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## **ANALYSIS OF PROBLEMS FACED BY THE DEAF WHILE USING PUBLIC TRANSPORT IN A BIG CITY**

**Summary.** The article presents aspects connected with the identification of the main problems of the deaf and the hard of hearing when they use public transport and the related infrastructure in Poland. For the purpose of the analysis, a survey was conducted among 71 deaf and hard of hearing persons who live in large conurbations and use public transport daily. The survey included questions concerning to what extent the public transport and infrastructure are adapted to the needs of the hard of hearing. The participants evaluated the system of passenger information and indicated problems they come across most frequently in public transport vehicles and at stops. The problems were related to two primary issues: difficulties communicating directly with the drivers or when paying the fare in the ticket window and problems hearing and understanding voice messages played in vehicles and at train/bus stations.

### **1. INTRODUCTION**

According to estimates, there are more than a billion people with some kind of disability living on Earth. That is about 15% of the world population. This number is increasing due to the ageing of the society, the growing number of people suffering from diabetes or cardiovascular diseases, which leads to disability, and other factors, such as diets, natural disasters and road accidents [1]. Based on data [2] collected in the National Census of People and Housing from 2011 in Poland, it can be claimed that in that year, there were about 4.7 million handicapped people, which made up 12.3% of the Polish population.

Mobility is an important aspect of every person's life. Transport facilitates economic growth and satisfies the needs of society. These needs are mainly caused by the desire to move around for various reasons, including private reasons and reasons related to work or education. People's mobility, especially in urban areas, is constantly increasing. Age, lifestyle, health, demographic structure and economic situations all have an influence on how often people travel. Currently, problems faced by the disabled and the elderly in the public space and related to transport are increasingly in focus. The need to use public transport by the disabled is noticed not only on the national and urban level but also internationally. People with disabilities share the same spaces with the able-bodied, and these spaces are characterised by numerous architectural and communication barriers, as well as obstacles that hamper free movement. In order to overcome those barriers, a disabled person must put in much more effort than others. Determination in eliminating barriers and obstacles in public space and making it more friendly is required from organisers of public transport and carriers. Collective passenger transport facilitates the fast movement of large streams of passengers and plays an important role in societies and cities. A well-organised and properly working public transport system helps raise the quality and attractiveness of a given region and competes with individual transport [3-5].

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Accessibility means ‘ensuring the disabled people, equally to the others, access to the physical environment, means of transport, including technology and IT and communication systems, as well as other devices and services, commonly accessible or ensured. These means, including recognition and elimination of obstacles and barriers in accessibility, are used in buildings, roads, transport and other indoor and outdoor devices’ [6]. Accessibility is of great importance for people with physical, visual or oral disabilities since it enables their independence, ability to undertake a professional career and gain free access to health care, education, cultural events, sports and tourism. It also prevents social exclusion [7]. Public space and transport that are adapted to the physically disabled give them the feeling of safety and independence and solve problems related to travel. Public transport, adapted to the needs of the disabled, requires not only low-floor trams and buses but also adequate equipment serving the special needs of persons with hearing or vision impairments. Issues related to the identification of problems of the deaf and the hard of hearing in connection with public transport are very rare in the literature on the subject. It may be caused by the fact that these persons experience certain difficulties in perceiving, locating and identifying sounds and that, until recently, ‘the disabled’ was synonymous with users of wheelchairs. Literature on the subject presents the following aspects related to the use of public transport by the disabled:

