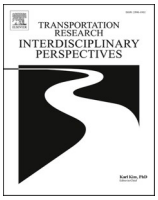
Transportation Research Interdisciplinary Perspectives 25 (2024) 101131

Contents lists available at ScienceDirect

Transportation Research Interdisciplinary Perspectives

journal homepage: www.sciencedirect.com/journal/transportation-research-interdisciplinary-perspectives



Disability, victimisation, and safety in train travel

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ARTICLE INFO

Keywords:
Asthma or allergy
Motion sickness
Depression or anxiety
Reduced mobility
Railway
Crime

ABSTRACT

Individuals with disabilities constitute a vulnerable heterogeneous group of travellers in public transport. The present study aims to investigate victimisation and perceived safety patterns among train travellers with disabilities (asthma/allergy, motion sickness, depression/anxiety, and reduced mobility). Exploratory data analysis and logistic regression were used to analyse the data coming from a sample of railway travellers across 28 municipalities in Sweden (N = 3374). Individuals with disabilities are more likely to be victimised in transit than those with no disability and declared feeling more unsafe than the rest of the travellers, especially if they had been previously victimised. Like other passengers, individuals with disabilities complain about aggressive panhandling, sexual harassment, the presence of intoxicated people, and a lack of staff. Including disability groups and their special needs in planning is essential to make public transportation safer and more inclusive.

1. Introduction

The World Health Organization (WHO) estimates that one in six, or 1.3 billion people, in the world experience a disability (2023). According to their definition, a disability emerges in the interaction between personal factors such as specific health conditions (e.g., allergy, visual impairment) and the environment. The same definition is commonly used in Sweden [Swedish word 'funktionshinder'] (Socialstyrelsen, 2024). According to the definition, an environment more adapted to people's needs can thus increase people's ability and decrease their disability.

Swedish law dictate that buildings must be planned and constructed to make it accessible and usable for persons with reduced mobility or orientation (SFS 2010:900, 8 chapter, 4§). There are also national regulations for "easily corrected barriers" for existing public buildings (Boverket, 2014) and the Swedish National Transport Administration's (2013) guidelines for design of the physical environment at stations for individuals with disabilities. The Swedish Transport Administration works under the governmental assignment to increase accessibility for individuals with disabilities, with the intention to use comprehensive solutions minimizing the need for complementary actions such as extra signage or ramps. They are, thus adopting a "universal design" approach to make the environment usable for as many as possible without special solutions.

Sweden ratified the United Nations Convention on the Rights of People with Disabilities (CRPD) in 2008, (United Nations, 2024) which includes freedom from exploitation, violence and abuse (United Nations, 2020). Article 16.2 reads "No provision in legislation which permits exemption from criminalization of non-consensual practices of any kind, including those based on a restriction/denial of legal capacity, or actual or perceived impairment of the victim and/or the determination of best interest by a third party."

According to the Facilitation of convenient access to public transport is included in the United Nations' 2030 global goals for sustainable development and entails inclusion and safety (United Nations, 2023). Yet, evidence on the safety needs of *individuals with disabilities* is relatively scarce in the international literature (see e.g., Sundling, 2016).

In the present paper, the respondents' definitions are used, namely "whether they identify themselves as having one of the health conditions: asthma/allergy, depression/anxiety, motion sickness, reduced mobility, impaired mobility, memory/attention/concentration problems, impaired hearing, reading/writing/speech difficulties, or gastrointestinal problems". Individuals with disabilities constitute a vulnerable heterogeneous group of travellers in public transport. To unravel the complexity of the safety needs of this group, we assess patterns of victimisation and perceived safety among train travellers with disabilities. This study examines victimisation as an array of offences, from property to violent crimes, including aggressive panhandling, a common problem around transit stations. Safety perceptions are used in this study as an umbrella term for fear of crime and other

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https://doi.org/10.1016/j.trip.2024.101131
Received 21 November 2023; Received in revised form 23 May 2024; Accepted 30 May 2024
Available online 8 June 2024

anxieties that are expressed by railway travellers at stations and during their trips, and this can vary over time. We investigate whether and how the disability of travellers affects their perceptions of victimisation and safety during their train travel and identify which are the most affected by safety incidents during the trip. The environment is bound to affect those physically impaired in particular, but do individual factors such as age, gender, and previous victimisation affect safety perceptions among individuals with disabilities? We are also interested in discussing the possible types of precautions they take in their daily life because of safety concerns. The article concludes with a discussion of expected improvements to make travelling easier according to those who answered the survey.

This research is unique because it makes use of a newly collected survey database from 47 railway stations in 28 connected municipalities, covering information about their travel patterns, the environment they spend time in from door to door, and their experiences during the day and evening. The study contributes to global transit safety literature, providing insights from diverse Swedish settings, ranging from rural areas to the second-largest city, with around 64,000 daily passengers according to the Swedish Transport Administration (Trafikverket, 2009).

The article is composed of six parts. First, we present a theoretical background of transit safety and transit safety with a focus on disability. This is followed by a section on research design explaining how the study has been conducted. Next, the results are presented, first, with findings concerning victimisation and then concerning perceived safety. This is followed by a discussion of the findings and conclusions.

1.1. Theory on transit safety

Research on safety deficiencies in public places often relates to the fear of being subjected to crime. “Fear of crime” has been researched since the 1960 s. According to Gabriel and Greve (2003), it includes affect (fear), cognition (thinking that something frightening will happen), and behaviour (behaving fearfully). In prospect-refuge theory (Appleton, 1975) the need for prospect (overview) and refuge (protection) is emphasised together with escape possibilities (Fisher & Nasar, 1992). On an individual-theory level, physical vulnerability (Skogan & Maxfield, 1981) has an impact on a perceived lack of safety due to the person concerned being physically weaker. Moreover, perceived likelihood, control, and consequences can predict fear of crime (Jackson, 2011). Safety is, however, not only related to fear of crime but also to fear of accidents. In the EU, technical standards (PRM TSI) aim to eliminate obstacles to accessibility for individuals with disabilities in rail travel. These cover for example visual and spoken information, doors, heights, lighting, and floor surfaces (European Commission, 2014).

