DRIVERS WITH DISABILITIES WHO USE HAND CONTROLS – CHALLENGES FOR SERBIAN SOCIETY

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Abstract

This study aims to identify the barriers of drivers with disabilities who use hand controls based on research of their experiences in Serbia. After identifying the barriers, we proposed recommendations based on best world practices and the real needs of drivers. The barriers are divided into two groups: before and during the driving experience. Within the first group, problems related to country support and training in driving schools are identified. The second group of problems is vehicle adaptations and everyday participation in traffic. For each barrier, we proposed recommendations based on the best practice and real needs of DwD. The expected effects of these recommendations are an increase in the number of drivers with disabilities who use hand controls and their mobility and road safety. Also, the proposed measures may have a good effect in countries and regions with a similar inclusion level as Serbia.

Keywords:

persons with disability, accessibility, mobility, drivers, barriers

Citation:

Petrović Đ., Mijailović R. M., Pešić D. Drivers with disabilities who use hand controls – challenges for Serbian society. Motor Transport, 67(1), s. 3-9

DOI: 10.5604/01.3001.0053.9427

Introduction

Persons with disabilities (PwD) face many barriers in their daily activities. Accessibility was recognized as one of the most critical problems. The United Nations [1] recognized accessibility within its Sustainable Development Goals by, for, and with PwD. Within Goal 11 (Target 11.2) – "*access to safe, affordable, accessible and sustainable transport systems for all, with special attention to the needs of inter alia persons with disabilities*" was especially emphasized. Also, European Commission recognized accessibility in strategic documents and ranked it very high on the list of barriers [2,3]. Both strategic documents emphasized the importance of access to transportation for PwD.

Their mobility best shows the problem of access to transportation. Namely, PwD made fewer trips per day than the rest of the population: 1 trip per day in the United States [4], 0.60 in Norway [5], and 0.55 in the United Kingdom [6]. A smaller number of trips was directly related to the poorer quality of life of PwD. As a consequence of poor access to transportation, PwD had hindered social life [7–9], reduced economic activity [8,10], poorer health services [10–12], demanded access to education [10], etc. Improving access to transportation for PwD would significantly improve their quality of life.

PwD can meet their travel needs in several modes: private vehicle (as a driver or a passenger), walking, public transport, etc. PwD most often made their trips in private vehicles (more often as a driver than as a passenger) – 60-80%, walking – 10-30%, public transport 4-10%, and other modes of transport – up to 3% [4,6]. The reasons why PwD most often traveled by private vehicle were a high level of flexibility [13], a high level of time efficiency [7], a better experience of leisure [14], poor accessibility to public transport [15–17], avoiding potential inconveniences in public transport [18], etc.

