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Spatio-temporal accessibility to public transport and nighttime leisure: a case study of youth in Alcobendas

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The long-standing tradition of studies on spatial accessibility has addressed a series of diverse issues such as access to the public transportation network, to workplaces, to collective facilities (health, cultural, etc.), to shopping, etc. The attention paid to the accessibility of certain population groups has also been considered, because of its undeniable relevance, placing the focus on the particularities (possibilities and limitations) that some segments of the population (e.g., the elderly, disabled people, children, women, etc.) have in terms of mobility.

The issue acquires its fullest dimension if it is assumed, as various studies argue, that mobility should be considered as a fundamental right of citizens (Cresswell, 2006; Habitat International Coalition, 2013) and as a key element in the fight against social exclusion (Lucas, 2012; Stanley & Stanley, 2017). Among others, Martens (2019) has recalled that the relationship between accessibility and participation in activities is complex, as it is influenced by many factors such as the characteristics of the population, the purpose of travel or the supply of activities at the destinations, etc. In the same work, the author points out that accessibility is a necessary prerequisite for participation.

In this regard, young population should occupy a primordial place in the planning of these services. They are at a critical stage in their personal development. It is the transition from childhood to adulthood, a complex period in which the individual's personality is shaped, their way of relating to other changes, their references are altered and their tastes shift (Aramayona et al., 2020; Crosnoe & Johnson, 2011; Johnson et al., 2011).

The study of these issues has historically been carried out using a wide variety of methods and data, with the use of General Transit Feed Specification or GTFS (McHugh, 2013), which has become a de facto international standard for the study of the supply of public transport, being worthy to note. Some works have already demonstrated its usefulness in detecting gaps in service supply and demand (Kaeoruean, 2020; Li & Fan, 2020), as well as to assess the effects of changes in the public transport network of a city or metropolitan area (Pereira, 2018).



Alcobendas has multiple attributes that make it a particularly interesting city. Located on the northeastern border of the municipality of Madrid and fully integrated in its metropolitan dynamics, in 2021 it had a population of 116,589 inhabitants and a per capita income of 18,118€ (one of the highest in Spain, although with notable internal contrasts). The municipality has a recently approved its Sustainable Urban Mobility Plan (Concejalía de Tráfico, Movilidad y Transportes, 2019), although its estimation of spatial accessibility is done through circular buffers, without GTFS data and with hardly any reference to young people or nighttime leisure.

Taking all of this into account, it is worth asking how the supply of urban public transportation influences the accessibility conditions of young people, particularly for their nighttime leisure trips. Taking the city of Alcobendas as an example, we have set out to answer this question by tackling four specific and interrelated objectives. The first will be to characterize the distribution of potential demand through population density and per capita income data by census tract. The second will be to determine the supply of public transportation mapping its service area during two time intervals for the Friday-Saturday and Saturday-Sunday nights (the periods in which such trips are concentrated). The third will be to evaluate inequalities, and possible spatial inequities, considering the areas served and the income levels of the population. Finally, the effect of the availability of public transportation on access to the city's main youth entertainment venues will be explored.

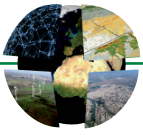
To this end, we first studied the distribution of the young population in the city and its economic characteristics by analyzing spatial kernel densities and per capita income. Next, the degree of coverage and supply of the public transport network was characterized with network analysis and GTFS data during the nights of Friday to Saturday and Saturday to Sunday, considering two time segments (before and after midnight). We then used the method of Moreno et al. (2022), based on inferential statistics, to determine the degree of inequality in accessing to the public transport service according to income level. Finally, several origin-destination matrices were generated between each building in the city having young population and a sample of nightlife venues, in order to establish the impact of public transport on the access to these destinations.

The results show a polarized municipality in terms of the spatial distribution of the young population and per capita income. Likewise, the supply of public transport varies considerably depending on the time segment analyzed. On Saturday nights, both the degree of coverage (81.59% of the young population covered) and the number of services per hour (9.14) are very high, with a relatively low average maximum waiting time (24.84 minutes).

Friday night begins to show a certain degree of reduction in the service (75.64% of the population covered and an average maximum waiting time of 28.59 minutes). However, it is after midnight, on both of the nights considered, when the greatest degradations occur. The population covered drops to 55.89% in both cases, the number of services per hour falls to 1.6 and 1.55 respectively, while the average maximum waiting time increases to 49.03 and 48.57 in the early hours of Saturday and Sunday respectively.

The analysis of accessibility inequalities shows that, although there are some areas of young population with poor accessibility to the network (between 14.81% and 16.21% of this socio-economic group), in general the service supply in the city prioritizes the young people living in the most densely populated areas and with lower per capita incomes. In fact, considering the levels of access (low, medium, high) in the total number of young people as a baseline criterion, the statistical tests reveal significantly better access to transport in the aforementioned lower income group, and access to transportation significantly worse among middle and upper income groups as well. Therefore, such discrimination appears aligned with the principle of socio-spatial equity.

Finally, the study of the origin-destination matrices has revealed that public transport in the city plays a significant role in improving the diversity of nighttime leisure destinations accessible to the population and, to a lesser extent, the increase in the number of people who can access at least one of them. For example, with a 30-minute cutoff, 86.36% of the population has access to all leisure destinations using public transport on at least one occasion compared to 22.93% on foot. For return trips, this impact is comparatively lower, although it is still present. In the case of a 30-minute cutoff, the proportion of the population accessible drops from 78.4% using public transport to 63.82% on foot.



All in all, we have sought to bring a different perspective to accessibility studies by introducing young population as the focus of the study, highlighting the importance of their access to nighttime leisure opportunities (Martens, 2019) during a critical phase in their development as citizens (Crosnoe & Johnson, 2011; Johnson et al., 2011). It is the combination of these two elements, the key problems and the methods, that introduces a greater degree of novelty to the work. In contrast to the studies by Curtis et al. (2019) and Ferreira de Gois (2018), that undertake the examination of the behavior of different groups in their nighttime leisure travel, in this case we address the issue of accessibility and spatial justice by adopting techniques, applied in previous research such as those of Bok and Kwon (2016) and Moreno et al. (2022).

At the same time, the proposed method grants results of high spatial and temporal resolution in a simple way, with a relatively low cost and based on data generated by public administrations themselves. Looking forward, the study could be pursued with additional transport data, such as the people use of CRTM Smart Cards, socioeconomic variables, such as household income, or public participation processes with greater depth and number of participants.