Expected negative consequences of a trip for example at night, may result in choosing not to travel, even though the actual risk of victimisation might not be high (e.g., Avineri, 2012). Therefore, the perceived lack of safety, rather than the actual risk, may decide how people will travel. But many people have no alternative; they rely on public transport to get to work, regardless of perceived safety. Thus, for those “transit captives”, choosing how to travel is outside their behavioural control. It is more common for women than for men to be dependent on public transport (Ceccato & Loukaitou-Sideris, 2020). A large body of research shows that women feel more unsafe in public transport (Sundling & Ceccato, 2022). Their victimisation is also underreported. In an international study, only 3–17 % of harassment or assaults had been reported, depending on the country (Whitzman et al., 2020). When it comes to age, both younger and older individuals are more unsafe. However, in some studies, age alone cannot explain differences in perceived safety (Sundling & Ceccato, 2022). Old age means a reduction of mobility (poorer health and physical vulnerability), which in turn affects perceived safety. Ceccato and Bamzar (2016) have found that the way the elderly perceived safety follows a “distance decay” from their residence (they felt safest in places immediately outside the entrance of their residence) and that they are afraid because they are aware of someone else’s victimisation, or they fear for others.

Research on individuals identifying as LGBTQI + or on ethnicity/being foreign-born and perceived safety vary (Sundling & Ceccato, 2022). Travel frequency is another individual variable studied in relation to safety. Frequent travel is associated with higher levels of safety (Delbosc & Currie, 2012), although other researchers have found that infrequent travellers feel safest (Vanier & de Jubainville, 2017). Travelling at night is also naturally more unsafe (e.g., Uzzell & Brown, 2007). Education can also be associated with safety. In a study by Zegras et al. (2015), people with higher education felt more unsafe.

Place variables often found to be important for safety are available staff (Cozens et al., 2003), and good surveillance facilities. These include guards, police (Yavuz & Welch, 2010), CCTV (Thomas et al., 2006), and help buttons (Libardo & Nocera, 2012). Also, good lighting (Sundling, 2020), open environments with a high degree of natural surveillance such as a shop or café, and maintenance and information areas (Coppola & Silvestri, 2020) can increase feelings of safety. Underpasses and other confined spaces are perceived to be unsafe (Coppola & Silvestri, 2020). There is, however, a lack of research studying these variables from an intersectional perspective with a focus on disability. Often, variables are studied separately, although there might be complex interactions between several characteristics.

1.2. Theory of transit safety and disability

Individuals with disabilities are more at risk of exclusion from public transport than others because of inaccessibility or unaffordability (WHO, 2023). For example, even if barriers in many countries have been reduced, travellers with restricted mobility can still meet problems with lifts, gaps, or steps to vehicles, or no accessible route to the stop or the station (Bezyak et al., 2017) despite regulations and laws (e.g., European Commission, 2024; SFS 2010:2014). Travellers with disabilities have also repeatedly been shown to be more victimised than others (Iudici et al., 2017). Women with disabilities are especially vulnerable to harassment and sexual violence (Hughes et al., 2012). More than 50 % of women with disabilities in Europe, Australia and North America have been subjected to some kind of physical violence, compared to a third of women without disabilities (Brownridge, 2006). Moreover, Bossarte et al. (2009) found an association between sexual victimisation and asthma episodes in women, indicating worsening of this kind of disability after being victimised. Travellers with disabilities also feel more unsafe (Yavuz & Welch, 2010) than others in public transport. Discrimination, vulnerability, and feeling exposed can lead to a perceived lack of safety in relation both to other passengers and to staff (Wayland et al., 2022). Other passengers’ attitudes and the fear of being harassed constituted essential travel barriers for older infrequent travellers with severe disabilities in a study by Sundling et al. (2014). In that study, those individuals who perceived public transport accessibility to be at the lowest level were those with the most severe disabilities and those with several concurrent disabilities. Individuals with disabilities can therefore also be more afraid to go out after dark (Ceccato, 2015, Ceccato and Bamzar, 2016).

However, victimisation and safety for individuals with disabilities are an under-researched area. Most research on public transport users focuses on the average traveller. In a recent systematic literature review on perceived safety in train travel (Sundling & Ceccato, 2022), only one of 52 included publications focused on disability even though travellers with disabilities constitute a specifically vulnerable group in the transport system. Also, individuals with disabilities constitute a heterogeneous group with different needs depending on the nature of the disability. For example, reduced mobility can result in difficulties in the environment that are completely different from difficulties arising from allergies or anxiety. Therefore, it is important to study the needs in public transport of individuals with disabilities more in detail, as results focusing on the “regular” person will hide important individual

differences.

This study contributes to this knowledge base by assessing victimisation and perceived safety for individuals with disabilities in different locations along the train-travel chain in Sweden. The aim of this study is to investigate victimisation and perceived safety in train travel for individuals with disabilities, asthma/allergies, motion sickness, depression/anxiety, and reduced mobility. We hope this evidence can be helpful for others suffering from any kind of disability in other contexts, given the limited empirical evidence available on this subject area.

2. Material and methods

The research questions are:

1) Are respondents, who identify themselves as having a disability, more victimised than others in public transport? Does disability affect individuals' safety perceptions during their train travel?
2) Do individual factors such as age, gender, and previous victimisation affect safety perceptions among individuals with disabilities?
3) What precautions, if any, do the respondents take because of poor declared safety perceptions?
4) What improvements would make travelling easier according to these respondents?