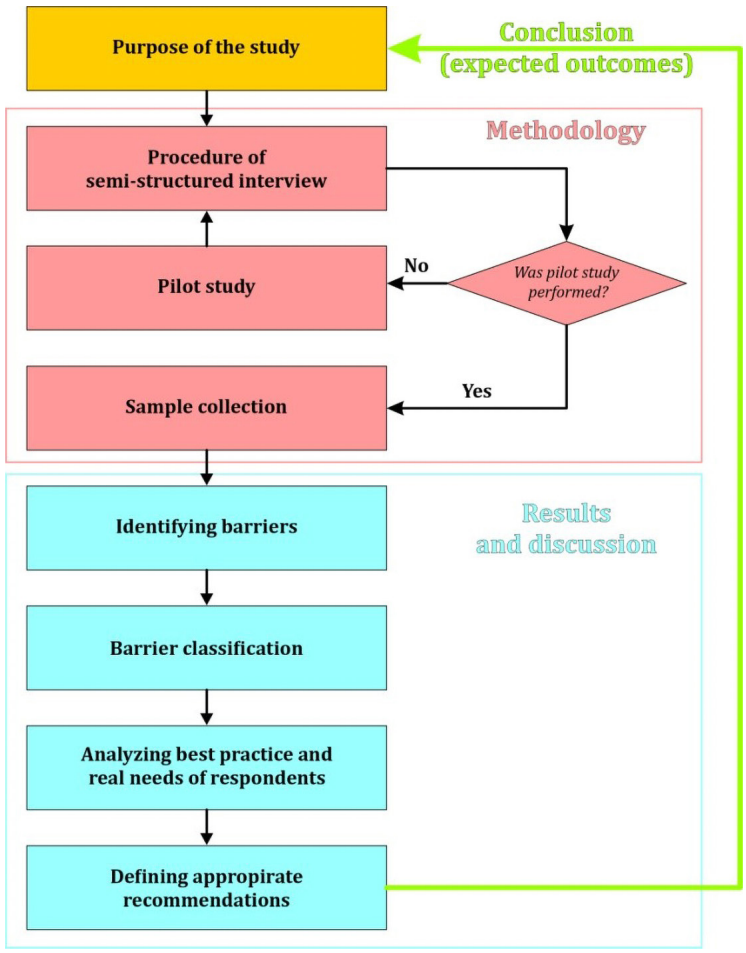
Although most PwD travel by private vehicle, even 25% of them had a problem with private vehicle accessibility [19]. The most common reasons that caused a barrier to a passenger vehicle were costs, health conditions, illness, impairment, and disability [19]. Sometimes adaptations can be made to the private vehicles that allow PwD to participate in traffic independently as drivers. The installation of hand controls was one of the most common vehicle adaptations [20–22]. Pilkey et al. [23] defined hand controls as: "*devices used by people who are unable to operate the brake and accelerator pedals with their feet due to physical impairment.*". Generally, drivers with disabilities (DwD) were mainly satisfied or delighted with hand controls [20]. The primary benefits of hand controls were improving mobility [24], quality of life [20,25], and economic benefits [26].

Access to transportation is a global problem faced by PwD [1–3]. The consequence was a significantly poorer quality of life for PwD [7–12]. The global challenge is to improve access to transport of PwD as identified by the United Nations – Target 11.2 [1]. The authors consider a specific group of PwD – DwD who use hand controls. This paper aims to identify the barriers of DwD who use hand controls based on their experiences. After identifying the problems, measures based on best world practice and the real needs of DwD are proposed. The expected effects of the proposed measures would be an increase in the number of DwD who use hand controls and an increase in their quality of life, mobility, and road safety. Proposed measures would also encourage potential DwD to drive. The research was conducted in Serbia, a country with a lower inclusion rate of PwD [27]. This research area brings a notable contribution to the applicability of the proposed measures to similar countries and regions, which have not been the subject of research so far.

Methodology

More details about the inclusion of PwD in Serbia are presented in the subchapter Research area. We performed the research in a few stages described in the following chapters and subchapters. The structure of the research is presented in Figure 1.

Fig. 1. Research structure



Research area

According to the last Census from 2011, about 570,000 PwD lived in Serbia (about 8%) [28]. However, The National Organization of Persons with Disabilities of Serbia [29] estimated significantly higher – about 870,000 (about 12.5%). Although they are a large part of the population, PwD face more pronounced problems than highly developed countries. For example, at-risk-of-poverty or social exclusion at the level of the European Union – 27 countries was 28.4%, while in Serbia, it was 42.6% [27].

Also, the poorer level of inclusion of PwD in Serbia affects their participation in traffic. Namely, PwD had substandard access to public transport [30], an unclear process of obtaining a driver's license [31], and relatively old vehicles they use – an average of 13.4 years [32]. There are no official data on the number of DwD who use hand controls. However, based on the number of adapted vehicles (installation of hand controls) in the previous five years [33], this number can be estimated at around 250 DwD. The number of DwD who use hand controls per 100,000 inhabitants is 3.6. In highly developed countries, this value is higher, for example, in Sweden – 28.5 [21], and in the United States – 30.9 [23]. Therefore, there is a capacity for a significant increase in the number of DwD in Serbia. In order to achieve that, it is necessary to recognize the problems and apply appropriate measures.

Research procedure

The research of DwD who use hand controls in Serbia was conducted using a semi-structured interview. The interview consisted of three parts. In the first part, the respondents answered socio-economic, health status, and driving habits questions. Further, the interview was conducted on two topics. The first topic was the experiences of respondents before starting driving. Within this topic, the respondents presented their experiences related to obtaining a driver's license or the process of rehabilitation. The second topic was related to the barriers during the driving experience. In both topics, the respondents recognized specific barriers that they talked about in more detail.