- Recognition of barriers and issues that prevent or make it difficult for the disabled to use public transport. Studies on this matter usually involve surveys carried out among defined groups of the handicapped [8-12] and their carers [13]. As far as it concerns the deaf and the hard of hearing, the most significant problems include access to up-to-date visual information (road signs, pictograms, dynamic information), acoustics (induction loops, live announcements) and problems communicating with the staff in vehicles and on platforms. Therefore, it is necessary to carry out research in order to create such visual messages that would enable better orientation in noise-polluted environments [14, 15].
- Setting requirements (legal acts, regulations) for newly designed and modernised elements of transport and infrastructure systems [16] (e.g. procedures of evacuating individual groups of the handicapped) [17] for TSI (Technical Specification of Interoperability) rail transport [18]. Moreover, the communication needs of the disabled should be taken into account in Poland while creating transport plans for cities and towns.
- Building devices that facilitate communication [19, 20]. The premise for building such devices is the assumption that a disabled person is able to reach their destination without the assistance of a carer. Moreover, in the case of the blind, they help acquire spatial imagination, where sounds made by vehicles in the city may be a source of vital information [21].
- Assessment of information found on websites of the infrastructure administrators from the perspective of their adaptation to the needs of the disabled [22]. Research shows that websites are the first indicator of transport accessibility for the handicapped. Many of them use the Internet to check how they can reach the destination prior to starting their trip. Depending on what they find, they decide whether or not to use public transport.
- Formulating logistic models of city transport for the disabled using bus transport [23]. These models help minimise the discrepancy between the planned and actual level of transport services provided for the disabled.

The last point of focus when using public transport by the handicapped is the question of training [24, 12] drivers, ticket sellers, train guards, ticket inspectors, and other staff related to, among other aspects, drivers’ kindness, willingness to help the handicapped to get on or off the vehicle, stopping at the platform to facilitate getting on and off, opening the access ramp, understanding sign language, helping while purchasing tickets or giving information at the station or in the vehicle, and recognising the nature of the specific disability, especially regarding the blind or the deaf. Another problem has to do with access to the infrastructure (e.g. lifts, escalators, timetables or seats).

In Poland, the level of infrastructure adaptation to the needs of the disabled is not high, especially in small towns, as was shown in an audit carried out in 2015 by the Supreme Audit Office in county towns [6] and research carried out among carriers [25]. The main problems in small towns include a

lack of low-floor vehicles, failure to inform passengers about such vehicles with timetables, inappropriate design of the area surrounding stops and gaps in staff training. Induction loops and online sign language interpreters have been available in Poland in main train stations since 2015 [26].

The main objective of this paper is to analyse problems related to the use of public transport and infrastructure by the deaf and hard of hearing in Poland. For the needs of the current research, a survey questionnaire was filled out by the deaf. The questions mainly concerned the adaptation of infrastructure and vehicles of public transport to the needs of the deaf and hard of hearing (i.e. an assessment of passenger information system in vehicles and at stops, the ease of communication with drivers or at the ticket window and an assessment of hearing and understanding voice messages played in stations, platforms and vehicles). This research was a pilot study aimed at recognising the problems of this group of the disabled.

## **2. ANALYSIS OF CHOSEN PROBLEMS OF THE DEAF AND HARD OF HEARING PERSONS WHO USE PUBLIC TRANSPORT IN POLAND**

Hearing is one of the human senses that enables the reception and processing of sound waves, as well as their transduction into a nerve impulse that is perceived by the brain. It is the second most important sense after vision. Hearing is connected with the ability to speak and hear the speech of other people, facilitates obtaining information and maintains body balance [27, 28]. Healthy auditory perception is essential in every child since it conditions the proper development of the voice and speech, the acquisition of language and its forms and the child's general development [29].

It is difficult to estimate the number of the deaf and the hard of hearing in society. It is accepted that in Europe, there are about 80 million people with hearing impairments. In Poland, this number is 800,000-900,000 people, of whom 45,000-50,000 are deaf [27]. Worldwide, there are about 500 million people with hearing impairments, which makes up 7% of the world population [30]. The most frequent precursors to hearing loss are ageing, noise exposure and disease.

Medicine uses the term 'deafness' regardless of the level of hearing loss. Deafness is a result of a defect of the hearing sense, limiting the ability to perceive acoustic stimuli, which hampers a person's functioning in society. Deafness may be congenital or acquired. The causes of inborn deafness may be a mother's illness during pregnancy, toxicological factors, serological conflict, hormonal disorders or genetic factors. Acquired deafness can be caused by mechanical injuries during birth, infectious or chronic diseases, mechanical injury and trauma of hearing or constant exposure to noise [27, 29].

