

Crowding in Public Transportation: Perceived Safety and Comfort of Persons with Mobility Impairments

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1 INTRODUCTION

Crowding in public transportation (PT) during peak hours is a major challenge in larger cities worldwide. With increasing urbanization and rising demand for mobility, PT systems frequently operate at or beyond their capacity, leading to discomfort, reduced service reliability, and increased safety concerns (Cox et al., 2006). To achieve a user-centered and efficient urban mobility system, PT has to be inclusive and accessible to all members of society. A transport system is considered inclusive when people with mobility impairments can use PT on equal terms with other passengers. However, high levels of crowding can create additional barriers and obstacles for these individuals, making their journeys more challenging (Bezyak et al., 2019). Designated seating or wheelchair-dedicated areas or the access to them may be blocked due to high passenger volumes, making it difficult for those who rely on them to travel safely and comfortably. Additionally, the ability to get on and off public transport efficiently is often compromised in crowded vehicles, increasing the risk of falls or accidents. These challenges highlight the need for a thorough examination of the impact of crowding on the travel experience of persons with mobility impairments. To gain valuable insights in how people with mobility impairments are affected by crowding and its influence on perceived safety and comfort, an in-vehicle online survey was administered.

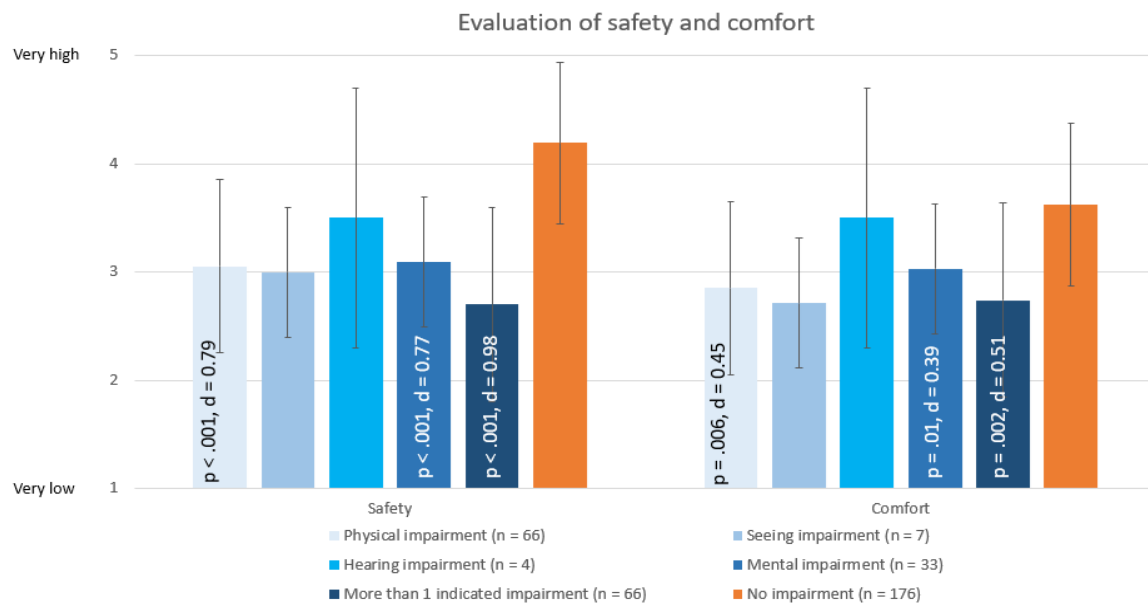
2 Method

Between July and September 2023 as well as January and June 2024 several public transport vehicles in the area of the city of Berlin and the surrounding federal state Brandenburg were equipped with QR-codes leading to a questionnaire. This questionnaire included items about demographics, potential mobility impairments, and several items about safety and comfort aspects. Altogether, 5098 persons filled in the questionnaire. 176 of the participants indicated to experience mobility impairments to some degree. To compare the data of participants with and without reported mobility impairments, a statistically matched subsample ($n = 176$) of a group of participants indicating not being mobility-impaired was created. The matching procedure was conducted via the variables “age” and “frequency of PT use”.

3 Results

The safety and comfort ratings were analyzed for participants with different kinds of mobility impairments and the matched group of participants who indicated to not be mobility-impaired. Figure 1 shows the results.

Figure 1. Evaluation of safety and comfort for different kinds of mobility impairments



Significance testing was conducted for the groups “physical disability”, “mental disability” and “more than one indicated disability” in comparison with the group “no disability”. Every group of persons with disabilities assessed both safety as well as comfort significantly worse than persons without disabilities, even though differences for comfort ratings were less pronounced. For the groups “hearing disability” and “seeing disability” no significance testing was conducted due to the small sample size.

In addition to the safety and comfort ratings, participants indicated their perceived level of crowding (PLC) of the vehicle on a scale from 1 (empty) to 100 (very crowded). Table 1 shows the correlation of PLC with the assessment of safety and comfort for groups of persons with different numbers of disabilities.

Table 1. Correlation of perceived level of crowding with safety and comfort

	Crowding Level (0-100)		
	One indicated disability (n = 115)	More than one indicated disability (n = 62)	No disability (n = 176)
Safety (1 = low, 5 = high)	r = -0.39**	r = -0.38**	r = -0.28**
Comfort (1 = low, 5 = high)	r = -0.50**	r = -0.70**	r = -0.61**

4 Discussion

The goal of this study was to examine safety and comfort assessments as well as the effect of perceived crowding among individuals with mobility impairments in public transport. The results show that individuals with different mobility impairments rated safety and comfort lower than a statistically matched control group without impairments. Safety received the lowest ratings from individuals with

multiple impairments, while comfort was rated lowest by those with physical impairments. The correlation between perceived crowding and safety was stronger for individuals with impairments than for those without. Regarding comfort, the highest correlation (-0.70) was observed among individuals with multiple impairments indicating that this group's perceived comfort is most affected by crowded public transport. A strong correlation between perceived crowding and comfort was also found in the other groups.

These findings underline the importance for targeted interventions to enhance the travel experience of people with mobility impairments. The significantly lower assessments of safety and comfort, particularly among individuals with mobility impairments, suggest that existing transport systems may not adequately accommodate their specific needs. Furthermore, the strong correlation between perceived crowding and comfort especially for persons with multiple impairments indicates that crowding plays a huge role in shaping the overall travel experience. These insights emphasize the necessity of implementing inclusive design strategies, such as improved spatial accessibility, priority seating, and real-time crowding information, to foster a safer and more comfortable public transport environment for individuals with mobility impairments.

References

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