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## **The Role of Public Transport in Transport Safety and Public Safety**

**Diana Henezi**

Széchenyi István University

**Agoston Winkler**

Széchenyi István University

**Abstract:** Public transport has a significant role in sustainable urban transport including the reduction of congestion, noise and air pollution. The main purpose of this paper is to present other important impacts of public transport i.e., the improvement of transport safety and public safety, too. Public transport is one of the safest transport modes according to the indication numbers in traffic accident and injuries. This phenomenon is illustrated through literature research as well as statistical data. Further opportunities are presented with a case study based on the transport system of the city of Győr, especially the positive impacts of the possible expansion of night public transport services. The severity of traffic accidents at nights is significant, and the enhancement of public safety is outstanding. Marketing is one of the most important tools for attitude formation, the paper contains some suggestions in this regard as well as in order to promote the goals above.

**Keywords:** Public safety, Public transport, Traffic safety, Sustainable mobility

### **Introduction**

Transport as a process does not create value, the user (may it be the driver, the person passing by or the passenger) realizes their goal through transport. This is what we call derived trait. Travel happens when the end result creates a higher value than the costs (including monetary and time spent). It is evident, that commuting to work and school is an everyday activity that carries this value (Kharola et al., 2010). Despite that, traffic-related accidents are one of the top leading causes of death in the EU and in Hungary. As transport is an integral part of everyday life, road safety is an important interest of society.

Each year in Hungary more than 20 000 people get injured in traffic accidents and out of that around 500-600 people lose their lives. The number of severe injuries is around 5000, and more than 14 000 people suffer less-serious injuries. These numbers are not just part of the statistics as these accidents have a direct effect on society as an accident or injury can change a family's life, it affects the healthcare sector, and has an effect on other transport participants when it comes to congestion and lost time caused by the accidents. Around 90% of traffic accidents are caused by human error, but we should not overlook the fact that infrastructure (road and its surroundings), and mechanical issues can also contribute to their occurrence.

If we examine indicators and mileage, it can be concluded, that in most cases the vehicle is at fault. If we consider the severity of injuries, unprotected participants such as motorcyclists, cyclists and pedestrians are highly endangered. The severity of injuries depends on various factors including age, physical fitness, and condition. A directive from the EU states that road accident fatalities and serious injuries should be reduced by 50% until 2030. Moreover, there is a „Zero Vision” goal for 2050 meaning that no one should lose their lives in a traffic accident. In order to reduce the number of accidents we can utilize and introduce a range of tools and activities. We can approach this goal from various perspectives:

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- infrastructure: building self-explanatory roads, inspecting existing roads, creating forgiving roads
- authorities: increasing the number of police inspections = higher probability of in flagrante delicto
- people: improving education
- other instruments: promoting public transport (with continuous marketing activity), campaigns (European Mobility Week, The Day of Transport Culture, raising awareness in kindergartens, schools, and workplaces).

## The Role and Advantages of Public Transport

The main function of public transport is to offer transport possibilities to people who are not able to use other transport modes (personal vehicle, bicycle, etc.). Reasons could be:

- their age limits their driving capabilities
- they are not able to afford a personal vehicle
- they are not able to drive due to medical reasons.

Apart from this, public transport should offer such possibilities where individuals who do have personal vehicles choose public transport instead. This can be achieved with push & pull (stick & carrot) methods (e.g., creating bus lanes, dynamic timetables, wide network connections). However, we should not forget, that there will always be social groups who will choose their personal vehicle regardless (Nævestad et al., 2022). Compared to individual transport, public transport has several advantages.

Even with 50% occupancy, buses use approximately five times less energy per passenger kilometer than cars. With public transport modes, urban air pollution could be four to eight times less per passenger compared to personal vehicles. The most significant advantage of public transport is connected to space occupancy: buses take up only 5% of space per passenger compared to personal vehicles (Koren et al., 2007). As a result, it is not surprising that both Hungary and the EU set goals to improve and promote public transport.

## Connection between Public Transport and Road Safety

Changing the model split, specifically improving and promoting public transport (one of the safest modes) could be a great solution to reduce traffic accidents: this is supported by several studies. Table 1 shows accident data in Hungary between 2018 and 2022 broken down by cause.

