



Received: 26-10-2024

Accepted: 06-12-2024

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

Safety of vulnerable persons in European road traffic

¹Gheorghe Neamțu, ²Marinela Ință

¹ Ph. D. Engineer, Associate Professor, "Lucian Blaga" University of Sibiu, 10 Victoriei Street, Sibiu, Romania

² University Lecturer, Ph. D. Engineer, Professor, „Lucian Blaga” University of Sibiu, 10 Victoriei Street, Sibiu, Romania

DOI: <https://doi.org/10.62225/2583049X.2024.4.6.3541>

Corresponding Author: Gheorghe Neamțu

Abstract

The scientific paper presents a concrete research carried out by the authors in order to implement some technical concepts, so that those interested in this field can become acquainted with a certain way of presenting the problems related to the safety of vulnerable persons in road traffic. In specialist literature, vulnerable persons in road traffic are persons other than drivers of road vehicles who participate in road traffic (pedestrians, cyclists, persons on scooters, bicycles, mopeds or motorcycles), who are exposed to danger or accidents, whose means of transport or locomotion, two or three-wheeled vehicles, are not fitted with protection or safety systems in the event of collision with other vehicles, falling or overturning. From this

scientific paper those interested can gather information on European statistics on road accidents involving vulnerable persons in road traffic in previous years, learn about the safety systems for the protection of vulnerable persons in road traffic that are fitted on current road vehicles, learn about the safety of pedestrians, cyclists, scooter riders and moped/cycle riders in European urban traffic and about the protection types for vulnerable persons in road traffic according to Euro NCAP requirements. At the end of the research, the case study entitled *KilometreGood* is discussed, followed by the conclusions drawn on the basis of the researched data.

Keywords: Vulnerability, Pedestrians, Cyclists, Motorcyclists, Safety Systems, Road Accidents

1. Introduction

Both road traffic in Romania and in the European Union (EU) still poses significant risks to the life and health of the population. Road accidents are a major cause of deaths and injuries both among people involved in traffic, as drivers of cars, motorcycles/mopeds, passengers, cyclists, people on scooters and pedestrians, and those not involved in traffic (children's playgrounds, public institutions, the courtyards of houses or apartment blocks located near streets or boulevards, etc). According to expert analysis, the causes of road crashes include a combination of factors, the most important of which is the human factor. The significant loss of life exacts a tragic toll, extending beyond personal loss to deep community impacts, including: personal economic costs and emotional trauma to those suffering; and significant taxpayer spending on emergency response and long-term healthcare costs. And because so many fear for their safety on our streets, there is no true freedom of mobility, and, as a result, we compromise our public health with increasing rates of sedentary diseases and higher carbon emissions. For too long, we've considered traffic deaths and severe injuries to be inevitable side effects of modern life. While often referred to as "accidents", the reality is that we can prevent these tragedies by taking a proactive, preventative approach that prioritizes traffic safety as a public health issue. Pedestrians are the most vulnerable people in road traffic, and the ones who suffer most casualties. Their vulnerability is defined by the fact that, in the event of a road accident, they have no protection system, in particular adults, children and the elderly. Children do not rationalize the risk to which they are exposed and do not pay close attention when crossing a road at a pedestrian crossing or outside a pedestrian crossing, when walking or cycling alone on a public road, or when running after a ball that has landed in the street. Older persons have a reduced vulnerability in road traffic, which is characterized by reduced reaction speed due to the older ageing process (Fig 1). In comparison, other road users such as drivers with no driving experience and professionally licensed drivers have, in most cases, high-performance crash protection systems on the vehicles they drive, which makes them non-vulnerable in road traffic. Other highly vulnerable road users, who are easily subject to road accidents, are motorcyclists, moped riders, cyclists, or more

recently, people who ride scooters (Fig 1). Against this background, in 2022, 20,640 people lost their lives in road accidents on EU roads, with pedestrians, cyclists and motorcyclists most at risk. The EU aims to halve the number of deaths and serious injuries caused by road accidents by 2030 and to almost zero by 2050 (Auditors, 2024, p. 5) ^[1].

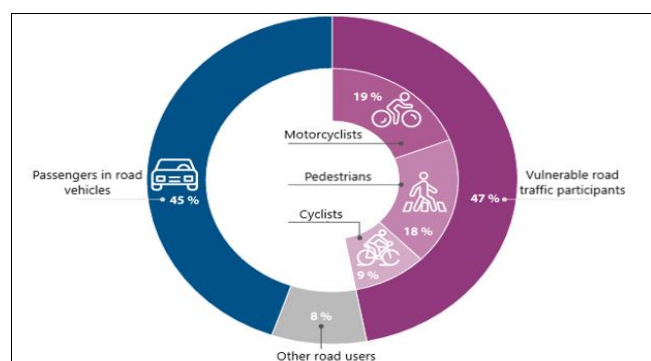


Fig 1: Percentage of road fatalities in the EU by category of road user (2021) (Auditors, 2024, p. 11) ^[1]

2. Literature review

As the number of people killed in road accidents continues to rise, the European Union (EU) has reaffirmed its long-term goal of approaching zero fatalities by 2050 – “*Vision Zero*”.