A questionnaire was specially developed for the study. After ethical approval, data were collected from May to September 2022 along three major rail routes in Sweden (Svealandsbanan & Mälarbanan, Västra stambanan, and Södra stambanan). In all, 47 stations were included, in 28 municipalities. The three lines serve approximately 64,000 passengers per day. The questionnaire was delivered as a paper-and-pen survey at train platforms and as a digital survey advertised in the municipalities along these routes. The latter way of advertising was selected to reach even those who were not travelling by public transport, as we wanted to assess reasons for not travelling by train. The questionnaire is divided into five main parts: control questions such as how frequently one used the train, questions on perceived safety, questions regarding own attitudes and behaviour concerning safety, questions regarding recommendations for improvement, and background questions such as age, gender, and potential disability.

2.1. Description of the sample

Table 1 shows the number of respondents (N = 3374) having a specific disability. The largest group is those with asthma/allergy; 595 (18 %). The second largest group is those with anxiety or depression (545, 16 %), followed by motion sickness (512, 15 %). Note that the same respondent can have more than one disability and thus be part of more than one sample.

Given the limitation of the sample, we will analyse the three largest groups of respondents, those reporting asthma/allergy, depression/anxiety, and motion sickness, and the group reporting reduced mobility.

Table 1
Respondents answering the question "Do you have any of the following?", N = 3374. Only respondents reporting a disability are included in the table.

Disability	n	%
Asthma/allergy	595	18
Depression/anxiety	545	16
Motion sickness	512	15
Impaired vision	332	10
Memory/attention/ concentration problems	293	9
Impaired hearing	206	6
Bladder or bowel problems	204	6
Reduced mobility	174	5
Reading/writing/speech difficulties	126	4

This latter group was selected as they stood out as being significantly more victimised than others (OR = 1.776; p = 0.018) in logistic regression with the whole sample. More generally, in previous research, travellers with reduced mobility are often found to encounter barriers in railway travelling (e.g., Sundling et al., 2014). Thus, with this background, we wanted to address victimization and perceived safety also for this, seemingly vulnerable group. In all the selected groups, women are in the majority, with 63 % (reduced mobility and depression/anxiety) to 74 % (motion sickness). Respondents with reduced mobility are older than respondents in the other groups; the largest age group in reduced mobility (25 %) is 50–59 years old, while those with depression/anxiety and motion sickness are younger; the largest group here is 19–29 years old (34 % and 30 %), and respondents with asthma/allergy are in between with 40–49 years old as the largest group (23 %).

Respondents with depression/anxiety are those who most often use public transport only, a bike, or walk (not car) as their only means of transport, 45 %, while, in the other groups, these potentially "captive travellers" are under 40 % of the respondents. For all the selected disability groups, the respondents are usually infrequent train travellers. Most commonly, they travel less than one day per month (from 37 % for respondents with asthma/allergy to 31 % for those with reduced mobility). Between 46 % (motion sickness) and 56 % (asthma/allergy) travel also at night by train. Looking at attitudes towards other people and society, between 47 % (depression/anxiety) and 55 % (motion sickness) feel safe travelling with others, and a larger part, between 72 % (depression/anxiety) and 81 % (asthma/allergy) report having trust in the police.

2.2. Analysis

SPSS (IBM SPSS Statistics 28.0.1.1.) was used to analyse the data. Chi-square for independence and logistic regression analyses were conducted for the respondents reporting asthma/allergy, motion sickness, and depression/anxiety (the most common disabilities) and for those with reduced mobility. The results will focus on these groups. The N may vary depending on the question. Both chi-square and regression analyses were conducted for victimisation and perceived safety, thus chi-square analyses and logistic regression were conducted for each of the four groups of respondents. In the logistic regression analyses, both place variables and individual variables are used as independent variables. The variables "restaurant/café" and "tunnel" were added from observation of the stations while all other variables are included in the questionnaire. For the different analyses, the individual and place variables differ (see further the results section), but examples of individual variables are age, gender, and travel frequency. Examples of place variables in the station areas are illumination, CCTV, and staff. A dichotomous dependent variable was created, both for victimisation analyses (victimised/not victimised during the last five years when travelling by train) and for perceived safety (whether they are afraid of being victims of crime or not when travelling by train). A significance level of 5 % was set and p-values are presented for significant results. The results are presented, first for victimisation and thereafter for perceived safety.

The following questions from the survey were used in the analysis of the study:

- Victimisation: *In the past five years, have you experienced or seen any of the following on the train, at the station or on the way to/from the station? (A list of seven alternatives.)*
- Perceived safety: *When travelling by train, do you often feel afraid of being exposed to the following? (A list of 12 alternatives seven of which relate to crime.)*
- Factors affecting safety: *Can you mark which of the following factors affect your safety perception at the station you usually travel from? (A list of 16 alternatives.)*

- Safety precautions: *Can you mark which of the following statements about safety/lack of safety apply to you when travelling by train daytime or evening/night-time? (A list of 15 alternatives.)*
- Recommendations: *Can you mark which of the following would make your journey by train safer? (A list of 17 alternatives.)*

For victimisation, we present the results regarding (a) the risk of being victimised compared to other respondents, (b) where in the station area the respondents had been victimised, (c) what kind of crimes they had been subjected to, (d) what place and personal factors impact the risk of being victimised.

3. Results

3.1. Disability and victimisation in train travel

Individuals with disabilities had been significantly more victimised than other travellers (highest for respondents with reduced mobility; 32 %; p = 0.009 followed by those with asthma/allergy; 30 %; p=<0.001) and depression/anxiety, 29 %; p=<0.001). The only exception was those who reported motion sickness (23 %; n.s.), Table 2. The most common *form of crime and harassment* the respondents had been subjected to was *aggressive panhandling*. This was followed by *sexual harassment* and *stalking* except for respondents with reduced mobility. For them, *threat or hate crime* was the third most common crime/harassment. The other variables were theft, robbery, and violence. These were experienced to a lesser extent. Note that all other groups of respondents except for those with motion sickness had been significantly more victimised than other respondents regarding at least some of these most common types of harassment or crimes. However, differences are often small between values.