Union of Persons with Paraplegia and Quadriplegia of Serbia (UPPQS) was contacted to find DwD who use hand controls and actively participated in traffic. This organization realized several projects related to DwD who use hand controls [34]. UPPQS enabled contact between DwD and the authors. The sample was collected with the help of the representatives of UPPQS. Also, the respondents suggested other DwD who use hand controls.

The research was conducted from January to February 2021 according to the Code of Professional Ethics University of Belgrade [35]. Interviews were conducted by an author face-to-face or telephone, taking into account health protocols due to the COVID-19 pandemic. After the initial introduction (5-10 minutes), the author asked the respondents whether they wanted to participate in the research and whether they were willing to consent to the authors to use the collected information for research purposes. Following the respondent's consent, the author proceeded with the interview. The interviews lasted around 40 minutes. Before the interviews, a pilot study included five DwD who use hand controls. In this way, the final structure of the interview was defined.

The analysis was performed using an inductive thematic approach proposed by Riessman [36]. The interviews were carefully examined repeatedly to find themes and patterns. This procedure was done by all authors, who then critically analyzed and discussed the material.

Sample characteristics

The research interviewed 56 DwD who actively use hand controls. In terms of gender, men are dominant, making up about 90% of the respondents. The average age of the respondents was about 42 years old. About 48%

of the respondents lived in urban areas, while the rest lived in suburban (18%) and rural settlements (34%). The majority of the respondents were unemployed (67%).

The most common cause of disability among the respondents was traffic accidents – 50%. The following most common causes were injuries at work (11%), consequences of disease (9%), wounding from a weapon (7%), and innate (7%). Because of disability, over 95% of the respondents have partial or total functional limitations of legs. In addition, over 65% of the respondents reported partial limitations of back and abdominal muscles.

A smaller number of the respondents had driving experience before acquiring a disability – 38%. The average driving experience with hand controls was over 12 years. The annual mileage was usually between 15,000 and 20,000 kilometers.

Results

The respondents pointed out many barriers they faced to driving private vehicles. In terms of the driving experience, the barriers were divided into two groups:

- Barriers before the driving experience.
- Barriers during the driving experience.

Barriers before the driving experience

Supporting by society

The respondents pointed out the country's support as the most significant barrier before obtaining a driver's license. The problems of the costs of purchasing, adapting vehicles for DwD and the procedures of medical examinations were highlighted as the most important.

The respondents recognized the lack of financial support as the most significant problem before the driving experience. Before starting a driving experience, PwD who use hand controls had very high costs. The costs of vehicle purchase and adapting were identified as highest. Providing financial support to PwD would significantly encourage potential DwD to enter the driving training process. Financial support should cover as many costs as possible.

Legislation regulating driver abilities does not recognize DwD who use hand controls as a specific category. These regulations imply absolute equality of DwD who use hand controls and other drivers. However, problems are noticed in determining the minimum required driving abilities and skills. All responsibility for the opinion of whether PwD were capable of driving a vehicle rests with medical experts in health facilities. The problem was that the criteria for driving ability were not defined. Therefore, the critical role was played by the subjective opinion of the medical experts, which may differ.

Training and retraining procedure

Another problem DwD who use hand controls was training and retraining for driving. The problems vary depending on whether the PwD acquired a disability before or after obtaining a driver's license.

Fewer respondents had a disability before obtaining a driver's license. These respondents pointed out the small number of driving schools that train DwD as the most critical problem. According to the data of the Road Traffic Safety Agency of the Republic of Serbia [31], only three driving schools provided training to DwD who use hand controls. This fact indicated that many potential DwD did not have the opportunity to do adequate training. Namely, 24 of the 27 counties did not have a driving school adapted for DwD who use hand controls. In these counties live 64.2% of the Serbian population [37]. Even in counties without adequate driving schools for PwD, the respondents did some driving training. This kind of training is problematic. First, the costs of purchasing and adapting vehicles were very high for many potential DwD, leading to postponing driving training. Also worries that instructors in private vehicles did not have double commands to correct driver errors. On the other hand, the advantage of this kind of driving training is that the driver performs training on the private vehicle, which the driver will later use in traffic.

