



Mobility Patterns of People with Disabilities in Public Transport: A Case Study in Serbia



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Abstract: The utilization of public transport by people with disabilities presents significant challenges, as the services offered are often inaccessible and fail to meet the diverse needs of users. Despite attempts to improve accessibility, these solutions are often partial and poorly planned, resulting in limited connectivity to daily activities. Therefore, increasing the usage of public transport by people with disabilities requires a multifaceted approach. In this context, a research study was conducted in the Republic of Serbia through open-ended questionnaires to investigate mobility patterns, primarily focusing on rail traffic and extending to other modes of transport. The study reveals several problems, highlighting the need for collaborative interventions among authorities, transport service providers, and people with disabilities. This is the first study in the Republic of Serbia to investigate this issue, and the results indicate that the process of improving accessibility is iterative and requires ongoing monitoring to assess progress and mutual understanding. To improve the usage of railways and public transport by people with disabilities, it is essential to implement interventions that target the identified issues.

Keywords: Railway; People with disabilities; Patterns; Transport barrier; Serbia

1. Introduction

When discussing people with disabilities, it is evident that they face many challenges in various aspects of life, including public transport [1]. For persons with disabilities (PWD), using public transport can be challenging, and experiences in overcoming obstacles differ [1]. Behavioral obstacles can arise due to a lack of self-confidence among PWD, who are aware of the difficulties they face while using public transport. These obstacles can hinder PWD's daily activities, mobility, and result in discrimination. Overcoming these obstacles is crucial for PWD to achieve better inclusion and participation in society.

Analyzing the mobility problem of PWD, it is apparent that increasing their mobility through public transport is not easy. Many studies fail to consider the effects, expectations, and requirements that cause certain types of behavior [2]. Developing an appropriate tool to measure this phenomenon is a challenge. While regulations cover most of the problems faced by PWD, proposed strategies with detailed steps and institutions involved in solving them lack proper implementation and monitoring on the ground.

Lack of adequate information can lead to difficulties in accessing public transport for PWD. Insufficient or no information provided and prolonged non-use of public transport can make it challenging for PWD to stay informed, despite improvements, including rail transport. Therefore, it is crucial to understand how PWD perceive obstacles and their problems while organizing travel by public transport.

This research aims to understand the experiences of PWD, including those who do not use public transport, particularly railway transport. Data were collected from PWD with various disabilities, focusing on the following:

- Mobility problems related to obstacles
- Discrimination in public transport
- Necessary information for traveling by train

The organizational chart of this research is shown in Figure 1.

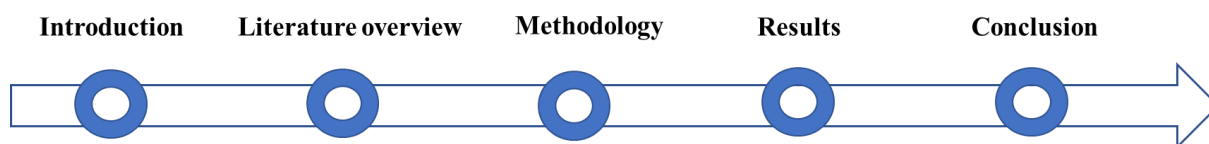


Figure 1. Structure of research

2. Literature Review

The analysis of the literature is divided into several topics that cover the observed issues through the general social aspect, obstacles, experiences, regulation, and some new directions of observation.

Some authors agree that improved transportation allows the PWD population to live more independently [1]. In the study, they presented the attitudes of the PWD population regarding transport and its approach, describing the discrimination related to transport and the obstacles they face.

In countries with weaker public transport, there is plenty of room to improve the mobility of the disabled population in particular [3]. What are the impacts that can represent, not only physical problems, costs or something else in the transport system can be just some of the questions? According to the study of Odufuwa [3], it is stated that if the problem is viewed from a holistic point of view, it will certainly give a greater opportunity to the PWD population in providing sustainable mobility, especially in developing countries.