Note that respondents with reduced mobility had not witnessed others being victimised more often than other respondents and had still been more victimised themselves. Thus, this cannot be explained by for example living in a more violent environment. Respondents with asthma/allergy and depression/anxiety had also significantly more often witnessed others being victimised (38 %; p=<0.001) besides having been more victimised themselves. Thus, there is a difference between the groups.

The risk of victimisation is uneven along the travel chain, and even within the same station area. The most common *place to be victimised,* regardless of kind of disability, was on the *platform* (Table 3). It was highest for respondents with depression/anxiety; 69 % (p = 0.003) of those who had been victimised had experienced this on the platform, significantly more than for other respondents. For the other respondents with disability, having been victimised at the platform was not significantly more common than for respondents without disability, although it was 68 % for those with reduced mobility, almost as much. The second most dangerous place differed, however, between groups. For respondents with asthma/allergy, it was at an *underpass/overpass* (40 %, n.s.), but for the other groups, the *waiting hall* was the second most common place for victimisation. The other variables were the toilet, bus terminal, and car park. These were less often places where victimisation had occurred.

When looking at both place and personal factors that *increase the risk of victimisation*, the logistic regression model for all groups except asthma/allergy turned out not to be significant and is therefore not presented. However, for respondents with asthma/allergy, intoxicated people (people under the influence of substances present) were the only place variable that significantly increased the risk of victimisation. Intoxicated people more than doubled the risk of victimisation (odds ratio 2.3; p = 0.011). The other place factors were the restaurant/café at the station, the toilet, poor illumination, no CCTV, lack of staff, poor maintenance, underpass/overpass, and location of station (isolation). Thus, none of these variables had a significant effect on victimisation for respondents with asthma/allergy. Among individual factors, only gender could predict victimisation on a 5 % level. Being a women doubled the risk (odds ratio 2.2; p = 0.040). The other personal factors were age, sexual orientation/gender identity, place of birth, travel frequency, time of day for travel, education, and means of travel.

Table 2
Victimisation by group of disability (n) and total N for each group. The total sample answering the question on victimisation is 3307. Only respondents reporting a disability is included in the table. Significance value at 5%.

Disability	n	%	N	p
Asthma/allergy	171	30	576	<0.001
Depression/anxiety	154	29	531	<0.001
Motion sickness	116	23	507	n.s
Reduced mobility	53	32	166	0.009

Table 3
The most common places in the station area where respondents had been victimised and most common kinds of crime or harassment for respondents with asthma/allergy, depression/anxiety, motion sickness, or reduced mobility in $\chi 2$ analysis. Significance value at 5%.

Victimisation	Asthma/ allergy	Depression/ anxiety	Motion sickness	Reduced mobility
Station areas	N = 106	N = 104	N = 72	N = 34
Platform	55 % n.s	69 % p = 0.003	50 % n.s.	68 % n.s.
Underpass	40 % n.s.	30 % n.s.	33 % n.s.	47 % n.s.
Waiting hall	38 % p = 0.038	34 % n.s.	39 % n.s.	50 % p = 0.01
Crime/ harassment	N = 576	N = 531	N = 507	N = 166
Aggressive panhandling	21 % p < 0.001	16 % n.s.	14 % n.s.	26 % p=<0.001
Sexual harassment	9 % p=<0.001	10 % p=<0.001	7 % n.s.	10 % p = 0.006
Stalking	9 % p=<0.001	9 % p=<0.001	6 % n.s.	8 % n.s.
Threat/hate crime	5 % n.s.	6 % p = 0.006	4 % n.s.	9 % p = 0.01

3.2. Disability and perceived safety in train travel

Just as respondents identifying themselves as having a disability were exposed to a higher risk of being victimised than others, they also felt significantly more unsafe than other respondents. However, again, the exception was those who reported motion sickness. The latter group felt safer, in line with respondents without disabilities (at night, from 18 % that felt unsafe at the station to 9 % on the train). For all respondent groups, night-time travel was perceived as more unsafe than daytime travel. Those who felt most unsafe were respondents with reduced mobility (24 % at the station at night; p = 0.002). However, differences between groups were small (depression/anxiety: 23 %; asthma/allergy: 21 %).

In χ^2 analysis, the two *place factors* that made respondents feel most unsafe at stations were, regardless of the kind of disability, *lack of staff,* and *intoxicated people* present (Table 4). The other important variables for all groups were *poorly guarded stations, poor illumination*, and whether there were *underpasses/overpasses*. (The other alternatives were no shelter, isolated location, lack of passengers, no emergency phone, crowds, noise, a feeling of entrapment/lack of overview, graffiti/vandalism/littering, poor information, difficulty buying tickets, drug use/selling.).

In logistic regressions for factors predicting safety deficiencies, both station factors and personal factors are included. Here results are more diverse depending on the kind of disability, see Table 5. All independent variables that were included in the regression analyses are (a) *individual variables:* gender; age; LGBTQI+; place of birth; travel frequency; travel at night; university education; victimisation; use of only public

Table 4
Most important variables for a lack of safety reported by respondents with disabilities in χ^2 analysis. Significance value at 5%.

Perceived safety	Asthma/ allergy	Depression/ Anxiety	Motion sickness	Reduced mobility
	N = 522	N = 514	N = 484	N = 145
Lack of staff	49 % p = 0.019	51 % p = 0.001	52 % p=<0.001	50 % n.s.
Intoxicated people	49 % n.s.	55 % p=<0.001	54 % p=<0.001	51 % n.s.
Poorly guarded	44 % p=<0.001	46 % p=<0.001	39 % n.s.	45 % p = 0.027
Poor illumination	40 % n.s.	40 % n.s.	41 % p = 0.042	34 % n.s.
Underpass/ overpass	39 % n.s.	39 % n.s.	38 % n.s.	45 % p = 0.027

transportation, biking, or walking, (b) *place:* restaurant/café; toilet; illumination; CCTV; lack of staff; maintenance; underpass/overpass; isolated station; intoxicated people. CI for odds ratio is 95 %. The model for asthma/allergy explained between 22.4 % (Cox & Snell R Squared) and 30.9 % (Nagelkerke R squared) of the variance, depression/anxiety 20.2 % and 27.4 %; motion sickness 20.9 % and 29.3 %; and for reduced mobility 39.5 % and 54.1 %.

