Accessibility as an indicator to estimate social exclusion in public transport

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Abstract

Accessibility is one of the key measures of urban transportation planning, which quantify how easy is the access to a facility. Public transport accessibility concerns of the access level of geographical locations to public transport. In this paper, accessibility will be used as an indicator to measure accurately the maximum walking distance that someone is expected to take to reach a station or stop of a public transport network. Different groups of the population will be assessed in order to estimate social exclusion. A real life case study was conducted to get insight into the transportation network of the Porto Metropolitan Area (AMP), Portugal. For this purpose, geographic, demographic and infrastructure data of the AMP were collected and integrated. Also, webservices were used to measure walking distances between two locations. The results of this study allowed to characterize the zones in the AMP by different levels of accessibility, providing insight into the social exclusion in public transport. This assessment is used not only to identify inequities but also to get an overview of the service quality of public transports.

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1. Introduction

Recent studies show that not just the performance of public transportation but also its impact on other social aspects should be considered in the planning of public transport facilities. Since the lack of access to transportation leads to social exclusion, social equity is increasingly incorporated as a long-term objective into urban transportation plans in order to enable people from distinct groups of population to reach destinations at reasonable costs and times. The degree of easiness to access a public transport facility is mainly driven by the walking capacities of travellers. However, the ability to walk may change due to several factors as demographic and physiological characteristics as well as external factors. Therefore, socially disadvantaged individuals as physically impaired people need to be carefully addressed.
The main goal of this research is to accurately assess the walking accessibility to public transport for different groups of the population. For each group, the maximum walking distance expected to take a public transport will be quantified taking into account the distance that a traveller takes to reach a station or stop of bus, metro and train.

2. Methodology and analysis

A common indicator to measure the functional exercise capacity that reflects the individual capacity to perform activities of daily living is the six-minute walking distance (6MWD), which is the main outcome of the six-minute walk test (6MWT). Several studies defined reference equations to predict the 6MWD in healthy subjects from specific places. To take public transport in a regular basis, people are expected to walk up to 8 min for getting a bus and 12 min for getting rail services. Hence, 6MWD reference equations (or values) can be used to determine the maximum distance an individual may walk to access the public transport.

The area that an individual can reach within a given walking distance (or time) is defined by an isoline. Functions for computing isolines based on the existing pathways (i.e., the Network Analysis approach) are commonly available in geographic information systems (GIS), as well as in webservices for routing and navigation. Considering the access points (stops and stations) of a public transport network, isolines can be used to measure the accessibility to public transport by identifying the covered area. Demographic and geographic information can be used to quantify the population and urban amenities in a specific space. This information can be obtained from various sources such as statistical offices or webservices.

3. Results and discussion

A case study was conducted to analyze the accessibility to the public transport network (over 11,500 bus stops and 170 train/tram stations) of the Porto Metropolitan Area (AMP), Portugal. Being the second biggest in the country with about 1.75 million inhabitants, the AMP covers 2040 km². The results show that less than 1% of the population living in the city center have no access to public transports. This value increase to around 5.5% in the outskirts of Porto and to more than 20% in the suburbs. According to these results, the elderly females living outside the city center is the group more prone to social exclusion in public transport.

In AMP, the elderly population (65 and older) is around 16%, but this figure may reach 23% in some municipalities. In Europe, the elderly is expected to grow from 19% in 2017 to 29.5% in 2060. Considering the previous figures, we can conclude that traditional public transport systems with fixed stops and stations are not a feasible solution for certain groups of the population. This is a major concern, particularly in areas with low intermodality and low accessibility as rural regions. This research provides effective means to identify either groups of population or regions with low levels of accessibility to public transport.

4. Conclusions

Social exclusion in public transport can be assessed by analyzing the walking accessibility to the public transport network for different groups of the population. This assessment can be used not only to identify inequities but also to provide insight into the service quality of public transports. Also, it provides an overview of the different regions such as city center, outskirts and suburbs. To the best of our knowledge, this is the first work based on demographic characteristics of the population for assessing walking accessibility to public transport.

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