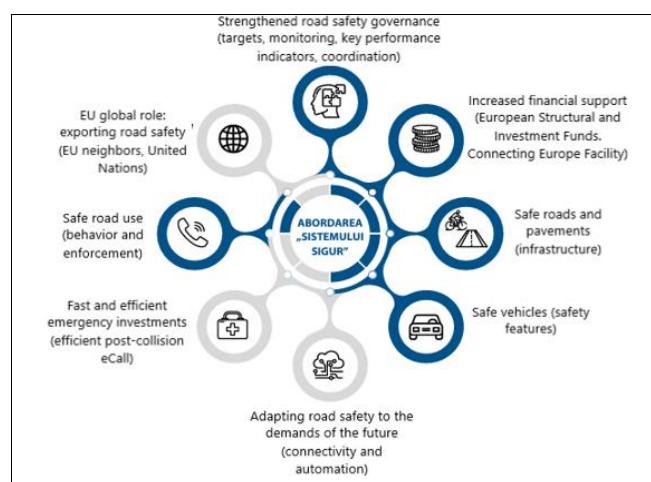


Fig 2: EU Safe System Approach (Auditors, 2024, p. 14) ^[1]

By approving the *Valleta Declaration* (Union, 2017) ^[16], in addition to the EU's long-term objective (to approach zero road deaths by 2050), it was added that the same target should also be achieved for serious injuries. The Communication also proposed new intermediate targets to reduce road fatalities by 50% between 2020 and 2030 and to reduce serious injuries by 50% over the same period. To achieve these goals, the European Commission is setting out a new approach to road safety for the decade 2021-2030, the “safe system”. (Auditors, 2024, p. 14) ^[1]. According to the

“safe system” approach (Fig 2), deaths and serious injuries caused by road crashes are not an inevitable price of mobility. Accidents will always happen, but deaths and serious injuries are largely preventable. The “safe system” approach aims for a less punitive road system, involves recognizing that people make mistakes, and proposes complex multi-layered measures to prevent people from dying, taking into account the characteristics of human vulnerability. Certain measures such as optimized vehicle construction, improved road infrastructure parameters, reduced traffic speeds can reduce the impact of accidents. Applied at a unitary level, the measures should provide a sufficient level of protection even if one element fails, because another element will compensate to prevent the worst outcome. This approach implies multisectoral and multidisciplinary action and management by objectives, time-bound targets and performance monitoring (adapted from EU Road Safety Policy Framework 2021-2030 - Next steps towards “*Vision Zero*”, 2019). Therefore, the long-term objective must remain to come as close as possible to zero road traffic fatalities by 2050 and the same objective should be pursued for serious injuries. The long-term goal of the “safe system” is to prevent road deaths and serious injuries. The Safe System is being adopted by a growing number of countries and is the basis of the United Nations (UN) Decade of Action for Road Safety. Its implementation requires a strong and consistent governmental commitment, as well as the involvement of stakeholders from a wide range of fields. To this end, this Strategy integrates the “safe system” approach and recognizes that while people will make mistakes and may be involved in road crashes, the aim must always be to provide an environment that mitigates serious unintended consequences. The system includes among other safety measures those vulnerable to road traffic. Through the technical and economic policy of the European Parliament to improve the quality and safety of the circulation of vehicles on European roads, on the basis of the Regulation of the European Parliament and of the Council (PE-CONS 82 of 18.10.2019) amending Regulation (EU) 858 of May 30, 2018, MEPs are coming up with new proposals on the fitting of safety systems in motor vehicles to protect passengers, pedestrians and cyclists (Neamțu, 2023, p. 106) ^[10].

3. European statistics on road accidents involving vulnerable road users

The number of road fatalities in Romania is 86 per million inhabitants, followed by Bulgaria, Croatia and Greece. On average, the number of road fatalities is 46 per million inhabitants in the EU. Considering the population of each EU country, the lowest road fatality rates in 2022 were recorded in Norway, Sweden and Iceland (Fig 3). Persons aged between 25 and 49 accounted for the largest share of fatalities (around one third), followed by those aged 65 and over with 29% of fatalities. Together these two groups accounted for just over 60% of all road fatalities in Europe.