One of the problems caused by public transport is finding jobs. What are the factors and reasons for overcoming, what needs to be fulfilled and how it reflects on the PWD population is part of the research that was carried out in the study of Coleman et al. [4].

Improvements that need to be made in order to increase social inclusion, quality of engagement, effective regulations, and strategies have been identified based on the research of best practice examples in Europe and are presented in the study [5]. Some of the tools observed in this research are the development of new technologies for assessing regulations grouped in three areas: accessibility of public transport, social impact on transport, and the transport sector. The conclusion is that an inclusive environment provides much better opportunities and a basis for participation in all activities. In order to ensure a better quality of life in an urban form, transport is also recognized according to the study of Dejeammes [6]. In this sense, improving accessibility for the PWD population and those with reduced mobility is recognized as a lifetime opportunity. Recognizing how a contribution to better inclusion of urban transport can be made, the European methodology for measuring transport accessibility was created [7].

In transport planning, accessibility is not always the first place [8]. Therefore, the offered transport services are not able to satisfy all users due to the existence of certain barriers. Transport in this case can become adapted for the PWD population only if an understanding of the planning and construction process is established, which can lead to better mobility. When talking about barriers, it can be said that they are different [9]. The increasing number of obstacles today certainly includes the provision of various information related to transport. Looking at good solutions applied in practice, an example can be given for contributing to a better society.

In the paper [10], an analysis of the population of elderly people in suburban areas was carried out using different types of interviews and travel diaries. They have determined different requirements, needs, and limitations according to different modes of transport. According to this research, obstacles represent limited access to different spaces and reduce participation in social activities.

Experience in the accessibility of London Underground travel is shown in a row [11]. An analysis of the experience of moving during peak hours was carried out by looking at the obstacles for the PWD population and how it reflects on their plans when choosing modes of transport. The research can be considered very significant because accessibility is also recognized in different regulatory parts because it is precise with such observations that a lot of room is left for increasing better accessibility.

When analyzing the social aspects of life, the physical environment, depending on the type of transport used, can have different barriers to accessibility [12]. The main component of this research is the conclusion that there is a different number of PWD population who avoid using public transport because of the difficulties they face.

In the research study of public transport and its role in society [13], which was carried out in Swedish municipalities, the positive results indicate a much-needed improvement and better interaction of all participants. Also, in the same sense, the study of Grunwald et al. [14] mentions improvements in accessibility from all aspects of vehicles, parking spaces, and arrangement of stations and stops. On the other hand, in a practical and executive sense, the study of Venter et al. [15] presented the creation of instructions for reducing obstacles in the mobility of the PWD population.

It can be said for sure that by looking at accessibility it is not possible to cover all aspects and causes of mobility. In the analysis of obstacles and a free environment in the study of Matuska [16], the accessibility of the entire transport system was analyzed. Also was mentioned one of the solutions for better accessibility is to implement

design for all.

According to the study [17], it is also suggested that it is possible to cover more aspects by implementing design for all. With this approach, a lot of space is left for a more accessible and inclusive environment by increasing accessible infrastructure and vehicles, information, and partnership participation of all interested parties to build a better urban environment by improving the regulatory aspect, technical standards in combination with the education of future designers and the application of the experiences of the PWD population.

A set of criteria was established for examining accessibility in the case of different disabilities, namely: Way of information, entry/exit from facilities, service provided, accessible environment, elevators, communication equipment for the hearing-impaired, blind and partially sighted [18]. Furthermore, these criteria can be grouped into four areas: vehicles and stations, information and staff training.

3. Study Area and Methodology

3.1 Study Area

To assess passenger perception, data was collected through a questionnaire survey about Serbian Railway network, as shown in Figure 2.