The respondents who had driving experience before acquiring a disability had different problems. Considering that this group of drivers had a driver's license, the Serbian regulations did not recognize the need to make driver training again. This situation is a potential issue due to the differences between the control of vehicles with hand controls and conventional vehicles. The consequence was that 88% of the respondents who had a driver's license before disability did not do any additional training for driving vehicles with hand controls. Respondents who had some driving retraining did so on their initiative. Lack of adequate and mandatory retraining can have a very harmful impact on the road safety of DwD who use hand controls. Until the driver fully acquires the skills of driving with hand controls, this can be very risky.

Barriers during the driving experience

New problems appeared when PwD began their active driving experience. Most of these problems were related to vehicle adaptations to the driver's needs. Also, many problems were observed in everyday driving.

Vehicle adaptation

The most significant group of problems that DwD faced was related to vehicle adaptations. The respondents pointed out the high cost and inadequately installed vehicle adaptations.

The high cost of hand controls was a common problem highlighted by the respondents. It is important to emphasize that data about manufacturers of hand controls was not collected. Namely, the purchase and installation of hand controls that a company produced were more expensive than hand controls made by a repairer. In general, the respondents' experiences showed that factory hand controls were more ergonomic than hand controls made by a repairer. In addition to the costs of hand controls, DwD often had the costs of installing wheelchair lifts, handrails, steering wheel sticks, mirrors, etc.

The respondents did not have significant complaints about the adequacy of the factory hand controls. On the other hand, drivers' problems with hand controls installed by the repairer were numerous. Respondents very often mentioned that the hand controls installed by the repairer did not fully match their needs. This situation indicated a problem with the expertise of the services that install hand controls. Primarily, hand controls should be adapted to the needs of DwD as much as possible. In addition, the number of companies dealing with vehicle adaptations and installation of hand controls was small. A small number of services forced PwD to contrive to adapt the vehicle to their needs. This situation led DwD to drive a vehicle that was not fully adapted to their needs. As a result, this increased driving effort and faster driver fatigue. Another problem that made difficult the driving process and increased driver fatigue was the lack of an automatic transmission. Namely, due to the higher costs of purchasing these vehicles, many DwD were forced to drive a vehicle with a manual transmission. The experiences of the DwD who use a manual transmission were pretty bad.

Barriers to everyday traffic participation

PwD faced new challenges when they started participating in everyday traffic. Based on the interviews with the respondents, certain critical circumstances were noticed when they avoided using the vehicle. Also, parking spaces for PwD and traffic accidents with DwD who use hand controls were problems.

Over 40% of the respondents pointed out that sometimes or more often avoid participating in traffic during peak hours and bad weather. The main reasons these situations were discouraged by the carelessness of other traffic participants (arrogant driving, driving under the influence of alcohol, social pollution) and the poor quality of roads in Serbia.

During the daily use of vehicles, DwD often encountered the problem of parking spaces. The number of parking spaces and their dimensions was adequate. Namely, according to regulations [38], 5% of parking spaces for PwD are mandatory at every public parking lot. In addition, it is possible to reserve a parking space for PwD. However, the problem was non-compliance with these regulations by other drivers. Namely, other drivers often park their vehicles in parking spaces reserved for PwD. Therefore, PwD had difficulty finding a suitable parking space to enter/exit the vehicle safely.

During their driving experience, about 30% of the respondents had the experience of participating in a traffic accident while driving with hand controls. Traffic accidents in which the respondents participated resulted in property damage or minor injuries. The category of DwD who use hand controls was not recognized when traffic accidents occurred. This fact significantly complicated monitoring the road safety of PwD and adopting adequate measures to improve their safety. In addition, data on the mobility of PwD were almost non-existent.