As can be seen in Table 5, for respondents with asthma/allergy, six of the independent variables gave a unique statistically significant contribution to the model. *Previous victimisation* constitutes the largest risk of feeling unsafe, more than four times compared to those who had not been victimised, checking for all other factors in the model (OR = 4.720; p = 0.001). Several variables doubled the risk of feeling unsafe; *intoxicated people present* (OR = 2.460; p = 0.001), *poor illumination* (OR = 2.131; p = 0.005), *being a woman* (OR = 2.054; p = 0.026), *lack of staff* (OR = 1.948; p = 0.016). With an OR = 0.422 (p = 0.001), university education was a protective factor for safety.

For respondents with depression/anxiety, the picture was somewhat different. Here, *identifying as LGBTQI +* was the strongest predictor (OR = 4.728; p = 0.001). The second and third most important variables were, again, *previous victimisation* (OR = 3.128; p = 0.000) and *intoxicated people* (OR = 2.801; p = 0.000). Being a *frequent traveller* (4–7 days/week) also almost doubled the risk (OR = 1.827; p = 0.024).

For respondents with motion sickness, *previous victimisation* (OR = 2.839; p = 0.003) and seeing *intoxicated people* (OR = 2.787; p = 0.001) were the strongest predictors, with *underpasses/overpasses* as the third most important variable (OR = 2.602; p = 0.003). Being a *woman* (OR = 2.147; p = 0.044) and *lack of staff* (OR = 2.081; p = 0.011) both doubled the risk of feeling unsafe.

Respondents with reduced mobility were most impacted by *intoxicated people* (OR = 5.574; p = 0.008) and this variable was the strongest predictor of all if all groups were compared. *Lack of staff* was almost as influential for the lack of safety (OR = 4.930; p = 0.014), almost five times as important for safety compared to whether there is staff available. This was followed by *previous victimisation* (OR = 4.303; p = 0.027).

Thus, intoxicated people and previous victimisation are the variables that were present as one of the three most important variables for the lack of safety in all groups.

Where do the respondents feel most unsafe in and around the station? χ^2 analysis shows that, regardless of the kind of disability, *underpasses/overpasses* are perceived as the most unsafe place (Table 6). For all groups except for respondents with motion sickness, more than 50 % felt unsafe at such places, which is also significantly more than for respondents without disabilities. The other variables that were perceived to be safer are the platform, the toilet, the waiting hall, the bus

Table 5
Place and person variables impacting safety deficiency at stations for the different disability groups. Logistic regression.

	Asthma/allergy				Depression/anxiety				Motion sickness				Reduced mobility			
	Exp (B)	CI Lower	CI Upper	Sig.	Exp (B)	CI Lower	CI Upper	Sig.	Exp (B)	CI Lower	CI Upper	Sig.	Exp (B)	CI Lower	CI Upper	Sig.
Person variables																
Woman	2.054	1.091	3.867	0.026	2.206	1.213	4.012	0.010	2.147	1.021	4.515	0.044	3.929	0.955	16.170	0.058
Old age (65 or above)	1.432	0.495	4.144	0.508	1.648	0.258	10.534	0.597	0.387	0.043	3.507	0.399	2.426	0.641	9.179	0.192
LGBTQI/Non-binary/Other	1.681	0.515	5.491	0.390	4.728	1.963	11.387	0.001	3.047	0.912	10.175	0.070	5.465	0.450	66.299	0.182
Foreign born	0.808	0.324	2.014	0.647	0.666	0.241	1.843	0.434	1.105	0.459	2.660	0.823	0.178	0.009	3.375	0.250
Frequent traveler (4–7 days/week)	0.925	0.507	1.689	0.800	1.827	1.084	3.080	0.024	1.238	0.676	2.270	0.489	0.981	0.264	3.648	0.977
Travel during nighttime	1.074	0.638	1.809	0.788	1.534	0.948	2.483	0.082	1.241	0.728	2.114	0.427	2.460	0.743	8.177	0.140
University education	0.422	0.252	0.708	0.001	0.705	0.427	1.165	0.173	0.896	0.520	1.543	0.691	0.315	0.092	1.073	0.065
Victim to crime	4.720	2.487	8.961	0.000	3.128	1.721	5.683	0.000	2.839	1.430	5.636	0.003	4.303	1.184	15.632	0.027
Only use PT, bike, walking	0.886	0.524	1.499	0.653	0.838	0.516	1.361	0.476	0.665	0.384	1.154	0.147	0.502	0.128	1.967	0.323
Place variables																
Restaurant/ café	0.954	0.409	2.224	0.913	0.933	0.441	1.974	0.855	0.498	0.217	1.114	0.100	0.838	0.075	9.386	0.886
Toilet	0.819	0.369	1.817	0.623	1.217	0.573	2.584	0.609	1.139	0.566	3.073	0.521	1.242	0.085	18.167	0.874
Poor lighting	2.131	1.258	3.611	0.005	1.000	0.603	1.658	0.999	1.671	0.946	2.950	0.077	0.985	0.270	3.596	0.982
No CCTV	0.770	0.585	1.014	0.062	0.863	0.662	1.125	0.275	0.883	0.669	1.166	0.379	0.900	0.422	1.831	0.772
Lack of staff	1.948	1.134	3.346	0.016	1.421	0.866	2.333	0.164	2.081	1.184	3.659	0.011	4.930	1.375	17.669	0.014
Poor maintenance	1.012	0.554	1.849	0.969	1.548	0.910	2.632	0.107	1.592	0.864	2.932	0.136	3.050	0.769	12.098	0.113
Underpass/ overpass	1.272	0.685	2.363	0.445	1.718	0.967	3.053	0.065	2.602	1.372	4.934	0.003	4.407	0.693	28.008	0.116
Isolated station	0.622	0.348	1.112	0.109	0.864	0.513	1.453	0.580	1.086	0.600	1.967	0.785	0.748	0.213	2.627	0.651
Intoxicated people	2.460	1.422	4.254	0.001	2.801	1.634	4.799	0.000	2.787	1.500	5.012	0.001	5.574	1.572	19.761	0.008

Table 6
The places in the station area were perceived as most unsafe in χ^2 analysis. Significance value at 5%.