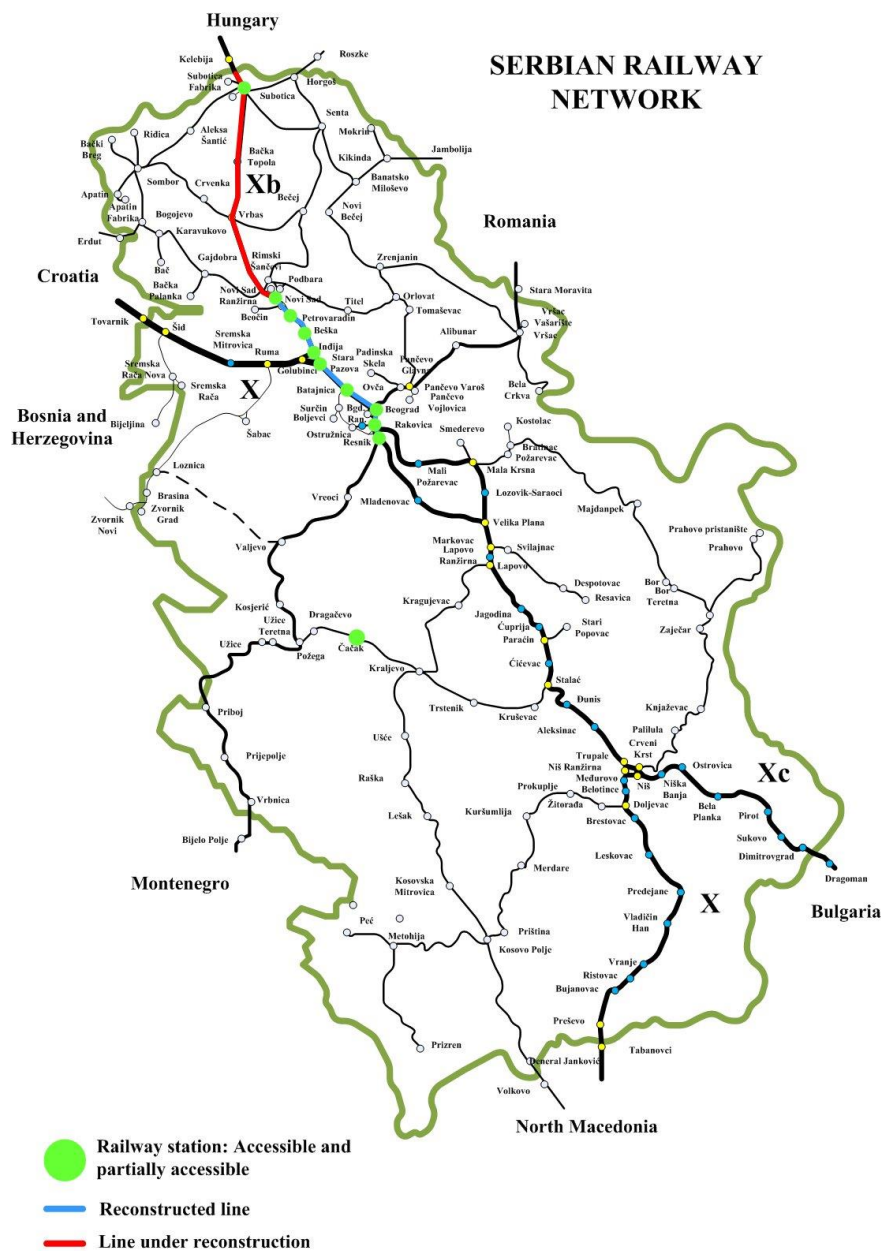


Figure 2. Serbian railway network

The total construction length of normal gauge railways within the territory of "Serbian Railway Infrastructure" a.d. is 3348.1 km, of which 3059.4 km are single-track and 288.7 km are double track. Main lines account for 1,744.4 km, while other lines account for 1,603.7 km. Moreover, 1,301.9 km of open track with main through tracks (1,013.2 km of single track and 288.7 km of double track) were electrified [19].

The railway network of the Republic of Serbia is connected to the railway network of seven countries: Croatia, Hungary, Romania, Bulgaria, North Macedonia, Montenegro and Bosnia and Herzegovina. Traffic can be organized through ten border crossings, while one is under the administration of UNMIK.