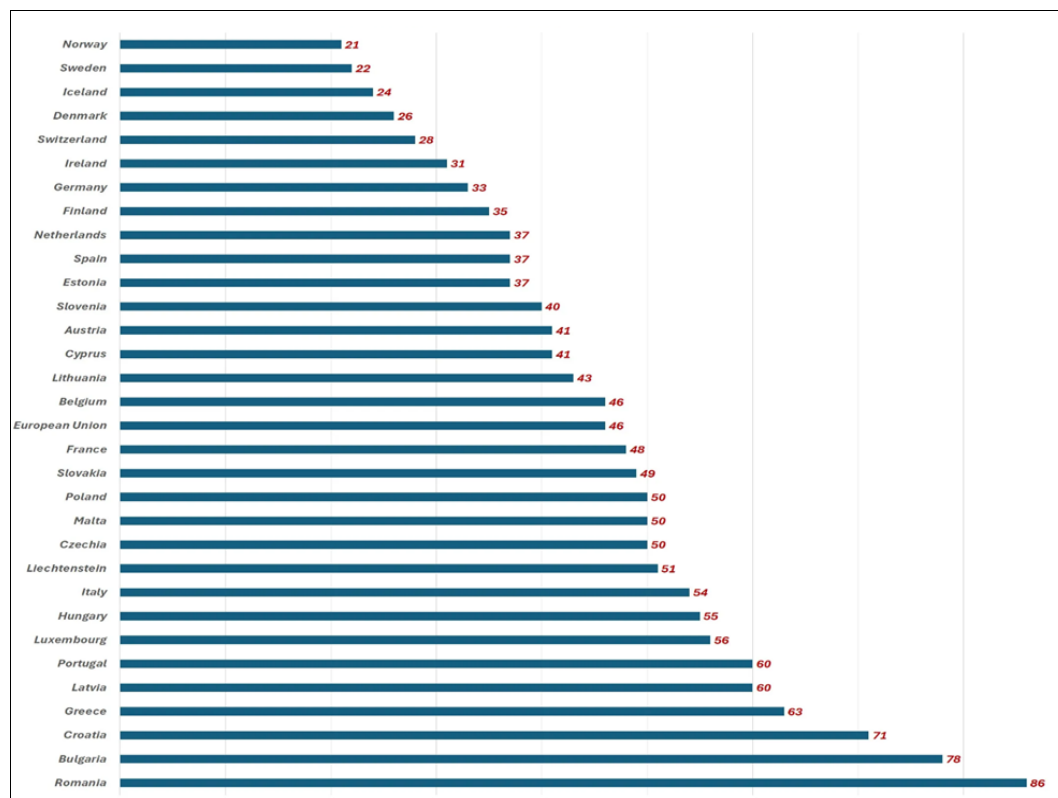


Fig 3: Road fatalities/ 1 million people in Europe in 2022 (Popa, 2024) ^[13]

Persons aged 50-64 accounted for 22.4% of all deaths, while persons aged 18-24 accounted for 11.5% (Popa, 2024) ^[13].

People aged 65 and over had the highest number of deaths in some countries (nine countries): the Netherlands (42.7%), Switzerland (37.8%), Germany (36.7%), Germany (36.7%), Slovenia (36.5%), Denmark (34.4%), Malta (33.3%), Norway (32.8%), Austria (32.2%) and Sweden (36.1%) (Popa, 2024) ^[13].

Among the 50-64 age group, Romania recorded the highest share of deaths at 29%, while among the 18-24 age group, Cyprus recorded the highest share of deaths at 27% (Popa, 2024) ^[13].

Passengers or car drivers accounted for 44.6% of people killed, while pedestrians accounted for 18.1% (Popa, 2024) ^[13].

Bicyclists and e-cyclists (powered bicyclists) together accounted for 10.1% of road fatalities in the EU, with the caveat that bicycle fatalities are sometimes underreported. The other vehicle categories together accounted for 10.9% of road fatalities in the EU in 2022: people killed in crashes involving light and heavy vehicles, buses and coaches, mopeds and "other" (essentially agricultural tractors and other motorized vehicles) (Popa, 2024) ^[13].

In countries where cycling is widespread, such as the Netherlands, it is not surprising that cyclists account for a higher share of fatalities than in countries where cycling is less common. Bicyclists accounted for 21.8% of all road fatalities in the Netherlands, followed by Belgium and Slovenia with 18.5% and 12.9% respectively. At the other end of the scale, cyclists accounted for only 2.2% of all road fatalities in Greece (Popa, 2024) ^[13].

Greece (34.3%) and Italy (24.7%) had the highest shares of motorcyclists among road fatalities in the EU, ahead of Cyprus (24.3%) and Spain (23.0%). The rest of the "two-wheeled" category - mopeds - accounted for 6.1% of all road

fatalities in Estonia, almost identical to the next highest country (the Netherlands with 6.0%).

The number of pedestrians killed in road accidents can still be considered relatively high: 3,723 pedestrians were killed in the EU, accounting for 18.1% of all fatalities. However, this share varies considerably between countries, from around 8.3% in Luxembourg to 44.4% in Malta. The share was also around 30% in Romania (32.5%) and Latvia (30.9% - 2020 data). Rural road deaths accounted for 52.7% (Popa, 2024) ^[13].

Road traffic fatalities in the EU were also categorized according to the type of road on which the accidents occurred. Rural roads accounted for the highest number of fatalities with 10 858 cases (52.7% of the total - estimated values), followed by urban roads with 7,882 fatalities (38.2%) (Popa, 2024) ^[13].

Highways had the lowest number of fatalities, 1 880 (9.1%), and there were a negligible number of fatalities with an unknown road type (only one fatality). Five Member States accounted for less than 40% of all deaths on rural roads: Portugal (36.9%), Slovenia (36.5%), Romania (35.4%), Croatia (33.5%) and Cyprus (24.3%) (Popa, 2024) ^[13]. According to my research, only seven countries had highway fatalities above 10%, with Slovenia having the highest share with 29.4% of their total fatalities. No highway fatalities were recorded in five countries (Estonia, Iceland, Latvia, Latvia, Malta and Norway). In 2023, according to a press release cited by Agerpres, 4,525 serious road accidents were recorded in Romania, resulting in the death of 1,545 people and serious injuries to another 3,535. Compared to 2022, 190 fewer accidents were recorded, 88 fewer people were killed and 160 fewer people were seriously injured, the source said, adding that, in order to increase road safety, at national level, the traffic police carried out 58,385 actions, 4,624 more than in 2022 (+8.6%)

(hotnews.ro, 2024) [8].