Most unsafe places	Asthma/ allergy	Depression/ anxiety	Motion sickness	Reduced mobility
Underpass/ overpass	54 % p=<0.001 N = 463	53 % p=<0.001 N = 447	46 % n.s. N = 405	54 % p = 0.019 N = 141
Bus terminal	30 % p=<0.001 N = 393	28 % p = 0.011 N = 389	25 % n.s. N = 355	33 % p = 0.008 N = 120
Car park	29 % p = 0.002 N = 382	28 % p = 0.026 N = 383	25 % n.s. N = 355	38 % p=<0.001 N = 117

terminal, and the car park. *Bus terminals* and *car parks* are the second and third most unsafe places for all groups, although the order differs for the different groups.

Theft and violence were the most feared crimes for all groups (Table 7). For respondents with depression/anxiety, *sexual harassment* was feared as much as theft. The other, less feared crimes were robbery, threat/hate crime, and stalking.

3.3. Type of precautions

Do respondents with disabilities take more precautions than others, what precautions are most common, and are there differences between groups? A large majority of the respondents took some kind of precaution because of a perceived lack of safety, especially at night. For all groups except for respondents with reduced mobility, at least 90 % of the respondents took some kind of precaution. This is significantly more than for respondents without disabilities (see Appendix A for all precautions). For respondents with reduced mobility, 85 % took some kind of precautions at night, which is not significantly more than for respondents without disability. However, they took significantly more precautions during the day (63 %; p=<0.001). The most common precaution regardless of disability was to *stay alert* and to *avoid certain people*. Other common precautions were to *travel with someone* at night and to choose a *seat where one is visible*.

3.4. Recommendations to improve safety for individuals with disabilities in train travel

When asked what would make the respondents feel safer when travelling, the most important improvement regardless of the kind of disability was *more staff* (Table 8); a majority of the respondents wanted more staff (around 60 % in all groups) and it was significantly more important than for other respondents for all groups. Also, other ways of getting in touch with staff or different ways of improving the surveillance were among the most wanted actions. In some cases, it was also significantly more important for these groups than for respondents without disabilities. For those with asthma/allergy or reduced mobility, *CCTV at the station* and an *accessible train host* were the shared second most important improvements. Those with motion sickness also chose

Table 7
The kinds of crime most feared in χ^2 analysis.

Most feared crimes	Asthma/ allergy	Depression/ anxiety	Motion sickness	Reduced mobility
	N = 573	N = 531	N = 504	N = 164
Theft	28 % p=<0.001	31 % p=<0.001	25 % n.s.	35 % p=<0.001
Violence	27 % p=<0.001	29 % p=<0.001	23 % n.s.	36 % p=<0.001
Sexual harassment	23 % p=<0.001	31 % p=<0.001	22 % p = 0.004	23 % p = 0.050

Table 8
Making train traveling safer according to individuals with disabilities*.

	Asthma/ allergy	Depression/ Anxiety	Motion sickness	Reduced mobility
	n = 570	n = 530	n = 496	n = 165
More staff	61 % p=<0.001	58 % p = 0.006	60 = p=<0.001	61 % 0 = 0.027
Maintenance	35 % p = 0.005	32 % n. s.	31 % n. s.	44 % p=<0.001
Illumination	47 % p = 0.001	45 % p = 0.040	48 % p=<0.001	49 % p = 0.048
Real-time Information	25 % n. s.	29 % p=<0.001	27 % p = 0.012	25 % n. s.
Info. place for arrivals, departures	24 % n. s.	29 % p=<0.001	25 % n. s.	32 % p = 0.002
Info tickets	11 % n. s.	8 % n. s.	11 % n. s.	15 % p = 0.004
Frequency	26 % n. s.	27 % n. s.	29 % p = 0.015	29 % n. s.
Fewer transfers	20 % n. s.	23 % p=<0.001	20 % n. s.	24 % p = 0.044
One phone no. for problems	30 % p=<0.001	29 % p=<0.001	29 % p=<0.001	39 % p=<0.001
Help button on train	41 % p=<0.001	44 % p=<0.001	40 % p=<0.001	46 % p=<0.001
Help button at station	41 % p=<0.001	43 % p=<0.001	40 % p=<0.001	41 % p = 0.007
Safety app	32 % p=<0.001	40 % p=<0.001	33 % p=<0.001	33 % p = 0.047
Police at station	48 % p = 0.024	55 % p=<0.001	45 % n. s.	49 % n. s.
Police on train	27 % p = 0.006	30 % p=<0.001	25 % p = 0.039	23 % n. s.
Accessible train host	52 % p=<0.001	48 % p=<0.001	47 % p = 0.005	56 % p=<0.001
CCTV on train	46 % p = 0.005	44 % n. s.	41 % n. s.	48 % p = 0.052
CCTV at station	52 % p = 0.023	52 % p = 0.031	50 % n. s.	56 % p = 0.046

*More than one alternative could be marked. Significance value at 5%.

CCTV at the stations as their second most important improvement (50 %) – however, not significantly more so than other respondents. For respondents with depression/anxiety, more *police at the station* (55 %; p=<0.001) was the second most important improvement. For the ranking of all improvements, see Table 8.