Parts of the station area intended for passengers in rail traffic are made available through "Serbian Railway Infrastructure." Additionally, the use of official places (station buildings, stops), other facilities required for the reception and dispatch of passengers, platforms, other areas required for access and approach to passengers, and other areas that enable the movement of passengers between public road access and trains are included.

From 2021 to 2023, the accessibility of facilities for persons with disabilities in wheelchairs is being analyzed on parts of the reconstructed railway network of the Railway Infrastructure of Serbia. The study of Djordjevic and Pajevic [20] conducted only on the main corridors of the Rakovica-Resnik and Belgrade center station line indicates that individual measures have been implemented, but access to all facilities and independent access to the platform for people in wheelchairs is not fully provided. It is important to note that the installation of movable platforms for the movement of persons in wheelchairs can only be replaced by an elevator construction that allows all other persons with reduced mobility to move freely, as it may be difficult to reach a person for support.

3.2 Methodology

It is important to note that people with disabilities face not only physical barriers in using rail transport. Therefore, the identification and resolution of their issues should begin from the planning stage to the practical implementation of measures. It is also imperative to consider the perspectives of people with disabilities, who are the end-users of the transport service, as their views are of invaluable significance.

This study involves 99 respondents from the PWD population, and the data was collected through a questionnaire survey conducted from September 8, 2017, to December 1, 2017. Despite the best efforts of individuals and associations, reaching the PWD population was a challenge, and the maximum possible number of respondents was collected. No further research of this type has been conducted since 2017.

The regular surveys on population mobility conducted in the Republic of Serbia do not adequately address traffic needs and accessibility issues. Therefore, data was collected from people with disabilities due to the lack of prior research or a database for this study. This is the first study in the Republic of Serbia that addresses the problems that people with disabilities face in public transportation, specifically regarding rail traffic. As there were no previous direct research studies related to transport problems and data, it was necessary to determine the presence of certain problems or concepts through the analysis of the descriptions and words that appear in the responses.

All questionnaires were submitted to associations, which were later sent by e-mail or personally handed over to the respondents. The study participants had various disabilities, including multiple sclerosis, muscular dystrophy, cerebral palsy and polio, paraplegia, hearing impairments and deafness, visual impairments and blindness, and intellectual disabilities. The surveyed population covered urban and rural areas within the Republic of Serbia.

The questionnaire was structured as an open-answer form, and an individual survey was conducted through a web-based survey. The questionnaire was divided into four parts:

1. Demographic characteristics of the respondents, including municipality of residence, gender, age, and work status (employed, dependent, pensioner).
2. Data on the type of means of transport used in the last month, such as car, bus, train, plane, taxi, and specialized vehicle for transporting persons with disabilities.
3. General data related to railways, including awareness of the accessibility of means of transport and stations arranged for people with disabilities.
4. General attitudes and open questions, including the obstacles faced by respondents in transportation, experiences of using escalators, moving paths, moving platforms, elevators, walkways, ticket machines, gates, and equipment for the hearing impaired.

The organizational scheme of the methodology is illustrated in Figure 3:

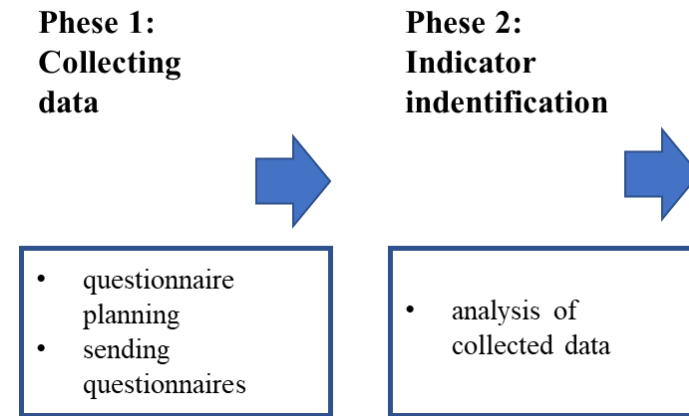


Figure 3. Scheme of data collection and processing methodology

4. Results

The classification of the PWD population was based on the databases used by PWD associations. An overview of some socio-demographic characteristics is presented in Table 1.