Discussion and recommendations

The most significant participation problems in traffic were identified by interviewing DwD who use hand controls. These problems can be solved by applying measures that result from best practices and the real needs of DwD. The following problems were recognized as the most significant:

- high costs of purchase and adaptation of vehicles and lack of subsidies;
- medical examinations (undefined criteria and staff expertise);
- inadequacy of the training and retraining process (vehicles and staff expertise);
- low quality of vehicle adaptations (inadequate hand controls, manual transmission, demanding driving, a small number of services);
- everyday participation in traffic (specific circumstances, occupancy of parking spaces);
- DwD are not recognized as specific categories of road users.

The costs of purchasing and adapting vehicles represented a vast financial burden for each PwD. The costs were recognized as the most significant barrier in driving a motor vehicle [19]. Additional problem was lack of adequate subsidies for training and adaptation of vehicles. These problems were especially pronounced in areas with a low social inclusion, such as Serbia. High-developed countries recognized the possibility of financial support for PwD. For example, the Irish government gives financial support for DwD in several ways [39]. Firstly, the Irish government provides subventions of up to €22,000 to purchase and adapt the vehicle. Regardless of the adaptations, the subvention was sufficient to cover about a third of the costs of purchasing and adaptation of the vehicle. The Irish government additionally gives subventions for the price of fuel. An excellent subvention system for purchasing vehicles for PwD was established in Sweden. In 2020, The Swedish Social Insurance Agency provided almost €14 million as a vehicle allowance for 1,400 PwD (average €10,000 per person)[40]. This allowance includes assistance with the purchase and adaptation of vehicles and possibly the cost of training at a driving school. Each PwD can use this grant every ninth year to purchase a vehicle.

Deciding on whether DwD had the ability and skills to drive a vehicle independently was crucial. PwD should participate independently in traffic, but this must not be risky for them and other road users. An example of good practice is the system of medical examinations for PwD in Australia [41]. In addition to a quality medical system, a good connection with the local authorities is also important. This system would ensure that PwD have the ability to participate safely in traffic. For this purpose, a study on the impact of chronic diseases on participation in traffic accidents is beneficial [42].

The training and retraining process problems vary depending on whether DwD acquired a disability before or after obtaining a driver's license. The existence of more driving schools adapted to PwD significantly facilitated taking the driving training in high-developed countries. For example, although Sweden has a slightly larger population than Serbia, it has several times more driving schools adapted for PwD. Namely, in Sweden, the number is around 20 [43]. Similar to Serbia, in high-developed countries, PwD can take driving training in a private or driving school vehicle. At the beginning of the driving training, PwD should drive a driving school vehicle with double commands. In these vehicles, the driving instructor would easier eliminate any driver error. The possibility of retraining for PwD who have previously obtained a driver's license was recognized in highly-developed countries. For example, in the Australian state of New South Wales, the local agency can require a practical driving exam from this group of drivers [44]. In general, driver retraining showed excellent results on the safety of old drivers [45]. According to that, retraining DwD who start driving with hand controls should positively affect their safety.

The inadequacy of hand controls for DwD was one of the biggest problems. The main reasons for this were the lack of a procedure that clearly defines the adequate adaptations, the lack of financial support, and the small number of services. The problem of adequate vehicle adaptation for PwD is multidisciplinary [46]. Defining the necessary adaptations in Ireland has been solved by a multidisciplinary team of occupational therapists (make Off-road Assessment) and on-road driving assessors (make On-road Assessment) [47]. Additionally, as mentioned earlier, there is a possibility to compensate the cost of vehicle adaptations in the amount of up to €22,000 [48]. Another advantage of the Irish vehicle adaptation system is the many services that deal with vehicle adaptation. In particular, in 17 to 26 counties in Ireland, at least one licensed service deals with vehicle adaptations for PwD [49].

During everyday driving, some problems were encountered by DwD. These problems were related to avoiding participation in traffic in specific circumstances (peak hours and bad weather) and the problem of occupancy of parking spaces reserved for PwD. The cause of these problems was misunderstanding and carelessness of other road users. In order to solve the cause, it is necessary to apply appropriate measures that will be aimed at increasing tolerance among other road users. These measures should contribute to a better understanding of the needs of DwD in traffic by the other road users. The problem of parking space occupancy can be solved by using cameras and sensors to quickly identify illegal parking [50,51].