4. Discussion

The study set out to investigate patterns of victimisation and perceived safety in train travel for individuals with four kinds of disabilities: asthma and/or allergy, depression and/or anxiety, motion sickness, and reduced mobility. The results show that all groups of respondents except those with motion sickness had been significantly more victimised than other respondents. It is in line with earlier studies that have found a higher degree of victimisation for individuals with disabilities in general (Hughes et al., 2012) and individuals with specific disabilities, such as mental illness (Teplin et al., 2005). Also, in the present study, all groups except the respondents with motion sickness felt more unsafe than others. Again, individuals with disabilities feeling more unsafe than others have been shown in earlier research (e.g., Yavuz & Welch, 2010).

Although the most common place for all groups to have been victimised in the station area was on the platform, the underpasses/overpasses were the places where the respondents felt most unsafe. All groups reported underpasses/overpasses as the primary place where they experienced a lack of safety in the station area. Railway underpasses being perceived to be unsafe is in line with earlier research (Coppola & Silvestri, 2020). However, even with regard to victimisation, underpasses/overpasses are among the three most common places to

have been victimised, so they also constitute one of the most dangerous places in the station area. The way the question was formulated, the respondents could not indicate if they referred to an underpass or an overpass, but we are inclined to suspect the underpasses might have been perceived as more frightening than overpasses (Libardo & Nocera, 2012). Underpasses are often dark, and not possible to see through if curved, long, or narrow. Even if underpasses are not the main place for victimisation, they can hinder people from travelling because of a lack of safety. In some cases, underpasses could be avoided if not already built, others are possible to improve to be perceived as safer. For example, in the planning stage, bridges are, in some cases, a better alternative, so that pedestrians do not have to walk underground. In other places, or where underpasses are already built, CCTV, swift removal of graffiti, suitable light, bright colours, or art can be ways to improve.

The present results indicate that the respondents with motion sickness are more like average travellers than the other groups, in general not being significantly more victimised or unsafe than other travellers, without disabilities. This is a logical result as motion sickness is experienced only in this special environment while they have no symptoms in other environments. It can also be medicated. The question is, however, why other groups in fact are both more victimised and feel more unsafe when travelling than others. There is a lack of research in this area that should be rectified for different types of disabilities.

In the present study, the two most important factors impacting safety were whether there were intoxicated people present and if the respondent previously had been victimised; these variables were among the three most important for all groups. Intoxicated people, drug selling, or other "deviant behaviour" are often perceived to make the place more unsafe (Sundling & Ceccato, 2022). Earlier victimisation is also repeatedly found to be an important source of safety deficiency (de Jubainville & Vanier, 2017; Stark & Meschik, 2018; Vilalta, 2011). As victimisation is even more common for individuals with disabilities compared to others, this is even more important to take into consideration for example in planning as it is an essential reason for safety deficiency. In light of this result, it is not surprising that it is significantly more important for our participants that there is staff present compared to other respondents.

More staff is the single most highly valued improvement by all groups, independently of the kind of disability (Table 8). This is a result often found (e.g. Cozens et al., 2004). Some groups may be more vulnerable in the transport environment and thus be more dependent on accessible staff nearby. In our study, the differences between groups are small, around 60 % of the respondents in all groups want more staff, for all groups significantly higher than for other travellers. However, even if staff is number one on the list, it is not always possible to have staff present at small stations or around the clock. So how can this need for safety be realised in other ways? It is clear from the present results that surveillance is the most essential improvement according to the respondents. However, apart from staff at the station, this can be achieved by police, CCTV at the station, and accessible train hosts, which are also among the most desired improvements together with "help buttons", while other kinds of possible improvements, not relating to surveillance, are not as important for safety. This concerns actions related to information, maintenance, or frequency of departures. It should be noted that even several of the desired improvements relating to surveillance and ways of getting in touch with staff are significantly more important for the respondents with a disability than for other travellers. Thus, not being left alone is especially important for travellers with disabilities, but staff physically present is not necessarily the only way of improving perceived safety. Knowing that there is someone in charge, who can help, is important for safety, whether this is solved by a help button at the station or on the train, a single telephone number to call for help (instead of several depending on e.g., operator), or a safety app. At stations where staff is not possible, a digital system with the possibility to get in touch with staff is needed. In many cases, these "proxies" for staff present can be ways of getting in touch with someone, making travellers feel more included and heard. Reports, which it is possible to collect if such digital means are in place, can also serve as a statistical base for what incidents happen at a special place, to be used as a basis for decisions regarding specific measures. For example, a help button or app with centralised customer support is already in place in some countries such as the Netherlands (R. Rademaker, personal communication, May 31, 2022) and Brazil (Ceccato & Paz, 2017). However, in Sweden, and many other countries, there is room for improvement.

It should be noted that in some of the analyses, certain groups are small. This concerns especially victimisation. Therefore, these analyses should be interpreted cautiously. Also, as in all cross-sectional studies, causal relationships cannot be determined. For causality, a longitudinal design would be necessary. Self-reported data can be biased in different ways. On the other hand, given the research questions, we cannot see that any other method would have been more suitable. The respondents were also recruited at different geographical locations, with different means (paper and pen at the station and digitally at a place they chose for themselves) to achieve a large variation in the sample. Presently, there is a need for more research focusing on individuals with disabilities in public transport. The overall goal of this paper is to increase the knowledge to help develop the transport system to meet the needs of individuals with disabilities, both present travellers and "would-be" travellers.

5. Conclusions and recommendations

This study set out to investigate victimisation patterns and safety perceptions in train travel among individuals with disabilities, finding that, except for those with motion sickness, all disability groups experienced significantly higher victimisation rates than non-disabled individuals, echoing previous research. Additionally, individuals with disabilities, excluding those with motion sickness, felt less safe while travelling. Underpasses and overpasses were identified as high-risk areas, offering opportunities for improvement through enhanced design, lighting, and surveillance measures. Respondents with motion sickness resembled regular travellers due to the condition's specific triggers and manageability. Intoxicated individuals and prior victimisation experiences were fundamental factors affecting safety. Increased staff presence emerged as a top priority for safety improvements, though alternative measures such as enhanced surveillance, accessible train hosts, and help buttons can also provide reassurance. The study underscores the importance of creating inclusive, secure travel environments. Increased staff presence should be prioritized as well as enhanced surveillance. Train hosts must be available and easy to get in touch with onboard the train during the whole trip. Help buttons would permit travellers onboard the train to get in touch with the train host. This would be especially assuring for travellers with disabilities. Help buttons in stations are important in smaller stations where is no staff. The result from the present study encourages further research to address the unique safety concerns of diverse disability groups. For example, how can the safety regulations be improved? Also, at what stations are staff presence most important and at what times of the day at? For example, some stations are small as bus stops, and therefore, it is not realistic to have staff physically present, but here, other possibilities to get in touch with staff could be an option. At larger stations, would it be enough to increase staff only in the evenings? Another question is why train hosts are not perceived to be available onboard the train and how this could be changed.

