low-income families or single-income households further out into the suburbs or to the surrounding municipalities outside of Oslo. Assuming that they will preserve their jobs in or around the city center, these households will to a larger extent rely on public transportation or may be forced to purchase cars. The success of a 15-minute city strategy for a city like Oslo could therefore, in part, depend on a better redistribution of offices and workplaces across the city. This somewhat contradicts the idea of concentrating office development in three large innovation districts (Oslo municipality, 2019b) and centralizing health services (Jakobsen, 2022). However, following findings by Di Marino et al. (2023), supporting increased remote working (from home, coworking spaces, etc.) could be a way to strengthen Oslo as a 15-minute city while still keeping to those ideas.

## 5.2. Should the 15-minute city concept be integrated in urban planning strategies?

Our findings support the criticism presented on how the 15-minute city concept cannot be considered a universal model for city-wide planning, at least not for existing cities (Capasso Da Silva et al., 2019; Pozoukidou & Chatziyiannaki, 2021; Allam et al., 2022b; Ferrer-Ortiz et al., 2022; Marchigiani & Bonfantini, 2022; Noworól et al., 2022; Staricco, 2022; Zhang et al., 2022; Birkenfeld et al., 2023; Khavarian-Garmsir et al., 2023; Limerick et al., 2023; Olivari et al., 2023; Wilberg, 2023). This relates, in part, to limitations regarding how much can be done in existing developed areas, and whether (potentially) radical changes are desired at all. While older parts of a city might meet the 15-minute city criteria, low-density suburbs are less likely to turn into 15-minute neighborhoods unless larger structural changes are made. Our study showed how this applies to Oslo. In general, there is often a need to strengthen walking accessibility in a city's outer and suburban areas, for sustainability and public health reasons, to mention some. However, the 15-minute concept might not (always) be the right approach. As an example, by focusing only on accessibility, the concept does not consider the demand for and intensity of use of certain facilities. Research in Oslo indicates that many sports fields, playgrounds, and other spaces for recreation around densely populated areas are used beyond their capacity. This is listed as one of the reasons why many families with children prefer to move to low-density areas (Nordbakke, 2018). Moreover, analyses like ours that follow the 15-minute city concept may overvalue accessing the greatest rather than a sufficient number of facilities. This is an important discussion regarding a city's urban development strategies and inhabitants' quality of life. Though likely without a distinct right or wrong answer. Living within close proximity to a larger choice of, e.g., commercial facilities or green spaces may be a privilege, but in some cases having one good quality facility of the same kind is just enough to maintain a high quality of life.

Another issue with a strict application of the 15-minute concept is how 15-, 10- or 30-minutes has been set as a 'benchmark' for measuring whether something is accessible or not. This tends to overgeneralize how many minutes different groups of people are able or willing to walk to access certain services. This is a well-known issue within walking research (see e.g., Hagen et al., 2019), and an aspect we observed while conducting our GIS analysis.

Based on our study, we suggest that the 15-minute city concept can be a useful analytical tool to assess how effective such strategies are in reaching defined goals across the same city. This is in line with the claim of Olivari et al. (2023), who write that the success of the 15-minute city model requires data-driven assessment of its development. Such approaches can also enable comparing results for one city with other cities where similar or different measures have been taken. What we find particularly useful is that the findings of such studies will recognize differences within the same urban areas. It can also serve for comparison and as a diagnostic tool to identify districts of a city with particularly poor accessibility where contextualized interventions may be prioritized. For example, in areas with low accessibility to particular facilities, e.g., retail, a contextual planning intervention may involve allocating or rezoning to permit commercial or mixed-use development. In another example, areas with a seemingly good facility mix yet high car use, might face problems with badly connected or unattractive pedestrian infrastructure. In these cases, planning interventions can focus on improving pedestrian conditions.

We must underline, however, that for such uses, GIS-analysis as those presented here should be complemented with place-specific, qualitative assessments 'in the field' and participatory processes for a more complete 'diagnosis' of an area or a neighborhood. As an example, overuse of recreation spaces and entertainment facilities, as mentioned above, may be difficult to document using quantitative and GIS methods. See e.g., Hagen and Rynning (2021) for further discussions on combining GIS and qualitative assessment approaches.