According to Romanian police statistics, Fig 4 and Table 1 show the dynamics of serious road accidents on public roads in Romania in 2019-2023.

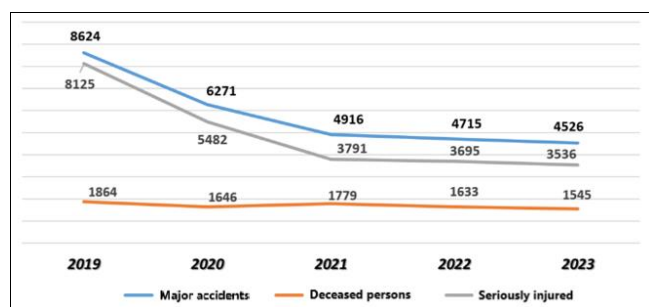


Fig 4: The dynamics of serious road accidents on public roads in Romania in 2019-2023 (politiromana.ro, 2024) [12]

Table 1: The dynamics of serious road accidents on public roads in Romania in 2019-2023 (politiromana.ro, 2024) [12]

Year	Accidents	Deceased persons	Seriously injured
2019	8.624	1.864	8.125
2020	6.271	1.646	5.482
2021	4.916	1.779	3.791
2022	4.715	1.633	3.695
2023	4.526	1.545	3.536

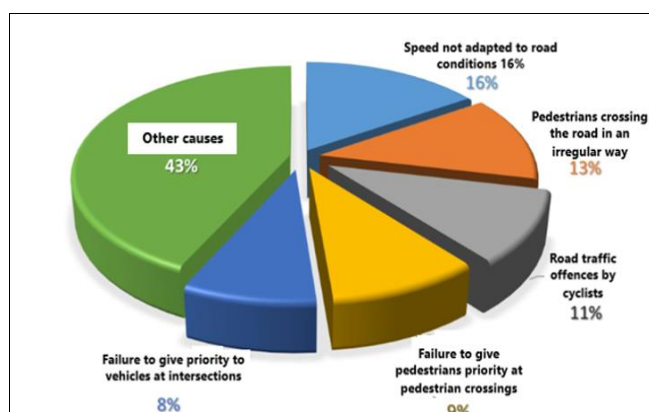


Fig 5: Main causes of serious road accidents in 2019-2023 (politiromana.ro, 2024) [12]

The main causes of road accidents in Romania in the period 2019-2023 are presented in the graph in Fig 5, and Fig 6 shows the evolution of serious accidents in 2023 compared to 2022. Analysis of the data presented in the graph in Fig 5 shows that indiscipline in road traffic on arterial roads in Romania accounts for a significant percentage of the total number of victims resulting from road accidents - 13% in the period 2019-2023. The vulnerability of pedestrians is also reduced in the context of casualties resulting among pedestrians who cross the road legally at pedestrian crossings. By not giving priority to pedestrians by drivers at pedestrian crossings, road events took place in 2023 occupying 8% of the total leading causes of serious road accidents in the analyzed period (2019-2023).

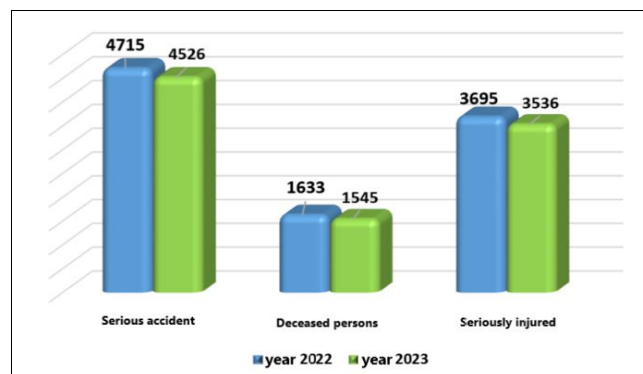


Fig 6: Evolution of serious accidents in 2023 compared to 2022 (politiromana.ro, 2024) [12]

By analyzing the data in the graph presented in Fig 6, we observe that in 2023 the number of serious accidents, fatalities and seriously injured persons decreased slightly on Romanian roads. However, all these figures remain high and are due to the main causes leading to road accidents. They have remained unchanged, with the main causes being indiscipline in road traffic on the part of pedestrians, either when crossing the roads or when moving on the streets or roads, failure to give pedestrians priority and indiscipline on the part of cyclists or motorcyclists in road traffic. We need to revisit the causes which, unfortunately, have remained unchanged over the years, and pedestrian indiscipline is at the top of the list. Many times in rural areas we do not have the necessary conditions for pedestrian traffic, i.e. no sidewalks, and often at night on the road. The second cause is speed, i.e. speed not adapted to road conditions or excessive speed. The third cause: indiscipline of cyclists, the fourth cause: failure to give right of way to vehicles and the fifth cause: failure to give right of way to pedestrians. These five causes account for 63.6% of all crashes recorded in one year, which is a very high proportion (digi24.ro, 2024) [5].

With regard to the days of the week on which accidents were recorded, it can be seen that most accidents were recorded on Friday and most fatalities on Monday. So we see that it somehow ties in with the weekend, which should give us food for thought. It's also interesting to see the road categories on which accidents happen. Most accidents happen on roads within towns and municipalities, made up of national roads, then county roads, municipal roads, other categories of roads, and the fewest accidents are recorded, naturally, on highways which are more comfortable in terms of traffic and have more protective elements (digi24.ro, 2024) [5].