Table 1. Accidents in Hungary (2018-2022)

Year	Passenger vehicle	Of this:				Cargo vehicle	Pedestrians	Other accidents	Total
		Motor-bike	Passenger car	Bicycle	Scooter				
2018	14 193	668	10 920	1 742	631	1 501	988	269	16 951
2019	14 042	766	10 865	1 607	604	1 467	848	270	16 627
2020	11 692	599	8 839	1 600	512	1 224	601	261	13 778
2021	12 047	623	9 484	1 289	483	1 362	557	267	14 233
2022	12 486	549	9 926	1 326	501	1 222	680	360	14 748
Total	64 460	3 205	50 034	7 564	2 731	6 776	3 674	1 427	76 337
%	84.44	4.20	65.54	9.91	3.58	8.88	4.81	1.87	

It is apparent that personal vehicles are responsible for more than 65% of accidents. Based on the table collected from the central database, the number of road accidents between 2018 and 2022 involving public transport vehicles is indicated in Table 2.

The Table 2 contains accident data for buses, suburban railway lines, trams, and trollies. If we compare this with the total number of accidents, we can see that they cause far less accidents than personal vehicles (note: the most accurate ratio would be based on data per mileage, but we do not have the sufficient information). As a first step, promoting public transport, and increasing the number of passengers would reduce congestion as if people choose public transport instead of their personal vehicles, the number of cars on the road would decrease.

Table 2. Road accidents involving public transport vehicles (2018-2022)

Accident type	2018	2019	2020	2021	2022
Collision between oncoming vehicles	52	50	28	50	33
Collision between vehicles travelling in the same direction	108	97	74	101	94
Collision between vehicles travelling in opposite directions	144	144	112	122	131
Collision between a railway vehicle and a road vehicle	3	4	3	1	3
Collision between vehicles travelling straight ahead and turning	121	129	90	96	105
Collision with a stationary vehicle	19	15	10	11	15
Collision with a solid object on the road	1	4	1	1	2
Slip, swerve, overturn on the road	17	8	4	10	10
Leaving the track without hitting a solid object	11	10	8	7	9
Leaving the road, hitting a solid object outside the road	8	5	4	6	4
Hitting a pedestrian	116	131	77	71	111
Passenger accidents	112	114	72	78	88
Collision with a wild animal	0	5	3	3	3
Other	1	1	2	0	0
Total	713	717	488	557	608

### The Example of Győr-Moson-Sopron County

We illustrate through the example of a county's public transport its safety, and effect that the introduction of night services would have. Due to the continuous structural changes of the bus service provider, we only have detailed data from 2015 to 2019, but our hypothesis is that trends and ratios have not changed; however, this sets new research goals. In this period, 804 accidents occurred in the county altogether that involved buses. This number includes all incidents involving personal injury or damages in property (Table 3).

Table 3. Accidents in Győr-Moson-Sopron county involving buses (2015-2019)

Only damages in property	Personal injury	Injury caused by scattering
732	64	8

It's apparent that only 8.1% of all accidents involved personal injury. In this period 100 people suffered injuries, with 72 people suffering minor, 25 people severe, and 3 people fatal injuries. In Győr-Moson-Sopron County the accident data in Table 4 was observed in this period.

Table 4. Accidents in Győr-Moson-Sopron County (2015-2019)

Accident	Death	Severe injuries	Minor injuries	All injuries
3,759	211	1472	3602	5285

In terms of bus accidents resulting in minor injuries, in 33% of cases the bus driver was at fault. This shows that personal vehicles cause most of the accidents. For accidents resulting in major injuries, this rate is only 16%. The most common causes of accidents are:

- reckless driving
- neglecting turning rules.

Even though we do not have data about mileage, the absolute numbers show that public transport is significantly safer than individual transport. We did not receive data from the transport service company for 2020. For 2021 and 2022 the company provided the data about accidents resulting in personal injuries in Győr's local public transport as seen in Table 5.

Table 5. Personal injuries in Győr's local public transport

Year	Number of accidents
2021	9
2022	5

Unfortunately, we did not receive detailed statistics about the ratio of injuries (fatal, severe, minor). However, the decrease in the number of accidents in 2022 compared to 2021 is still apparent which is due to several factors. One of them is the reduction of mileage as reduced mileage means lower accident risk. Also, the

frequency and standard of education can also make a difference in public transport safety. It is a question if this tendency continues in the coming years.

