Urban Labyrinth: Accessibility and 15-Minute Cities

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Abstract. The "15-minute city" concept aims to enhance urban sustainability by ensuring that residents can access essential services, employment, and recreational opportunities within a 15-minute walk or bike ride from their homes. While this model offers numerous benefits, such as improved accessibility and reduced car dependency, it has faced criticisms regarding potential marginalization of individuals with reduced mobility and those in less densely populated areas. Concerns have also been raised about the variables used to define the concept and potential exclusions based on walking speed. Despite these challenges, the 15-minute city model is gaining global traction, with significant support from urban leaders, planners, and the European Union, which is funding initiatives to implement this model across Europe. This study investigates the practical application of 15-minute city principles in various urban environments within the Basque Country, revealing that denser cities exhibit greater disparities in service access based on demographic factors like gender and age. The findings suggest that while the concept holds transformative potential, it may necessitate redefinition to address issues of exclusion and inclusivity, highlighting the importance of incorporating alternative transport modes and adapting the model to diverse urban contexts.

1. Introduction

The concept of "15-minute cities" has emerged as a promising solution to address urban challenges in the context of rapid urbanization and sustainability concerns. These cities aim to provide residents with access to essential services, employment, and recreation within a 15-minute walking or biking radius from their homes (Moreno et al., 2021).

By creating compact and diversified neighborhoods, 15-minute cities promote accessibility, reduce car dependency, and encourage healthier lifestyles (Nieuwenhuijsen, 2021). Concentrating activities in smaller areas can also mitigate traffic congestion, lower carbon emissions, and decrease the ecological footprint of urban areas (Nieuwenhuijsen, 2021).

While the 15-minute city concept offers numerous benefits, critics raise valid concerns. Some worry that this approach may marginalize individuals with reduced mobility or those in less densely populated areas (Pozoukidou & Chatziyiannaki, 2021). Questions about the variables considered in defining a 15-minute city and potential exclusions based on walking speed have also been raised (Pozoukidou & Chatziyiannaki, 2021). These criticisms highlight the importance of addressing biases and ensuring inclusivity in the development of 15-minute cities, understood 'bias' as inequality in access to essential services within a 15-minute walking radius, influenced by factors such as population density, gender and age.

Given the growing interest in the 15-minute city model as a sustainable urban planning solution, this study seeks to answer the following research question: How does the implementation of the 15-minute city model impact accessibility to essential services among different demographic groups in diverse urban settings? This question is crucial to understanding the inclusivity and practical feasibility of the model, especially in diverse urban settings with different population densities and socio-economic conditions. In this concern, the European Union has recognized the transformative potential of this approach and is supporting initiatives to implement 15-minute city principles in cities across Europe (European Commission, 2023).

Through funding programs, research, and policies, the EU aims to foster the creation of sustainable, inclusive, and resilient neighborhoods aligned with the ethos of 15-minute cities. Research examining the practical implementation of 15-minute city principles in real urban environments provides valuable insights into designing cities that are equitable, sustainable, and people-centered (Moreno et al., 2021). By studying how these principles materialize on the ground, urban planners and policymakers can better understand how to create urban spaces that enhance quality of life, promote sustainability, and prioritize the well-being of residents.

2. Methodology

This study focuses on the assessment of accessibility to essential services within a 15-minute walking radius in several cities of the Basque Country, using geospatial data obtained from OpenStreetMap (OSM).

OpenStreetMap was selected as the primary data source due to its detailed and up-to-date mapping of urban environments, as well as its open access nature, which allows for extensive customisation and integration into GIS-based models.

Although OpenStreetMap has a label to characterise the main use of each building (residential, commercial...), there are a large number of buildings that are under the

standard "yes" label. This can be seen in figure. 1, where the buildings are shown under the labels "residential" (blue) and "yes" (green).

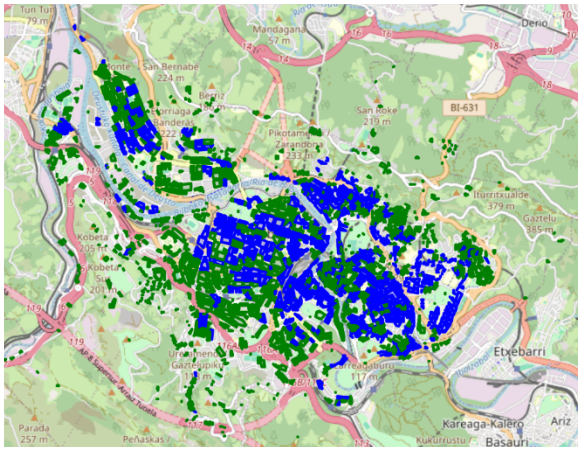

Figure 1. Analysis of the buildings under the labels "residential" (blue) and "yes" (green) on the Bilbao area.