The 15-minutes city concept as an analytical tool can, furthermore, be useful for redevelopment projects such as Hovinbyen, or to plan new neighborhoods and city extensions. A 15-minute (or similar) analysis can be done for the existing situation (before development) and to evaluate different planning alternatives in terms of connectivity, distribution of uses and density. This could identify areas with limited accessibility, which, in turn, can help planners assess whether these challenges could be addressed through, for example, improvement of the road network or different configuration of desired land uses, including distribution of green spaces.

Based on our findings, we would therefore be hesitant to say that the 15-minute city concept can serve as a stand-alone or principal urban planning strategy. Perhaps the concept is more applicable and beneficial for urban planning if viewed beyond increasing proximity and rather decreasing the need for travelling. If adhering somewhat strict to inhabitants being able to access everyday facilities and essential services within 15 min walking (or cycling) the concept could be a means to promote sustainable and health-promoting mobility habits through urban planning.

## 6. Conclusion

In this article, we tested the 15-minute city concept on Oslo, Norway, by analyzing accessibility to different facilities within a 15-minute walk using GIS software. We also reviewed relevant planning documents, interviewed municipal planners in Oslo, and studied the planning strategies of a case area currently in development (Hovinbyen). Considering the lack of studies on the 15-minute city in the Nordics and mid-sized capitals, our article contributes with a relevant case for those interested in this region or cities of similar size.

We found that large parts of Oslo, particularly those centrally located, already have many of the characteristics of a 15-minute city. Moreover, that several neighborhoods around the city center are being transformed in a similar direction. We also found that there are several low-density and mono-functional neighborhoods further out with low walking accessibility scores, which, according to current plans, are unlikely to change much in the foreseeable future. Hence, we conclude that Oslo is to a large extent already a 15-minutes city, but with a considerable disparity between its inner and outer parts.

The lack of studies that apply similar analytical methods and definitions of facility types in other cities makes it difficult to compare accessibility across contexts. We believe that the methodology presented here offers a way to do so, for example, to compare cities and metropolitan regions to study the effectiveness of their planning strategies.

Based on our study, as well as ongoing discussions regarding the 'real-life' applicability of the 15-minute city concept, we question whether it ought to serve as a city's main development strategy. However, it can be an interesting complement to existing strategies as a means to advocate for sustainable and health-promoting mobility habits by focusing on accessibility to facilities. The concept can therefore be considered a flexible tool that can support other planning strategies that aim at promoting walking and other sustainable modes of transportation, or creating livable and more self-sufficient neighborhoods. Indeed, our study shows how analyzing a city from the perspective of a 15-minutes' walk can be useful as a diagnostic, for example to assist planning in rapidly redeveloping areas or city extensions.

This methodology can be further improved by ensuring good quality and updated network, considering slopes and different walking speeds. Similar studies would also be more robust if they include accessibility analysis not only for walking, but also cycling as a preferred way of moving around. Moreover, as suggested in the discussion, it should be combined with place-specific, qualitative assessments and participatory planning processes before contextual interventions are implemented.

By acknowledging the limitations of the 15-minute city concept and our study, we would like to suggest a few ideas for further research. As mentioned before, including cycling and/or public transport in accessibility studies could result in mapping more robust and realistic travel patterns (see Knap et al., 2022 and Wolański, 2023). Rather than approaching cities as if they were a system of more or less self-sufficient neighborhoods (as studies like ours tend to do), such an approach would enable a better understanding of how local, city-wide and metropolitan networks are intertwined. A qualitative study could also explore to what extent people enjoy having numerous facilities nearby, and how this is linked to a neighborhood being considered a good neighborhood to live in.