As regards coercive measures, the situation of sanctions applied for failure to comply with the provisions of the Romanian Highway Code shows that the main causes are (digi24.ro, 2024) [5]:

- pedestrian indiscipline - more than 80,000 penalties;
- speed - over 660,000 speeding penalties;
- indiscipline of cyclists - 75,000 penalties;
- failure to give pedestrians the right of way - more than 16,000 penalties.

4. Safety systems for the protection of vulnerable persons in road traffic installed in motor vehicles

The European Commission has published a list of 19 life-saving safety technologies that will be mandatory on new cars in the next update of EU vehicle safety rules, which is expected as early as the beginning of 2017. The Commission has set out a number of advanced safety measures that should be fitted on new motor vehicles, which have a life-saving role and potential to save the lives of all road traffic participants. These measures will be examined in detail to decide exactly how tomorrow's vehicles will become safer. The measures are contained in a Report from the Commission to the European Parliament and the Council entitled, *Report on the monitoring and evaluation of advanced vehicle safety features, their associated cost-effectiveness and their feasibility in view of the revision of the rules on general vehicle safety, pedestrian protection and other vulnerable road users* (Commission, 2016) [3]. The report presents viable and cost-effective car safety measures. The main objectives are to reduce road casualties and help prevent accidents. As vulnerable road users, particular attention has been paid to children and the elderly.

In recent years, the EU has introduced a number of mandatory measures, which have contributed to an estimated reduction of 50,000 road fatalities per year. Examples include electronic stability control systems on all vehicles, advanced emergency braking systems and lane departure warning systems on trucks and buses.

The Commission believes that the full benefit of these and new safety technologies that have become available in the meantime can only be fully secured if these technologies start to be used in all vehicles, which is not yet the case.

The report proposes 19 specific vehicle safety measures that could be considered when revising and updating the General Safety Regulation and the Pedestrian Safety Regulation. These measures should become mandatory to increase road safety. Fig 7 shows the main car safety elements regulated by the European Union.

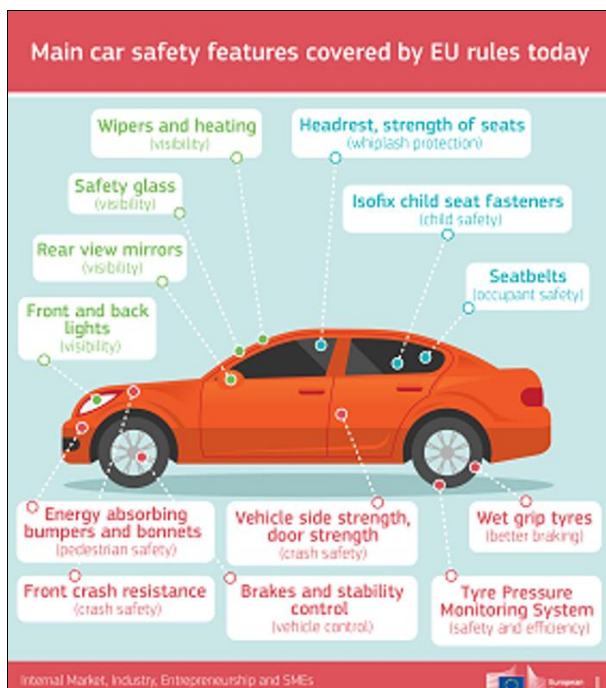


Fig 7: Main car safety features covered by EU (t-times.ro, 2017) [14]

The targeted measures are included in the main areas of vehicle safety (t-times.ro, 2017) [14]:

a) Active safety measures

This main area encompasses measures that ensure the ability to avoid crashes as a whole, not to reduce their consequences, and is generally considered to be the most important area for future legislative developments in vehicle safety.

The safety elements concerned are:

- automatic emergency braking;
- intelligent speed adaptation;
- lane-keeping assist;
- driver fatigue and distraction monitoring.

b) Passive safety measures

This area covers accident reduction measures consisting of introducing new requirements or strengthening existing measures in terms of:

- emergency braking display (flashing stop lamps);
- seat belt reminder;
- frontal impact testing;
- side impact testing;
- rear impact testing;
- standardization of the interface of the interlock device when detecting driver alcohol consumption;
- accident data recording system (black box);
- tire pressure monitoring (TPM).

c) Trucks and buses

Measures to improve truck and bus safety include introducing or improving:

- frontal model and direct visibility;
- rear underrun protection of the truck and trailer (rear bumper);
- side protections (side guards);
- fire safety for buses.

d) Pedestrian and cyclist safety

This area provides:

- introduction of pedestrian and cyclist detection systems (linked to automatic emergency braking systems);
- front impact protection on A mounts and front window;
- system for detecting persons behind vehicles when the vehicle is reversing.

To date, vehicle manufacturers already use advanced safety technologies that go beyond the mandatory requirements set out in existing safety regulations. With this in mind, the Commission's report calls for a debate on making the introduction of these technologies mandatory for all vehicles.