A special survey was created to be filled by the deaf and the hard of hearing in order to recognise the problems they face when using public transport. The survey consists of 46 questions, 44 of which are close-ended and two of which are open-ended. The first 13 questions concerned general information about the respondents and their use of public transport. Nine questions were connected to the assessment of public transport infrastructure and its means of transport. Two questions were requests for suggestions on solutions to the passenger information system, and 17 questions concerned problems faced by the deaf and hard of hearing while using public transport. The two open-ended questions were requests for suggestions to improve the functioning of public transport and remarks on public transport.

In total, 71 people took part in the survey, of whom 65% were women and 35% were men. The largest age group (59%) comprised people aged 20-40, while 25% were people 19 years old and younger, 9% were aged above 50, and 7% were aged 41-50. The largest part of the group (48%) was working people, followed by school and university students (38%). The unemployed and the retired were the smallest group, making up only 7% of the total number. Moreover, 41% of the respondents lived in cities with populations above 500,000, and 31% lived in towns with populations of 20,000-250,000 people. Inhabitants of villages and towns inhabited by 250,000-500,000 people made up 15% and 13% of the sample, respectively. The participants used public transport daily or a few times a week. The average time of trips was over 30 minutes. The means of transport used most often were bus, tram, train and underground. The survey was carried out across the country, with most surveys

filled out by inhabitants of the following cities: Warsaw (34%), Poznan (27%), Wroclaw (10%) and Cracow (10%).

The last three questions of the survey concerned the level of hearing loss, the type of hearing aid used by the respondents, and the way they communicate. The majority of the participants (65%) declared that their hearing loss is profound (above 90 dB), 17% chose the answer 'severe' (71-90 dB), 11% chose 'moderate' (41-70 dB), and only 7% chose the answer 'mild' (21-40 dB). The question regarding hearing aid use was answered as follows. The largest group (31%) use two hearing aids, followed by one cochlear implant (22%), no hearing aid (17%), one hearing aid/one implant (13%), two cochlear implants (10%), and one hearing aid (7%). Furthermore, 44% of the respondents said they speak to communicate, 42% use varied techniques, and only 14% said they use sign language.

Fig. 1 shows answers to the question, 'How do you evaluate the adaptation of means of public transport to the needs of the deaf?' Answers to this question were quite even in individual options. The most varied answers were given for the underground transport and trolleybus. These means of transport are not available in every city in Poland. The participants evaluated the adaptation of public means of transport as 'badly' and 'very badly' adapted to the needs of the deaf. The distribution of assessment in these categories ranged from 10% to 17%, and it was similar for all answer options (trolleybus, underground, train, bus and tram). Buses obtained the answer 'sufficiently' from 34% of the respondents. Rail means of transport (underground, train, tram) were evaluated as sufficient by between 20% and 27% of respondents. 'Well' was the answer given by over 20% of the respondents for train, bus and tram, 13% for underground and 3% for trolleybus. No means of transport, excluding trolleybus, obtained the answer 'very well' from more than 20% of the respondents. Fig. 2 presents answers to the question, 'How do you evaluate the adaptation of the infrastructure to the needs of the deaf?'

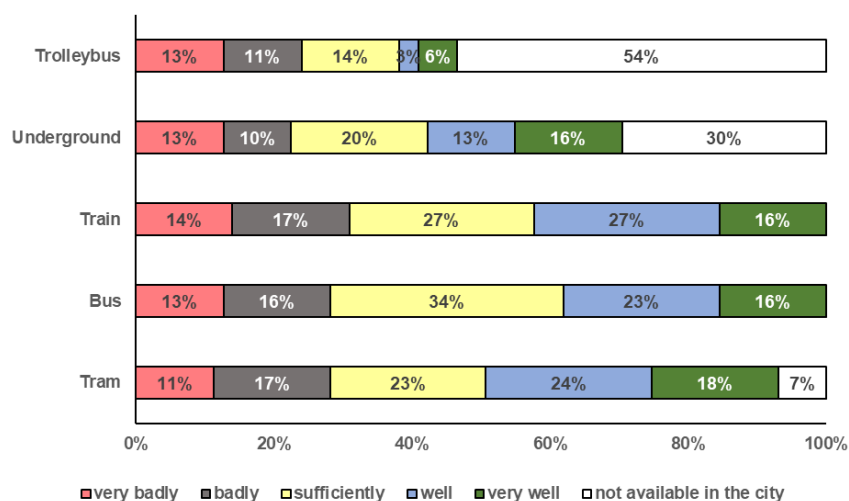


Fig. 1. Answers to the question regarding the assessment of the adaptation of public means of transport to the needs of the deaf