### **Passenger Injury**

Passenger injuries are considered separately in this context as it is possible that the driver avoids an accident with an emergency brake, so financial damages do not occur (Amadori & Bonino, 2012). However, the emergency brake causes passengers to fall down and sustain injuries. These are what we call passenger injuries. We divide these into three main categories:

- during boarding and disembarking
- on the move
- in case of emergency braking.

In its public service report for the years 2021 and 2022, the company provided data on passenger accidents in this breakdown, which were as shown in Table 6.

**Table 6. Passenger accidents in Győr’s local public transport**

Type of accident	2021	2022
During boarding and disembarking	6	4
On the move	4	5
In case of emergency braking	4	9
Total	14	18

There is a significant increase in passenger accidents during emergency braking in 2022 compared to 2021. Unfortunately, the causes and details of the accidents were not provided. The best way to avoid passenger accidents is to provide seating areas and proper handrails. Here we should consider increasing the capacity of buses during peak hours as well as optimizing vehicle design (Wang et al., 2020).

Despite this, public transport still has many advantages (especially safety) over individual transport. If we look at the statistics it is evident, that bus transport is considerably safer than using personal vehicles. It is important to use various methods to encourage more people to use this safe transport mode, e.g., safe design of buses as well as the use of the aforementioned push & pull tools (e.g., convenient timetables and routes, preference techniques).

### **Introducing and Promoting Night Bus Services**

A highlighted category of traffic accidents are the so-called disco-accidents that often involve drunk driving and a specifically high rate of major injuries. The severity of accidents is worsened by the higher speed, and the risk of accident is increased due to driving under influence.

The severity of night accidents is twice as significant as day accidents, and as the data from Győr-Moson-Sopron County shows (Table 7), drunk driving is a major contributor. Győr is one of the most dynamic cities in Hungary and the center of the Western Transdanubia region with a population of 130,000 and with its own university. Consequently, the city has a number of various services and transport infrastructure as well as a high demand for them. This is true for public transport, too, however most of the services are scheduled around factory working hours (4 am to 11 pm).

It has to be noted that the local government has organized several events that go on longer than the regular service time for public transport. People attending summer opening and closing concerts as well as New Year’s Eve festivities have expressed the need for public transport services to be able to get home after these late-night events. An even bigger problem was that on 31 December, the bus services ended at 7 pm, so people were not able to get home even at 8 pm, let alone after midnight.

This problem was finally solved in 2009, when the local government organized a bus service on 6 specifically designed lines from 7 pm to 2 am. This compact service that reaches all parts of the city (but not every stop) is now running with 7 lines (Figure 1) after night events (Winkler & Szabó, 2019).



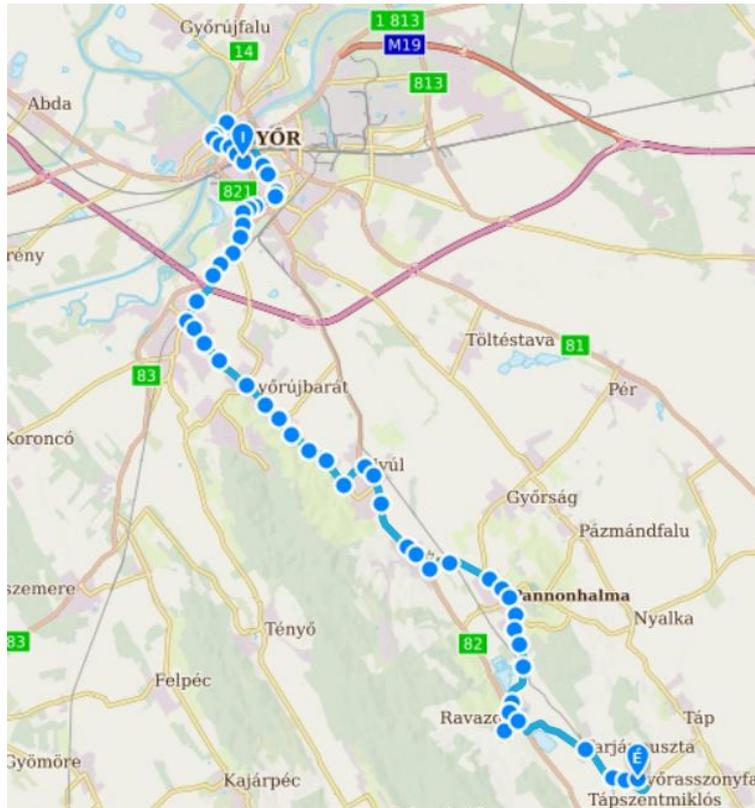


Figure 2. The route of night bus line 7044

This provides a solution for public transport on the most important nights, but this service is still not available most of the year. Even though during European Mobility Week several tests were successfully completed regarding running night services every weekend, it was only in 2018 when the next significant milestone was achieved.