The model developed for this analysis, defined as an algorithm that calculates access to services within a 15-minute walking radius, takes into account different demographic profiles. A ‘profile’ in this context refers to a group of people defined by characteristics such as gender, age and mobility.

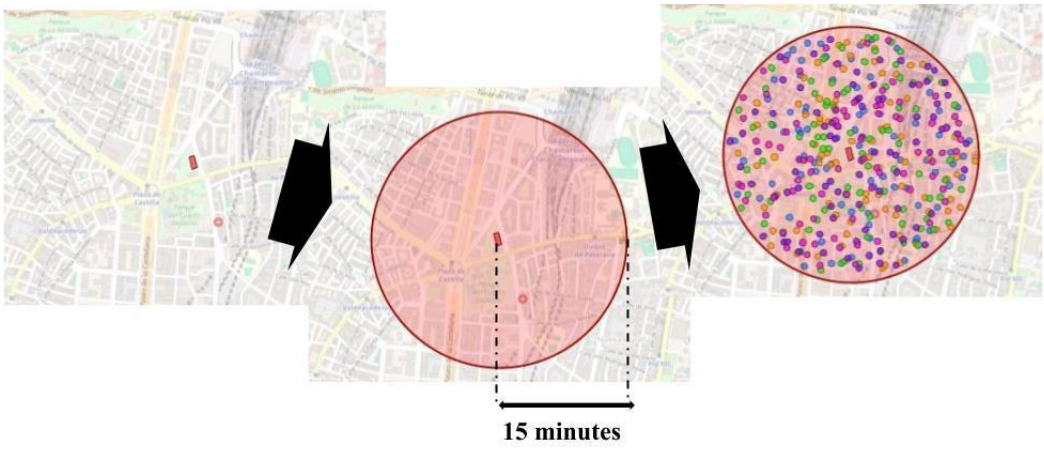

Figure 2. Visual representation of how the algorithm works.

As depicted in Figure 2, we start by taking a building as a reference and then create an area equal to all possible destinations that can be reached within a 15-minute walk. After this, a call is made to OSM to collect all the services (amenity) of the given area and work with this data. This process is repeated for each building and for each profile, i.e. a building is taken and the available services are evaluated for each of the 12 profiles to be considered. The following figure 3 shows this operation in the form of a pseudocode.

```
Determinate all buildings from an area
for = 1 : building all buildings:
     Assign a building to evaluate
     for = 1 : agent all types_of_agents:
          Create a 15min area based on the centre of building
          Gather all service data on the area from OSM
     end for agent
     Services clustering
end for building
Data printing
```

Figure 3. Pseudo code of the algorithm.

The validation of the model was carried out by visualising the results generated by the algorithm and the researchers' in situ knowledge of the territories. Using their experience in the urban areas of the Basque Country, the researchers compared the model's predictions with actual observations, adjusting it to accurately reflect local conditions. Although no comprehensive quantitative validation was carried out, this qualitative approach provided an adequate level of confidence with what was considered necessary for the study.

3. Results

This study has been carried out considering three large cities, three medium-sized cities and three towns in the Basque Country region of Spain. The main reason for focusing on such a small geographical space is to be able to compare infrastructures. As we collect our first data, we are not yet sure about the impact of differences in culture, policies, types of urbanisation, etc. Therefore, comparing areas in close proximity allows us to do so in a more confident and informed way, as it is the territory where we are located. This Figure 4 shows, in order of highest to lowest population, a total of nine urbanised areas.

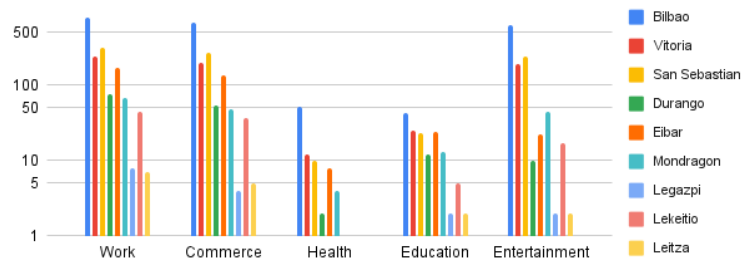

Figure 4. Services offered on 15 minute-area.

This figure shows that the higher the population, the higher the density of services available within a 15-minute radius.