For the assessment of infrastructure and its adaptation to the needs of the deaf, answers were more varied than for individual means of transport. Almost all options included in the survey received the assessment of 'sufficiently' (ranging from 20-37%). The best assessments, 'very well' and 'well' (27% and 30%, respectively), were given to ticket machines. They received responses of 'badly' and 'very badly' from only 6% and 11% of participants, respectively. Assessments of 'well', making up over 20% of the answers, were given to tram and bus stops (27%), information points (24%) and passenger information systems (20%). Respondents pointed out that tram and bus stops, train stations, ticket machines and information points are lacking in their neighbourhoods. These answers did not exceed 10%.

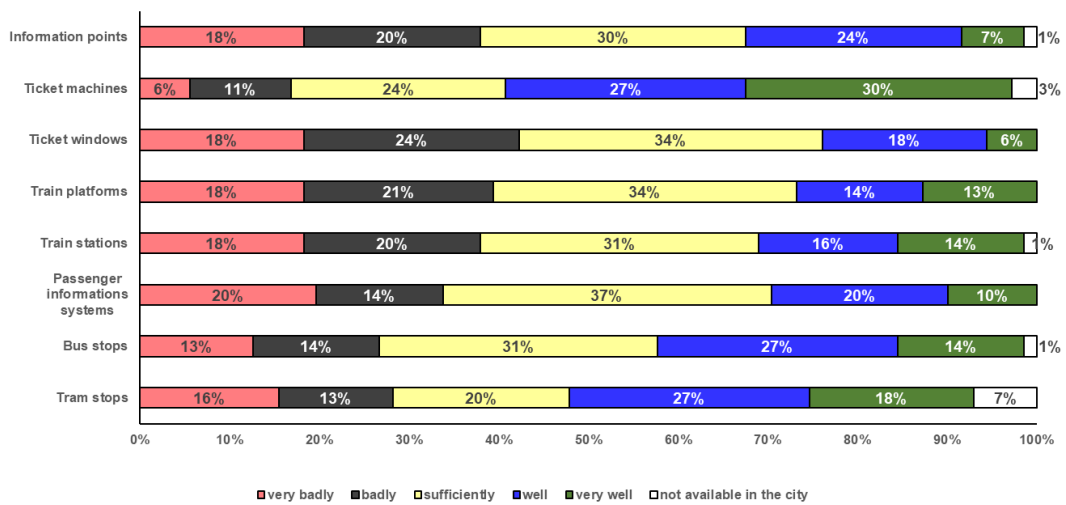


Fig. 2. Answers to the question concerning the adaptation of the infrastructure of public means of transport to the needs of the deaf

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The next two questions of the survey concerned the respondents’ assessments of the functioning and adaptation of the passenger information system in vehicles and stops, platforms or stations to the needs of the deaf. Fig. 3 presents answers to those questions.

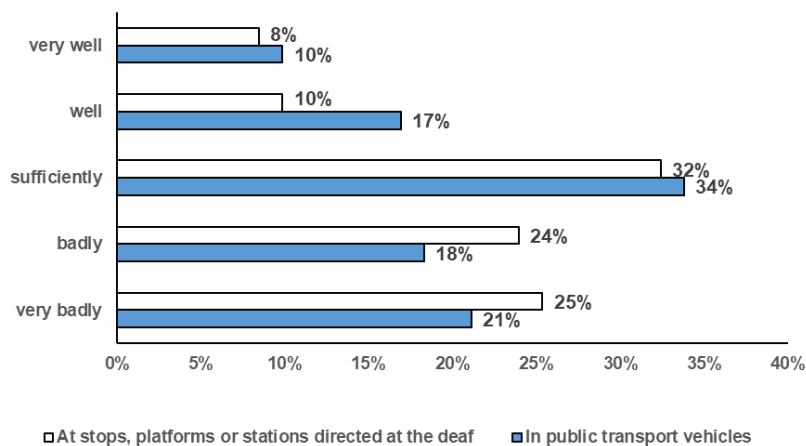


Fig. 3. Answers to the question regarding the assessment of passenger information systems in vehicles and stops based on the needs of the deaf