All the safety measures presented in the Commission's report will be followed by an impact assessment, which will contain a cost/benefit analysis and will include a public consultation and a debate with stakeholders. Depending on the results of the consultations, the Commission will consider the next steps to be taken on measures that are likely to produce a clear benefit for vehicle safety.

From January 01, 2022 in accordance with Regulation of the European Parliament and of the Council (PE-CONS 82 of 18.10.2019) amending Regulation (EU) 858 of May 30, 2018 (eur-lex.europa.eu, 2019) [6], The European Union through its policies obliges European road vehicle manufacturers to fit/install on new vehicles safety packages for both road vehicles and their users and for vulnerable road users. They consist of the following obligations (Commission, 2019) [4]:

- a) **For cars and light vehicles:** systems that help the driver maintain the lane; emergency braking and seatbelt systems with crash-test improvements; extended crash protection zones for pedestrians', cyclists' and motorcyclists' heads in the event of a road crash.
- b) **For trucks and buses:** systems to improve the line-of-sight of bus and truck drivers; systems that eliminate blind spots; vehicle-mounted front and side systems that detect and warn of vulnerable road users such as pedestrians and cyclists The latter are necessary and support heavy vehicle drivers when cornering.
- c) **For cars, light vehicles, trucks and buses:** warning systems for situations when the driver is dozing at the wheel or not paying attention to the road (e.g. using mobile phones or other gadgets while driving); intelligent speed assistance systems (ISA); warning and visibility systems for reversing

the road vehicle; on-board accident recorders ('black box'); alcohol warning systems (Neamțu, Țițu, Pop, & Bogorin-Predescu, 2024) ^[11]; systems that provide emergency braking of the vehicle; TPW tire pressure monitoring systems (some manufacturers have already adopted this system).

In 2024 by the European Court of Auditors' Special Report 04/2024, paragraph 58 classifies the requirements according to the type of vehicle, i.e. whether the vehicle is a new model or a new vehicle based on an existing model, and sets different deadlines for its requirements (see Fig 8 for examples of requirements applying to new vehicles). In addition, the provisions of the General Safety Regulation allow the Commission to adopt secondary legislation and amend the list of requirements to take account of technical and regulatory developments.

Dashboard symbol	Option	Date when it becomes obligatory for new models of road vehicles
	Lane keeping system	July 7, 2024
	Autonomous emergency braking system	July 7, 2024
	Autonomous emergency braking to prevent collisions with pedestrians and cyclists	January 7, 2026

Fig 8: Examples of future mandatory requirements for new vehicles under the General Safety Regulation (Auditors, 2024) ^[1]

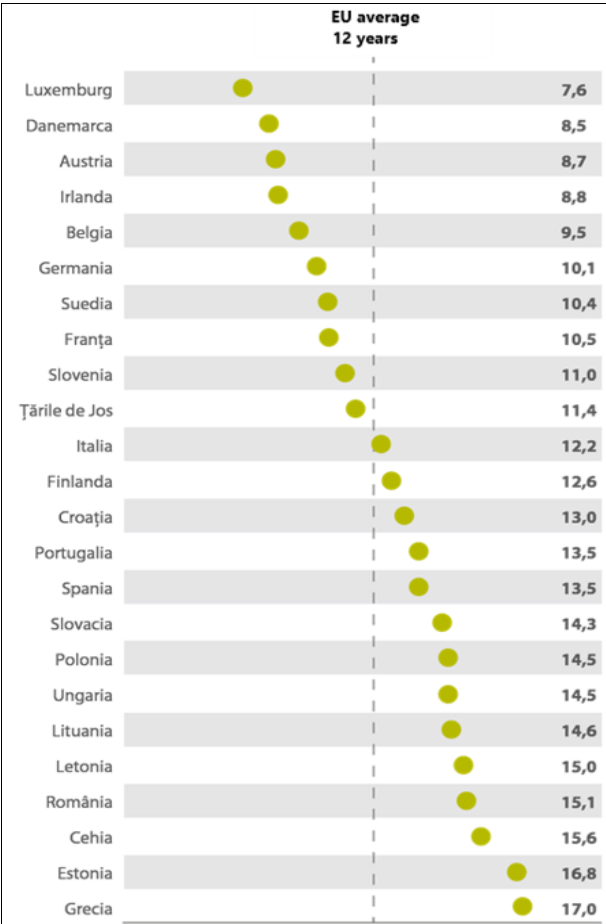


Fig 9: Average age in years of Member States' vehicle fleets (Auditors, 2024) ^[1]

The age of the vehicle is important because determines the physical wear and tear of vehicles, which in turn determines their technical condition. A vehicle with a considerable age may be in a poor technical condition. This endangers the safety of users and other road users. In this context, it should also be borne in mind that an old vehicle manufactured before January 1, 2022, is not equipped with the safety packages required by the EU on that date. For this reason, it is unreliable with regard to the safety of users and vulnerable road users. It will therefore take time for the impact of the General Safety Regulation and the new vehicle safety features to materialize. In addition, although in 2018 the Commission had intended to encourage Member States to stimulate vehicle renewal with a focus on road safety performance, the Court did not identify any such support schemes in the member states visited. Instead, support schemes exist for other purposes (such as better environmental performance of vehicles) which may indirectly benefit road safety through fleet renewal (Auditors, 2024)^[1].