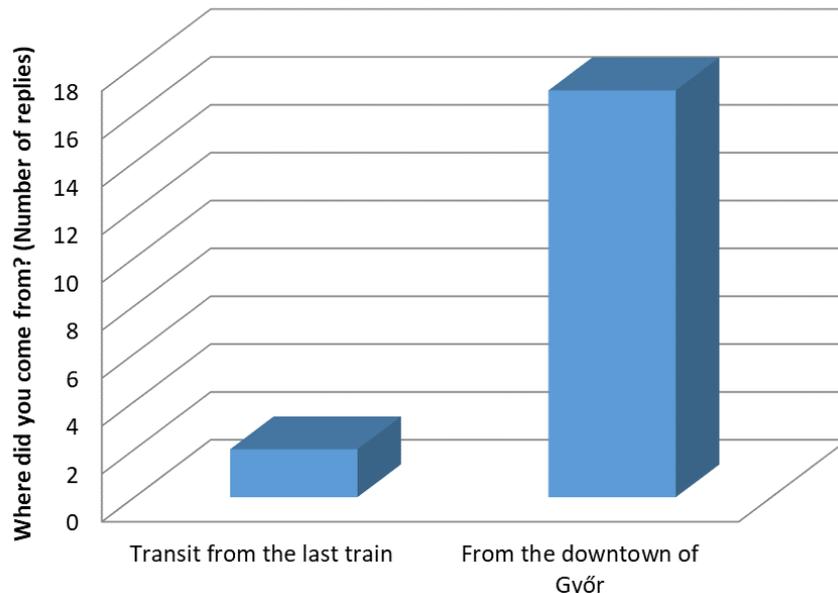


Figure 3. The reasons for using night bus line 7044

The S10 train leaving Budapest at 11:20 pm was extended from Komárom to Győr (based on civil requests) on 9 December 2018, and connected to this train there is regional bus line 7044 (city line number 900) that runs on the weekends and it passes through the major residential areas (Adyváros, Marcalváros) and has various stops in the agglomeration between 1 and 2 pm (Winkler & Szabó, 2019).

The service was initially on a demand-driven basis (departing only when there were passengers at the stop), but the number of passengers constantly grew, so from 16 May 2020, the service runs every weekend and covers a much bigger area (Szeghalmi, 2020): inside the city it stops at the university and at the city center, and in the southern agglomeration it has stops in Győrújbarát, Nyúl, Pannonhalma, Ravazd, Tarjánpuszta and Győrasszonyfa (Figure 2).

This night bus usually has around 15 to 30 passengers every time, but this number would increase with marketing activity. Although it is not possible to exactly show how many accidents and other incidents were avoided with the help of the bus service, but it is evident that it effectively improved road safety and public safety. However, a survey result from 2019 (Figure 3) indicates its relevancy as it shows that most passengers who take the night bus are using it to get home from a nightclub in the downtown of Győr (Winkler & Szabó, 2019).

Based on the data above the expansion of the night bus service both in terms of route (northern parts of the city and agglomeration) and time (frequency and service even during the weekdays, especially in the summer) would be beneficial. Győr's recently accepted Sustainable Urban Mobility Plan (SUMP) also indicated: these developments are some of the most efficient transport measures (Makó et al., 2023).

## **Conclusion**

In this paper we discussed the benefits of public transport in terms of traffic and public safety, as well as its potential for development and promotion. In case of night accidents, the ratio of intoxication is significant, so we highlighted the importance of night public transport, illustrated by a case study from Győr. In order to achieve positive changes, it would be essential to raise awareness (from an early age), promote existing public transport services and advertise new services through targeted marketing activities.

## **Scientific Ethics Declaration**

The authors declare that the scientific ethical and legal responsibility of this article published in EPSTEM journal belongs to the authors.

## **Notes**

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### **Author Information**

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**Diána Henézi**

Széchenyi István University

Győr, Hungary

Contact e-mail: [kdiana@sze.hu](mailto:kdiana@sze.hu)

**Ágoston Winkler**

Széchenyi István University

Győr, Hungary

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