Table 1. Key parameters of socio-demographic characteristics

| | User's characteristics | Frequency | Percent | Cum Percent |
|-------|---|-----------|---------|-------------|
| 1 | Gender | | | |
| 1.1 | Man | 55 | 55,56 | 55,56 |
| 1.2 | Female | 44 | 44,44 | 100 |
| Total | | 99 | 100 | |
| 2 | Age | | | |
| 2.1 | < 20 | 1 | 1,01 | 1,01 |
| 2.2 | 21-25 | 3 | 3,03 | 4,04 |
| 2.3 | 26-30 | 10 | 10,10 | 14,14 |
| 2.4 | 31-40 | 27 | 27,27 | 41,41 |
| 2.5 | 41-50 | 21 | 21,21 | 62,63 |
| 2.6 | 51-65 | 28 | 28,28 | 90,91 |
| 2.7 | > 66 | 9 | 9,09 | 100 |
| Total | | 99 | 100 | |
| 3 | Mobility | | | |
| 3.1 | Walk alone | 29 | 29,29 | 29,29 |
| 3.2 | Walk alone with difficult | 19 | 19,19 | 48,48 |
| 3.3 | Walk alone with aids | 9 | 9,09 | 57,58 |
| 3.4 | Walk with the help of another person | 1 | 1,01 | 58,59 |
| 3.5 | The Wheelchair drives alone | 11 | 11,11 | 69,70 |
| 3.6 | The Wheelchair drives with the help of another person | 30 | 30,30 | 100 |
| Total | | 99 | 100 | |
| 4 | Damage to speech | | | |
| 4.1 | Without | 84 | 84,85 | 84,85 |
| 4.2 | Not much difficult conversation | 7 | 7,07 | 91,92 |
| 4.3 | Hard to understand | 5 | 5,05 | 96,97 |
| 4.4 | Do not speak but communicate | 3 | 3,03 | 100 |
| Total | | 99 | 100 | |
| 5 | Damage to the senses | | | |
| 5.1 | Does not have | 71 | 71,72 | 71,72 |
| 5.2 | Eyesight | 18 | 18,18 | 89,90 |
| 5.3 | Hearing | 8 | 8,08 | 97,98 |
| 5.4 | Combined | 2 | 2,02 | 100 |
| Total | | 99 | 100 | |
| 6 | Employment Status | | | |
| 6.1 | Employed | 27 | 27,27 | 27,27 |
| 6.2 | Supported person | 13 | 13,13 | 40,40 |
| 6.3 | Retired | 59 | 59,60 | 100 |
| Total | | 99 | 100 | |

4.1 Using Different Modes of Transport

According to the data, only around 5% of the respondents used railways in combination with other modes of transport in the last month. However, approximately 27% of the participants answered positively when asked about their general use of rail transport.

The percentage of responses related to the use of railways by individuals is presented in Figure 4.