Public awareness campaigns could be implemented to inform and educate the public and transportation staff on the challenges faced by individuals with disabilities. One way would be to create committees with representatives from different disability groups to ensure diverse perspectives, leading to more inclusive and practical solutions. Individuals with disabilities should also be invited in planning and decision-making, as their insights help develop effective policies.

Sweden's regulations mandate that public buildings and transport

facilities be accessible. Despite laws and regulations, individuals with disabilities are still more victimised and unsafe than others, thus, the transport system is not as accessible and usable for them as for others. Strict enforcement of accessibility standards in construction projects is essential including public transportation and services they may provide, such as toilets. The transport system must be shaped for all passengers, not only "the regular traveller". More research on the needs of those with special safety needs in the transport system is called for, as the body of knowledge is still small. Also, what policy needs to be in place? How can design be applied to create an inclusive and secure travel environment for everybody? Groups with different kinds of disabilities must be included in urban and transportation planning. As long as they are both more victimised and feel more unsafe when they are travelling by train, improvements must be made.

CRediT authorship contribution statement

Catherine Sundling: Writing – original draft, Funding acquisition, Conceptualization. **Vania Ceccato:** Writing – review & editing, Project administration, Investigation, Funding acquisition, Conceptualization. **Gabriel Gliori:** Writing – review & editing, Software, Investigation, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

Acknowledgments

This work was supported by the Swedish Transport Administration [grant number TRV 2020/22903]. All procedures have been performed in compliance with relevant laws and institutional guidelines, and the project has been approved by the Swedish Ethical Review Authority [Dnr 2021-06393-01]. Thanks to all travelers who responded to our survey from May to September 2022. The authors wish to express their gratitude to Russel James for proof reading.

Appendix A

Table A1
Precautions because of a lack of safety.

Precautions	Asthma/allergy		Depression/anxiety		Motion sickness		Reduced mobility	
	N = 538		N = 506		N = 487		N = 155	
	Night	Day	Night	Day	Night	Day	Night	Day
Travel with someone	43 % n.s.	10 % n.s.	60 % p=<0.001	13 % p=<0.001	51 % p=<0.001	12 % n.s.	47 % n.s.	20 % p=<0.001
Avoid trains/routes	30 % p=<0.001	6 % p = 0.003	31 % p=<0.001	4 % n.s	27 % n.s.	5 % p = 0.046	34 % p = 0.003	10 % p=<0.001
Avoid specific station	30 % p = 0.005	8 % p=<0.001	31 % p = 0.002	6 % p = 0.048	31 % p = 0.001	6 % n.s.	29 % n.s.	11 % p=<0.001
Avoid specific people	72 % p=<0.001	36 % p=<0.001	74 % p=<0.001	35 % p=<0.001	72 % p=<0.001	32 % p = 0.021	63 % n.s.	41 % p=<0.001
Seat visibly	51 % p=<0.001	22 % p=<0.001	51 % p=<0.001	21 % p = 0.002	49 % p = 0.003	21 % p = 0.003	47 % n.s.	28 % p=<0.001
Place myself close to another person	38 % p=<0.001	8 % n.s.	41 % p=<0.001	10 % p = 0.012	37 % p = 0.007	10 % p = 0.009	33 % n.s.	8 % p = n.s.
Phone contact with someone	41 % p = 0.002	9 % p = 0.005	52 % p=<0.001	11 % p=<0.001	44 % p=<0.001	8 % n.s.	37 % n.s.	14 % p=<0.001
Stay alert	78 % p=<0.001	23 % p=<0.001	81 % p=<0.001	20 % n.s.	78 % p=<0.001	18 % n.s.	71 % n.s	26 % p = 0.005
Wear certain clothing	24 % p=<0.001	10 % p=<0.001	23 % p=<0.001	9 % p = 0.003	21 % p = 0.008	9 % p = 0.003	23 % p = 0.034	11 % p = 0.008
Wear no jewellery	19 % p = 0.018	10 % p = 0.005	15 % n.s.	7 % n.s.	15 % n.s.	7 % n.s.	27 % p=<0.001	16 % p=<0.001
No handbag	18 % p = 0.001	7 % p=<0.001	16 % n.s.	5 % n.s.	14 % n.s.	5 % n.s.	24 % p=<0.001	8 % p = 0.034
Bring a weapon	10 % p = 0.008	4 % p = 0.006	11 % p=<0.001	5 % p=<0.001	10 % p = 0.004	3 % n.s.	11 % n.s.	7 % p = 0.003
Try to look confident	40 % p=<0.001	22 % p=<0.001	47 % p=<0.001	26 % p=<0.001	40 % p = 0.001	20 % p = 0.028	45 % p = 0.003	28 % p=<0.001
Take a detour	26 % p=<0.001	5 % p = 0.003	28 % p=<0.001	5 % p = 0.002	26 % p = 0.001	4 % n.s.	29 % p = 0.008	8 % p=<0.001
Avoid certain times of the day	49 % p = 0.045*	3 % n.s.*	44 % n.s.**	6 % n.s.**	44 % n.s.***	6 % n.s.***	52 % n.s. ****	10 % p = 0.013 ****

Calculated on *N = 255; **N = 198; ***N = 149; **** N = 84. Significance value at 5 %.

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