Respondents evaluated the passenger information system in vehicles and at stops and on platforms to be sufficiently adapted to the needs of the deaf. This answer was given by 32% of respondents for stops and platforms and by 34% for vehicles. However, 18-25% of the respondents gave assessments of ‘badly’ and ‘very badly’ for all answers. Only 10% of the respondents gave assessments of ‘well’ and ‘very well’. For vehicles, 17% of participants gave the response of ‘very well’ for the passenger information system.

Fig. 4 shows answers to the question, ‘What problems do you experience when using passenger information systems?’ Respondents could choose more than one answer to this question.

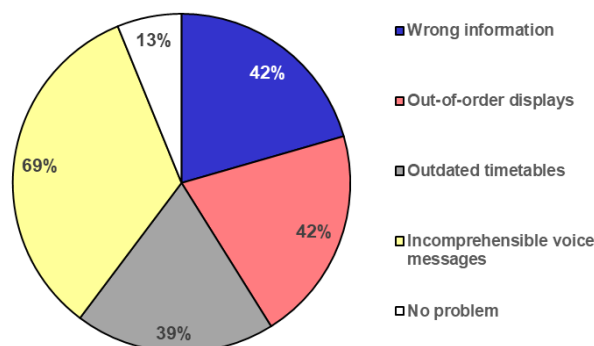


Fig. 4. Answers to the question, ‘What problems do you experience when using passenger information systems?’

Problems pointed out by the respondents regarding the use of passenger information systems were incomprehensible voice messages (69% of the answers), incorrect information on displays (wrong departure time, wrong platform) and out-of-work displays (42% of the answers) and outdated timetables (29% of the answers). Only 13% of the answers showed that the respondents did not experience any problems using passenger information.

The next group of questions was related to communication between the deaf and staff in ticket windows and vehicles. Fig. 5 shows answers to the following questions: ‘Are staff in vehicles and ticket windows adequately prepared to deal with the deaf?’ ‘Do staff in ticket windows give clear information?’ ‘Do the deaf have communication difficulties with the person working in the ticket window?’

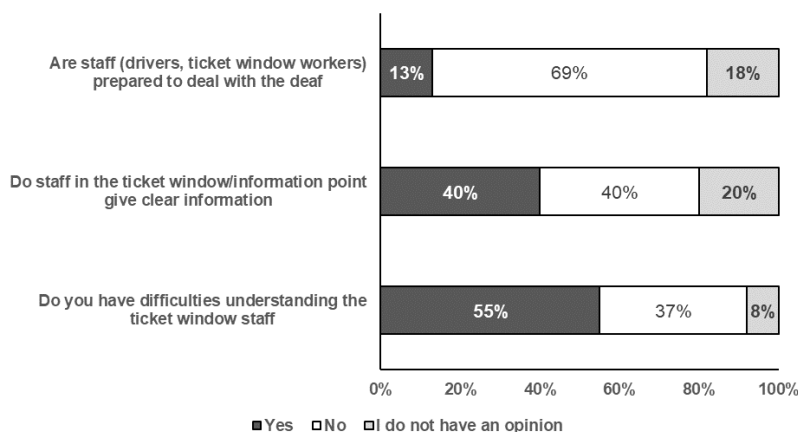


Fig. 5. Answers to questions about communication between the deaf and staff in the vehicle and at ticket windows

The respondents indicated that the staff (drivers, cashiers) are not prepared to deal with the deaf. Such an answer was given by 69% of the respondents. Only 13% of the answers were positive, and 18% of participants did not have an opinion. This fact is confirmed by the answer given to the question of whether the respondents have difficulties understanding the staff in the ticket window. In this regard, 55% gave affirmative answers, 37% of the respondents claimed they did not experience problems, and 8% of the respondents did not have an opinion.