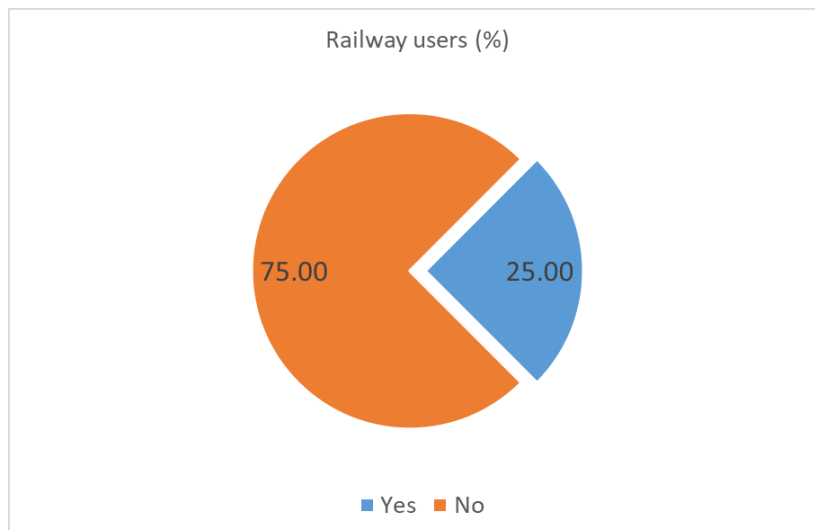


Figure 4. Percentage review of answers related to use of railways

4.2 Obstacles/Barriers and Transport

The obstacles faced by the PWD population varied depending on the type of disability and were generalizable in some segments and specific in others. The study found that the problems of meeting transportation needs for PWDs arise from the beginning, with the greatest number of responses related to the accessibility of infrastructure and vehicles, as evidenced by the following answers:

“The first obstacle is curbs, i.e., the architectural inaccessibility of streets, sidewalks, stops, etc., the second is buses and means of transport, the third is the entrance to the station, the fourth is parking spaces and their use.” (Female, walking independently, age 41-50)

“Inaccessible vehicles, inaccessible train stations.” (Male, wheelchair user, age 41-50)

“Almost no form of public transport is adapted for people with disabilities (first of all, I'm thinking of wheelchair users). From the fact that there are no ramps to enter public transport, there are no ramps to enter the train.” (Male, wheelchair user, age 31-40)

The existence of a problem is indicated by the fact that many of the PWD population do not use public transport and prefer personal transport, due to small physical obstacles that can cause great difficulties in their movement. Infrastructural obstacles such as unorganized approaches to stations or stops, insufficient numbers, or absence of parking spaces also contribute to the problem.

Wheelchair users, in particular, encounter challenges due to the absence of movable or mechanical entry/exit ramps, which are often defective, leaving them with limited options for accessing public transport services. Some individuals carry handy tools to unblock broken entry/exit ramps. For people with difficulty walking, unevenly distributed handrails or high stairs present significant obstacles. According to the respondents, there is a general lack of adapted vehicles for the PWD population.

The study also found that the provision and display of information present significant obstacles, particularly for individuals who are hearing or visually impaired. One such answer is:

“There are two basic problems in the city traffic in Belgrade: the bad sound announcement of the station, which is persistently maintained by some kind of technical service, and the number of buses at the stop.” (Male, walking independently, blind, over 66 years old)

In some cases, it can be said that the behavior of staff in public vehicles is inadequate and borders on discrimination, as indicated by the following representative responses:

“The staff who are supposed to help generally don't even know the basics about disabled people, they don't know how to approach them, or what kind of help they need. Also, the staff is often rude, I know that to some of my friends who use wheelchairs, the city bus driver the bus didn't even want to stop at the station. I used all kinds of transport, but abroad, I can say that we are at least a hundred years behind them.” (Male, wheelchair user, age

31-40)

“Drivers refuse to accept seeing a blind person at a bus stop. You can only get on the bus in front of you. If you don't get on the next bus, (means of transportation), you’ve lost it. You'll wait for the one that stops in front of you.” (Male, walking alone, blind, over 66 years old)

As shown in Table 2, the percentage of responses by individuals related to the obstacles or barriers.

Table 2. Percentage review of answers related to obstacles or barriers

| Obstacle and Barriers in transport | Percentage |
|--|-------------------|
| Without answer | 32% |
| Infrastructure | 6% |
| Vehicle | 29% |
| Infrastructure/Vehicle | 12% |
| InfraVehStaff | 4% |
| Vehicle/Staff | 4% |
| Vehicle/Passengers | 1% |
| Infrastructure/Vehicle/Price | 1% |
| Information | 4% |
| Do not have | 1% |
| Psychological | 1% |
| Vehicle/Parking | 1% |
| Safety | 1% |
| Vehicle/Staff/Passengers/Parking | 1% |
| Infrastructure/Vehicle/Staff/Passenger/Information | 1% |

4.3 Violated Rights/Discrimination

Eliminating discrimination against the PWD population can lead to better treatment in various aspects of life, including finding employment, accessing healthcare and education, and improving access to public transportation, which can increase their self-confidence.