Although almost every eighth inhabitant of Serbia is a person with a disability, data on their characteristics of participation in traffic are very deficient. Data on the mobility of PwD almost do not exist. Also, although many PwD experienced participating in traffic accidents, they were not recognized as a specific category of traffic participants. Recognizing the category of PwD in traffic would enable better management of their traffic needs (improving traffic infrastructure, road safety management, etc.).

Summary

Based on the performed analysis, the critical barriers for DwD were identified. Table 1 presents identified barriers with appropriate recommendations, which are obtained based on the best practice and real needs of DwD.

Table 1. Summary of identified barriers and appropriate recommendations

	Areas of actions	Barriers	Recommendations
Before the driving experience	Supporting by society	High costs of purchase and adaptation of vehicles and lack of subsidies	• The government should provide financial support to DwD (purchase and adapt the vehicle fuel, driving school training, etc.).
		Medical examinations	• The government should adopt the Law on the medical fitness of DwD, which would regulate this field in more detail. • The courses about road safety and PwD for medical staff should be organized.
	Training and retraining procedure	Inadequacy of the training and retraining process	• A system at the national level that will enable everyone who wants to have adequate driving training should be created. • Retraining programs for DwD who previously had driving experience should be created.
During the driving experience	Vehicle adaptation	Low quality of vehicle adaptations	• The procedure and legal framework for determining the necessary adaptations of vehicles for DwD should be defined. • Financial and educational measures should be created to enable DwD to adapt vehicles and purchase vehicles with automatic transmission appropriately. • Training on new hand controls for experienced DwD should be organized. • The companies dealing with vehicle adaptation for DwD should be licensed.
	Barriers to everyday traffic participation	Everyday participation in traffic	• The campaigns among other participants on the mobility of PwD to raise awareness and understanding of the population should be conducted. • Implementation of modern systems to ensure the availability of parking spaces should be performed.
		Lack of databases	• The category of PwD should be defined in relevant traffic databases.

Conclusion

This paper aims to identify the barriers of DwD who use hand controls based on research of their experiences in Serbia. Therefore, 56 DwD who actively drive using hand controls were interviewed. In this way, the respondents' experiences from everyday life were collected and analyzed. The respondents' problems were divided into two groups: before and during the driving experience. Within the first group, problems related to country support and training in driving schools were identified. The second group of problems was related to vehicle adaptations and everyday participation in traffic. Recommendations were given for solving the practical problems based on the experiences from the high-developed countries and the specific problems that the respondents emphasized. The expected effects of these measures would be an increase in the number of DwD who use hand controls and their quality of life, mobility, and road safety. Proposed measures would also encourage potential DwD to drive.

The additional contribution of this research is the research area. In addition to Serbia, the status of PwD is similar in other countries. For example, the at-risk-of-poverty and social exclusion parameters were similar in other European countries (over 39%): Estonia, Latvia, Lithuania, Bulgaria, North Macedonia, and Turkey [27]. The proposed measures may positively affect countries and regions with a similar inclusion level as Serbia. Therefore, the proposed measures gain importance due to their universality and applicability to other areas.

During the research, certain limitations were noticed. The first limitation was the relatively small number of DwD who actively use hand controls. This limitation was exactly the motive of the authors to deal with this topic. There is a possibility that a large number of PwD drive a vehicle. Compared to the high-developed countries, the number of DwD who use hand controls can increase several times in Serbia. Another limitation was the imbalance of the sample from the aspect of gender. This fact may indicate gender inequality, but the female respondents who participated in the research did not recognize it. In any case, it is necessary to consider this issue in detail in the future.

Future research should be directed in two directions. First, the problems that PwD have when participating in traffic by other modes will be analyzed. That research would give a complete image of their traffic needs. Further, the mobility and road safety of PwD need to be examined in more detail. In particular, influential predictors of their mobility and road safety should be explored. This research would provide clear guidelines on measures that would improve the accessibility of traffic for PwD.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Acknowledgment

The research presented in this paper has been realized in the framework of the technological projects financed by the Ministry of Education, Science, and Technological Development of the Republic of Serbia.

We express special gratitude to the Union of Persons with Paraplegia and Quadriplegia of Serbia, Road Traffic Safety Agency of the Republic of Serbia, for their great help during the realization of the research.

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