The question of whether the staff in the ticket windows or information points give understandable information (simple messages, speaking clearly at the right pace) returned relatively even answers: 40% of the respondents gave positive and negative answers, and 20% of the respondents did not have an opinion. One of the questions in the survey was connected to the respondents’ assessments of their

contact with the staff at ticket windows or points of sale. For this question, 38% of the respondents gave a 'sufficient' assessment, 28% claimed the contact was bad or very bad, and 34% gave 'good' or 'very good' assessments. Fig. 6 shows answers to the question, 'What form of communication do you use in contact with the staff of the ticket window or point of sale?' Respondents could indicate all forms of communication they use.

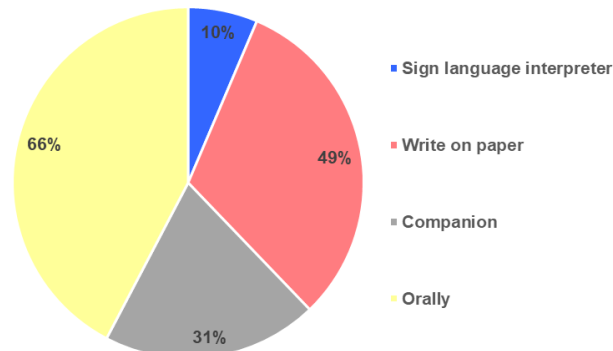


Fig. 6. Answers to the question, 'What form of communication do you use in contact with the staff of the ticket window or point of sale?'

The respondents chose the option 'orally' most often (66% of the answers), followed by 'write on paper' (49%). Moreover, 31% of the respondents use a companion or – if available – a sign language interpreter in order to buy a ticket (10%). However, 59% of the respondents claimed they did not see a sign informing that a sign language interpreter is available or that an induction loop is installed at the train station, whereas 41% did see it. Whenever the respondents claimed they saw the interpreter sign, they were asked to give its most common location. They pointed to Warszawa Wschodnia train station (Warsaw East), Warszawa Centralna train station (Warsaw Main), the Warsaw City Transport Office at the Main Station and in bigger cities (Wroclaw, Katowice and Lodz).

Another question raised in the survey was whether vocal and visual messages in vehicles and stations are correctly understood by the deaf. Fig. 7 shows answers to the question, 'Do you hear voice messages?'

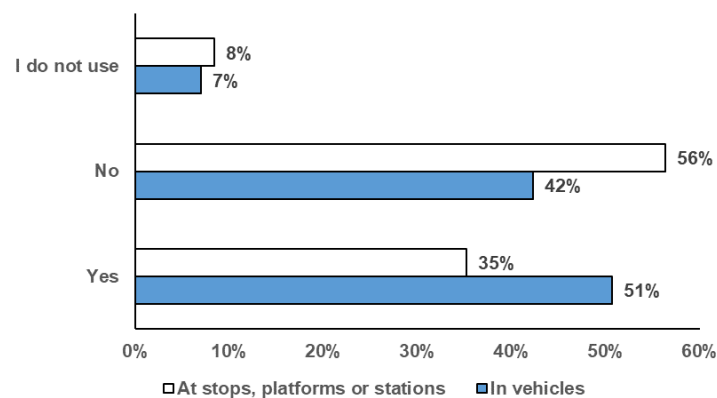


Fig. 7. Answers to the question, 'Do you hear voice messages?'

For voice messages that are played in vehicles, at stops, on platforms and at stations, 51% of the respondents hear them in vehicles, and only 35% hear them at stops and stations. Negative answers were given as follows: 56% of the respondents do not hear such messages at stops, and 42% do not hear them in vehicles. Less than 10% of the respondents do not use voice messages. Answers related to the assessment of the voice messages quality are shown in Fig. 8.

The respondents stated that voice messages played in vehicles and infrastructure are not understandable (54% of the answers), not up-to-date (38% of the answers) and not concise and clear (46% of total negative answers). In addition, about 30% of the respondents do not use voice

information played in vehicles, at stops or on platforms. Only about 30% of the respondents claimed they can understand voice messages played in vehicles or stops [31].