It can be said that there is a considerable number of respondents who believe that discrimination exists everywhere, as indicated in the following response:

“I am discriminated against every day when trying to do any normal thing. In transport, at the counter, in public institutions, centers for social work.” (Female, wheelchair user, age 26-30)

Access to traffic terminals in many cases, despite the provided parking spaces, represents a major obstacle for the PWD population due to disrespect for their occupation. There is also a small number of cases in which an insufficient understanding of the non-disabled population towards the PWD population is indicated. A large percentage of the PWD population has negative experiences with staff in public transport vehicles, which can be seen from the following answers:

“Arrogant behavior of the driver or passenger on my physical handicap.” (Female, walking with the help of aids, aged 51-65)

“Impatience of drivers - they won't wait for me to get into the transport. Fewer drivers willing to help.” (Male, walks independently but with difficulty, age 51-65)

“There are fewer and fewer carriers that do not recognize preferential tickets, and the correctness and treatment of workers in urban and suburban transport (drivers, flight attendants, conductors) is also present. Passengers with any handicap often face inconveniences, belittlement, and humiliation in front of numerous passengers in city, suburban, and intercity traffic, all because of the discriminatory and arrogant attitude of conductors and drivers. My personal experience with the problem of traveling with the use of preferential tickets is a terribly bitter experience that I experienced traveling all over Serbia and the former Yugoslavia using all types of transport.” (Male, walking independently, blind, over 66 years old)

“I’m completely blind and I always carry a white cane. The service always asks for some kind of document, even though it’s clear. I had to take the prosthesis out of my jaw several times instead of a document.” (Male, walking independently, blind, over 66 years old)

“I avoid public transport precisely because of that. Once, on the way back from Montenegro by train at the Belgrade railway station, the conductors and people who were letting me off the train onto the platform dropped me and I fell. That humiliation and feeling of worthlessness absolutely distanced me from using public transport in Serbia. I used public transport successfully in Vienna, Athens, and Prague, with a sense of satisfaction.” (Male, uses a wheelchair, aged 41-50)

As shown in Table 3, the percentage of responses by individuals and unified topics related to the necessary violated rights.

Table 3. Percentage review of answers for necessary information regarding the use of the train

| Violated rights | Percentage |
|-------------------------------------|-------------------|
| Do not have | 32% |
| Without answer | 21% |
| Staff | 11% |
| Passengers | 7% |
| Infrastructure/Vehicle/Staff/Policy | 7% |
| Staff/Passengers | 5% |
| Parking | 5% |
| Staff/Privileges | 4% |
| Policy | 3% |
| Vehicle | 2% |
| Infrastructure | 1% |
| Vehicle/Passengers | 1% |

4.4 Necessary Information for Using the Railway

The poor utilization of rail transport by the PWD population is mainly due to poorly accessible infrastructure and vehicles in the past. Surveys conducted on railways, not only in the Republic of Serbia but also in the former Yugoslavia, have failed to recognize the needs of the PWD population, resulting in insufficient responses from the few who do use this mode of transport. The primary objective of these surveys is to understand their perspectives and the necessary conditions for using rail transport.