We can also compare the data by gender, as shown in Figure 5, which reveals another interesting aspect. The percentage showing the reduction in access to services by gender indicates that, for example, in the case of Bilbao, women have 7% less access to services in each category. It can be seen how the more populated areas have a more pronounced bias than the others.

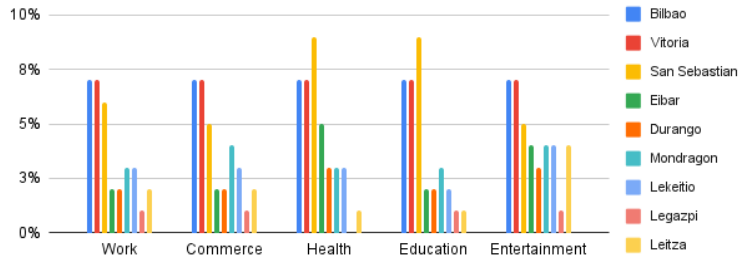

Figure 5. Gender inequality between analyzed areas.

This difference becomes more evident when comparing by age group. The following figure compares access for people aged 70-80 with that of people aged 20-30. This comparison allows us to draw other conclusions, such as that densely populated areas tend to marginalise those with a lower capacity for speed of travel or mobility.

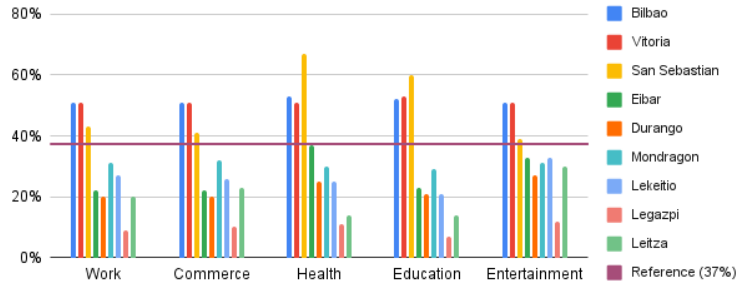

Figure 6. Age inequality between analyzed areas (70-80 compared to 20-30).

This phenomenon is accentuated when considering the reference line shown in the graph. Since, as mentioned above, travel speed varies according to gender and age, reference indicates the bias that we should consider only by taking into account the speed of travel. So, results show how big cities tend to have worse results than they should, based on walking speed decrease due to age, while small towns and villages act better than supposed to.

It can also be seen that, at the level of type of service, large cities also have more marked differences, with up to a 10% difference between the service with the least bias (entertainment) and the one with the most (health). These biases can be seen in the following table.

Table 1. Age inequality between analyzed areas (70-80 compared to 20-30).

		Work	Commerce	Health	Education	Entertainment
70-80	Big City	48%	48%	57%	55%	47%
	City	24%	25%	31%	24%	30%
	Town	23%	24%	22%	20%	28%

Table 1 shows how large cities are more biased in health and education, cities in health and entertainment and towns mostly in entertainment.

4. Conclusions

The results indicate that more densely populated cities exhibit a more pronounced bias compared to what might be expected based on certain criteria. This "bias" refers to the inequality in access to services within a 15-minute walking radius, with less populated areas showing a lower degree of inequality. However, these conclusions should be interpreted with caution, as the methodology used may not fully capture the complexity of factors influencing service accessibility.

This suggests that in contemporary cities, it is essential to consider the integration of other modes of transport, beyond walking or cycling, to fulfill Carlos Moreno's original definition of the 15-minute city. This definition should be expanded to include access to services via public transport, especially in areas where service density is insufficient to meet citizens' needs within walking distance. In these cases, regions with a high level of services in a small area, such as some tourist cities, may function as 15-minute cities without having been planned as such.

For instance, in the case of Lekeitio, we observe that the density of services, especially in the work and commercial sectors, is notably higher than in other areas with a similar population. We hypothesize that this peculiarity is due to the fact that the town's main economic activity is tourism, suggesting that tourism could improve access to jobs and other services.

5. Future Research Lines

Our current main focus is on adapting the model to a more realistic environment, considering more complex technical and social aspects. A key technical aspect will be the analysis of accessibility through isochrone maps, rather than using a simple radius around each building. This will provide a more accurate picture of service accessibility.

In the social sphere, we are highly interested in applying demographic factors specific to each region to understand the real needs of the population. Similarly, after objectively evaluating accessibility, we will integrate this data with social aspects to justify the 15-minute city concept, assessing accessibility in contrast to the real needs of residents.

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