Whenever possible, similar analyses should attempt to include variables regarding capacity and demand to different facilities, as well as socio-economic characteristics of the different neighborhoods. Our accessibility analysis only took into consideration the physical location of different facilities within all areas with 30 or more registered residents. What remains invisible in our maps is how some facilities (especially recreational spaces, schools, kindergartens or health services) might be accessible for many by a short walk, but are in fact used beyond their capacity. The analysis can be further improved by adding socio-economic variables, which would help to prioritize interventions where poverty and vulnerability levels are highest. Further studies can measure accessibility and demographic changes over time to identify potential negative consequences, such as gentrification, segregation and growing inequalities. More detailed studies can also be done to measure accessibility to different types of jobs across the city in terms of the chosen transportation modes.

We would like to repeat that planning based on accessibility studies should take into consideration the socio-economic inequalities within urban areas. As noted by Cavicchia (2021; 2023), urban inequality and housing unaffordability are problems that Oslo has been faced with in the last decades, similar to many other cities worldwide (see for example UN-Habitat, 2022). Analyses that do not consider the socio-economic factors could potentially exacerbate these socio-spatial segregation processes by focusing interventions in upper-income areas or neighborhoods in danger of gentrification. Instead, the aim should be for the 15-minute city concept to, together with other planning strategies, improve accessibility in such a way that its benefits are distributed fairly and more equally throughout the city, or perhaps the metropolitan region, making it more sustainable not only ecologically but also economically and socially.

## CRediT authorship contribution statement

**Mahsa Akrami:** Writing – original draft, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Marcin Wojciech Sliwa:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Software, Project administration, Methodology, Formal analysis. **Maja Karoline Rynning:** Writing – review & editing, Validation, Supervision, Methodology, Conceptualization.

## 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

We would like to thank Per Gunnar Røe and Mina Di Marino for commenting on the draft of this article, Torstein Storsveen Throndsen for assistance with developing a walkable network for GIS analysis, and Katherine Rose Weir for language editing. We appreciate the support of the University of Oslo, the Agency for Planning and Building Services at the City of Oslo and the Institute of Transport Economics (TØI). We would also like to thank the anonymous reviewers for their very useful suggestions. This article was made possible in part by the project Making people walk more in small Norwegian cities (WALKMORE financed by the Research Council of Norway (project number 301992).

## Appendix: interview guide

1. What is your position today (where do you work, and what do you do), and which work-related positions have you had earlier?
2. What is your educational background and your current degree?
3. To what extent have you worked with transport and land use-issues?
4. What kind of knowledge do you use in your work with transport, land use and urban planning issues?
    a. Cases from other Norwegian Cities
    b. International examples
    c. Reports and consultancy reports
    d. White papers
    e. Research literature and articles
5. Do you know the concept of the 15-minute city?
    a. If yes, go to the next question.
    b. If no, use time to explain the concept and its principles, and add some examples.
6. To what extent Oslo is a 15-minute city?
    a. How far has Oslo got in creating 15-minute neighborhoods?
    b. To what extent Oslo have the potential to satisfy the 15-minute city criteria?
    c. To what extent Oslo's planning policies are in the direction of creating a 15-minute city/neighborhood?
7. What kind of strategy or policy exist that leads the city to become more in line with the 15-minutes city concept? Is there any plan to make Oslo as a 15-minutes city?
    a. Is it a strategy known by politicians?
    b. Has it been discussed politically?
    c. Has it been used amongst municipal planners
8. To what extent planners would welcome the 15-minute city concept in Oslo's future plan?
    a. Is this a good strategy?
    b. Is it a good strategy for reducing emissions and energy use?

c. Is it a good strategy to create livable and socially inclusive urban and suburban districts?

9. How may Oslo's policies be changed to develop 15-minute city strategy? And based on the current situation of Oslo, what are the main priorities to implement 15-minute city in Oslo?
   a. What is needed to become a 15-minute city?
   b. Political decisions and governance?
   c. Land use changes and infrastructure changes?
   d. Other things?

10. What are the differences between TOD-principles (TOD: Transit Oriented Development or “knutepunktsutvikling”) and the 15-minute concept?
   a. With respect to infrastructure development and densification
   b. With respect to the location and diversity of urban functions, services, work places, etc.
   c. With respect to densification of dwellings and urban functions
   d. With respect to livability, social inclusion, social justice, etc.

11. Do you have any further comments?



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