5. Safety of pedestrians, bicyclists and moped/motorcyclists in European urban traffic

Pedestrians, cyclists, moped/motorcyclists become more vulnerable in urban traffic, where vehicle speeds are reduced and their vulnerability decreases as a result of congested road traffic generated by high vehicle density on urban arteries, the geometry and narrow, confined space of some streets or intersections, or congestion and traffic jams in cities choked by high levels of road traffic at certain hours.

- **Pedestrians** in an urban environment are the most numerous and ubiquitous, somewhat undisciplined, heterogeneous and vulnerable category of road users. The causes of road accident victimization of this category are low road risk perception, poor or non-modernized road infrastructure, ease or carelessness in crossing the road, and a hurried or somewhat leisurely approach to urban road traffic.
- **Moped/motorcyclists** in an urban environment are at particular risk due to some of the following: their small size compared to most other road partners; low grip, which poses problems in many weather or road conditions; lack of physical protection, which increases their vulnerability to impact; high likelihood of becoming unbalanced while riding a moped or motorcycle; the need for more intense concentration for longer periods of time, increasing stress and mental fatigue.
- **Cyclists** have the following particularities in urban road traffic: they are a growing category of road users; insufficient dedicated lanes to separate traffic flows have direct consequences on road safety; lack of solid road safety education to ensure safe "living" safely with other road users; low level of use of equipment.

At the European level, the European Transport Safety Council (ETSC), which has been founded in 1993 in Brussels, we provide an impartial source of expert advice on transport safety matters to the European Commission, the European Parliament, international organisations, and national governments. The European Transport Safety Council is the independent voice for road safety in Europe. It is an international non-profit organization, with members from all over Europe, dedicated to reducing deaths and injuries in transport. The work of the Council is based

on two concepts. First, 'Vision Zero', that we should put an end to deaths and serious injuries on the roads while increasing safe, healthy, sustainable and equitable mobility for all.

Second, the 'safety system approach': a widely accepted strategy for road injury prevention that recognizes that while human error on the road is inevitable, death or serious injury resulting from a crash is not inevitable. Many accidents involving driver error also involve other critical factors such as vehicle and infrastructure-induced design deficiencies.

The safety system approach is based on the understanding that effective road accident prevention is achieved through the interdependence and multiplier effects of different policy measures and a well-balanced set of effective interventions. The six "road safety pillars" of the safety system approach are: road safety management, safe roads, safe roads, safe vehicles, safe speeds, safe road user behavior and post-crash care.

At its core ETSC is an organization that scientifically addresses road safety, with its secretariat in Brussels - Belgium, collaborates with over 50 member organizations across Europe, has over 200 experts whose work is rewarded by the European Commission, Member Organizations and private sponsors.

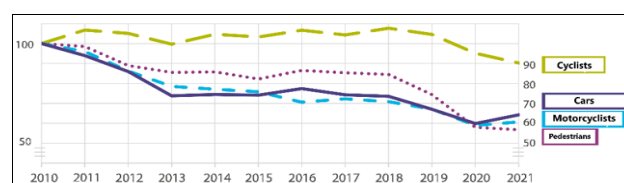


Fig 10: Fatality rates in urban areas, by type of road user (2010-2021) (Auditors, 2024)^[1]

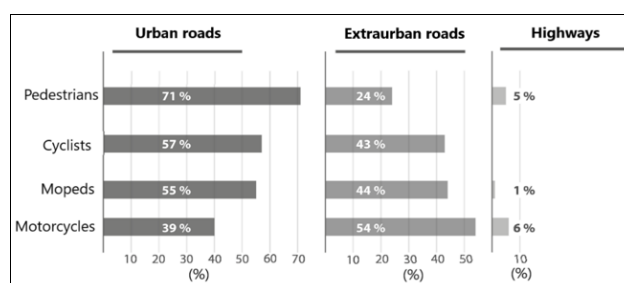


Fig 11: Fatality rates among vulnerable road users in 2020, by road types in the EU (Auditors, 2024)^[1]

In the PIN (the ETSC Road Safety Performance Index) program, 32 countries (all EU Member States - 32 experts) participate and produce annual reports (40 PIN Flash, Benchmark, PIN Talks and PIN Award thematic reports).

As regards the safety of vulnerable urban road users, the EU calls for a greater focus on active mobility, such as walking and cycling, especially in urban areas. While pedestrian fatalities showed the same downward trend between 2010 and 2021 as vehicle occupant fatalities, for cyclists the decrease was much smaller (see Fig 10). In addition, there has been an increase in the number of fatalities among the latter in urban areas between 2010 and 2021 in some Member States. For example, in Austria, the number of cyclist fatalities in urban areas increased by 68% over this period (Auditors, 2024)^[1]. Future road safety challenges, such as new forms of mobility in urban areas and the presence of autonomous vehicles, are likely to require better

integration and coordination of the different Commission actions. In 2020, urban areas accounted for almost half of all fatalities (Fig 11), even more among vulnerable road users. However, road safety in urban areas is not the responsibility of DG MOVE's road safety unit, but of a separate unit responsible for mobility in urban areas, which is not only concerned with road safety. At the same time, road safety issues related to autonomous vehicles are covered by several Directorates-General of the European Commission. In addition, member states are obliged to carry out a network-wide road safety assessment for the areas covered by the Directive. These assessments must be completed for the first time by the end of 2024 and at least every five years thereafter. For the purpose of prioritizing interventions, Member States will then have to rank their road network sections according to their safety level. The Commission will then publish an online map highlighting the different categories (Auditors, 2024) ^[1]. The requirement is stipulated in paragraph 73 of the European Court of Auditors' Special Report 04/2024. Some recommendations for improving the safety of vulnerable people in urban road traffic are presented by project manager Teodora Călinescu in Fig 12. In order to improve the safety of vulnerable people in urban traffic, ETCS also makes the following proposals for Romania included in Teodora Călinescu's project (Călinescu, 2021) ^[2]:



Fig 12: Recommendations for improving Pedestrian and Cyclist Safety under ETSC (Călinescu, 2021) ^[2]

a) For the traveling speed of road vehicles.