Many respondents have stated that they require comprehensive information to decide whether to use rail transport. Based on their experiences and the conducted study, it can be inferred that a large proportion of PWDs do not use rail transport at all. Accessibility is the primary concern, and it appears to be the primary obstacle that prevents them from utilizing rail transport. In this regard, the following views are presented:

“It’s hard to get on the train, so I don’t intend to use it.” (Female, wheelchair user, age 31-40)

“I don’t know if there is a train in our country that is accessible to people in wheelchairs. I don’t like someone taking me in and out.” (Female, uses a wheelchair, aged 51-65)

“I have traveled by train from Belgrade several times. At the counter itself, it is difficult to understand the ticket seller. They should highlight the updated and visible timetable. In trains, it is great that you can see which station it is, but the problem is not marking which platform the train is leaving from.” (Female, walking independently, deaf person, age 51-65)

“Timetable, fare, benefits for transport in the country and abroad.” (Female, uses a wheelchair, aged 31-40)

“Which routes can I travel on, arrival and departure times, access to a seat or place for a wheelchair user as well as the toilet.” (Male, uses a wheelchair, aged 51-60)

“I’m able to get information on the internet, but I haven’t taken the train. Maybe just a matter of physical accessibility.” (Male, uses a wheelchair, aged 31-40)

“Is there a list of stations in Braille? Is there signal, tactile, audio signaling, and are stations marked according to the needs of people with visual impairments.” (Female, blind, age 51-65)

Table 4. Percentage review of answers for necessary information regarding the use of the train

| Necessary information for using the train | Percentage |
|--|-------------------|
| Without answer | 40% |
| Do_not_use | 17% |
| Internet/Infrastructure/Timetable/Vehicle/Price | 11% |
| Vehicle | 7% |
| Information_Announcement | 4% |
| TimeTable | 3% |
| Satisfied | 3% |
| Infrastructure | 2% |
| Timetable/favored price | 2% |
| Internet | 1% |
| Priviledge/Policy | 1% |
| Support_Entering_Vehicle | 1% |
| Help_Deaf/Ticket_Office | 1% |
| Information_over_PWD_Associations | 1% |
| Plannig_Strategies | 1% |
| Infrastructure/Time_Table | 1% |
| Information/Marking_Stations | 1% |
| Infrastructure/Staff/Marking_Vehicle | 1% |
| Priviledge/Information/Sound_Announcement | 1% |

As shown in Table 4, the percentage of responses by individual and unified topics related to the necessary information for traveling by rail.

5. Conclusions

Planning and utilizing public transport for the PWD population can be extremely challenging in certain cases. A wide range of barriers can be faced by individuals with disabilities, and these barriers can be generalized to specific types of disabilities. In cases of multiple disabilities, the barriers may be compounded.

For a comprehensive understanding of the PWD population and their use of railways and public transport, the primary concerns and lack of awareness of the rights of this population can be identified based on the observed factors. In the territory of the Republic of Serbia, it has been observed that despite a sound positive regulatory framework, numerous issues remain inadequately addressed in practice.

The current state of railway vehicles on the railways of the Republic of Serbia that meet all accessibility parameters is limited, with only partial compliance on main corridors and reconstructed infrastructure. Additionally, a small number of cars and train sets do not meet accessibility requirements at all. The infrastructure, from the entrance to the platform area, is not well organized. While some stations have partially organized infrastructure, most stations do not meet accessibility standards across the entire network.

The information provided is not sufficiently tailored for the OSI population, and there is an apparent lack of coordination of accessibility elements for the PWD population at present. As such, the issue of passenger transport must be considered holistically. Drawing from the experiences of other countries with positive practices, it is crucial to further specify the strategy for rail transport, encompassing all aspects of vehicles, infrastructure, and services provided, from information to personnel.

An essential supporting element is the parallel education of students and engineers who plan, as well as the executive authorities and transport service providers. This approach is expected to foster the adoption and acceptance of positive attitudes towards addressing the challenges faced by the PWD population, rather than relying solely on legal penalties due to inadequate infrastructure or the provision of low-quality transport services.

Informed Consent Statement

The Association of Paraplegics and Quadriplegics of Serbia - SPIKS was the leading organization under whose approval the collection and approval for the presentation of data was carried out. All necessary confirmations or information can be obtained via the contact email: spiks@spiks.org.rs, <https://spiks.org.rs>.

Data Availability

The data supporting our research results are included within the article or supplementary material.

Conflicts of Interest

The authors declare no conflict of interest.

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