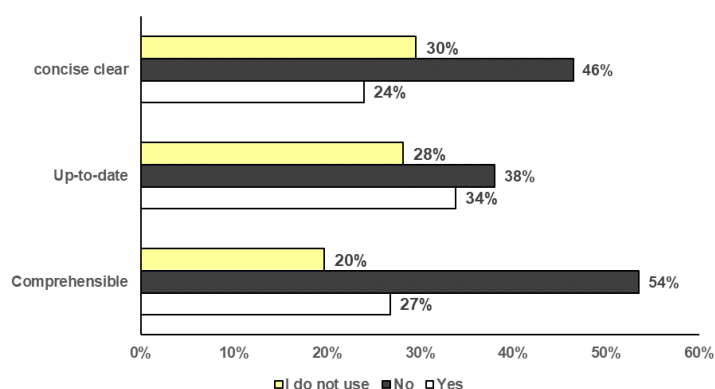


Fig. 8. Assessment of voice messages played in vehicles and infrastructure

### 3. CONCLUSIONS

The main objective of this paper was to analyse difficulties concerning the deaf and hard of hearing who use public transport (trams, buses, trains, underground and trolleybuses) and its infrastructure in Poland. Based on the survey, the following conclusions can be drawn:

- The adaptation of public transport (buses, trams, trains, underground and trolleybuses) and its infrastructure to the needs of the deaf and hard of hearing in Poland have been generally evaluated as ‘sufficient’. Buses and trains obtained about 40% ‘good’ and ‘very good’ assessments, and that was the highest among means of transport. In the area of infrastructure, ticket machines were given 57% ‘good’ and ‘very good’ answers.
- ‘Sufficient’ ratings were given to passenger information systems in vehicles and at stops or stations (32-34% of the answers). ‘Good’ and ‘very good’ responses constituted 10% of the answers. Information systems in public transport vehicles was the only option that received an assessment of ‘good’ (by 17% of the respondents).
- The main problems faced by people with hearing disorders using public transport are incomprehensible voice messages, out-of-order displays in stations and platforms and being given wrong information.
- The respondents frequently mentioned that the staff (drivers, cashiers) are not properly prepared to deal with the deaf (69% of negative answers). Moreover, 55% of the respondents have difficulties understanding the person in the ticket window. Very often, the deaf must write on paper or use the help of other people, mainly their companions. It is rare to use the help of a sign language interpreter, even if one is available.
- In most cases, voice messages played in vehicles or stations are incomprehensible for the deaf (54% of negative answers) or clear (46% of negative answers). Therefore, voice messages are used to a small extent by the deaf.

Based on the survey and the implementation of solutions in other countries (e.g. Germany, Austria and the Netherlands), the transport system in Poland may also be adapted fully to the needs of the disabled, especially to the needs of the deaf and the hard of hearing. An improvement in conveying indispensable information in the passenger information system can be obtained through the following steps:

- creating an app for barrier-free travelling that informs passengers about available connections in city and rail transport, considering the needs of the user, with the option to buy the ticket and receive messages about changes in the connection the ticket was purchased for;



- ensuring unified, clear and up-to-date information at every stage of the trip so that the disabled feel safe and secure by simultaneous information in two channels (verbal and visual);
- introducing a unified system of selling tickets in the ticket machines of all available carriers;
- clearly organising public spaces;
- using clear pictograms along with text information and light signals.

Passenger information is a significant part of today's public transport. An adequate passenger information system allows passengers to limit their involvement in finding information, as well as the time needed to do so. Visual messages help persons with hearing impairments have a sense of direction when travelling. Visual information systems raise the quality of transport, impact the comfort and safety of travel and, as a result, trigger positive associations among passengers using public transport.

The awareness of organisers of public transport and carriers is of great importance. Transport organisers and transport companies should continuously monitor the needs of passengers and aim at improving transportation quality and introducing new solutions. The implementation of such solutions should increase the popularity of public transport among inhabitants and encourage them to use it more often. The problems raised in this article do not form an exhaustive list of topics related to the impediments that persons with hearing impairments encounter when using public transport. Still, they may be effectively eliminated by removing infrastructural, organisational and communication barriers [31].

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