- speed limits in urban areas must match the function of the road;
- speed limits must be backed up by infrastructure measures to be safe and credible;
- at 30 km/h - cyclists and pedestrians can co-exist in traffic in relative safety.

b) For road vehicles and speed.

- intelligent Speed Assist (ISA) systems;
- Autonomous Emergency Braking (AEB) systems.

c) For Sustainable Urban Mobility Plans.

- road safety should be integrated into Sustainable Urban Mobility Plans;
- road traffic safety - the main barrier to cycling as a means of transportation;
- road safety - an important challenge for sustainable travel choices.

e) For local authorities.

- road safety plans based on the Safe System principles;
- integration of road safety with other policies, including post Covid-19 strategy;
- modal priority based on vulnerability;
- 30 km/h zones with traffic calming and enforcement measures (automated systems);
- dedicated cycle lanes;
- vehicle safety requirements in public procurement.

f) Requirements for EU member governments.

- involving city representatives in the development of national road safety strategies;
- encouraging local authorities to adopt 30 km/h zones supported by adequate infrastructure;
- encouraging cities to apply Safe system design principles.

g) Requirements for the EU to help cities.

- specific EU funds to support priority measures such as 30 km/h zones;
- making urban mobility funding conditional on road safety standards;
- integrating road safety into the Guidelines for Sustainable Urban Mobility Plans (SUMPs);
- monitoring and promoting best practice in road safety in the framework of the UDLMP.

6. Types of protection of vulnerable persons in road traffic according to Euro NCAP requirements

Speed is a critical factor in determining injury outcome when a vulnerable road user is hit by a car. Many vehicle manufacturers now offer autonomous emergency braking systems which can bring the car to a safe halt before a vulnerable road user – typically a pedestrian or a cyclist – is struck, or at least reduce the speed of the collision. According to EuroNCAP tests to ensure that vulnerable road users are protected at all times, tests are carried out in daylight and at night.

For pedestrian detection, Euro NCAP tests three accident scenarios in which the pedestrian crosses directly in front of the path of the test vehicle, one in which the pedestrian is walking in the same direction as the vehicle, one in which the pedestrian is crossing a road into which the test car is turning and one where a pedestrian is behind the reversing car. All these scenarios represent situations which could result in fatal injuries to the pedestrian if the car did not intervene to prevent or mitigate the collision. The crossing scenarios are an adult running from the driver's side of the vehicle; an adult walking from the passenger's side (two tests are performed for this scenario); and a child running from between parked cars on the passenger's side of the car. In the longitudinal scenario, two tests are done: one with the pedestrian aligned with the centre of vehicle; the other with the pedestrian offset to one side. The longitudinal scenario and one of the crossing scenarios are repeated in low-light conditions, as this is a situation in which many pedestrian accidents occur. Two scenarios are used where the pedestrian is crossing a road into which a car is turning: one where the car is turning into a road to its nearside; the other where the road is to its offside. These two versions of the same scenario present different challenges due to the relative angles and distances between test car and pedestrian. The final scenario is reversing. Many pedestrians, especially children, are injured or killed by

vehicles reversing into them. Euro NCAP's test replicates such a situation for different vehicle and target speeds (euroncap.com, 2024) ^[7].

From 2020, Euro NCAP is testing the vulnerability of road users in two scenarios: a pedestrian crossing a road into which a car is turning; and a car reversing into a pedestrian. A specially designed pedestrian target is used which has articulated limbs to replicate the walking motion of a human. Cars that perform well in these tests can be expected to have a significantly reduced risk of pedestrian accidents in real-world driving. In some cases, AEB Pedestrian technology may not be able to completely avoid the collision. For this reason, Euro NCAP only rewards the technology if the pedestrian impact tests show that the car has a forgiving front-end design (euroncap.com, 2024) ^[7].

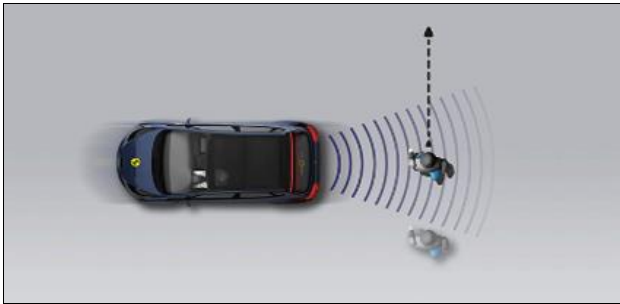


Fig 13: Car reversing into pedestrian (euroncap.com, 2024) ^[7]

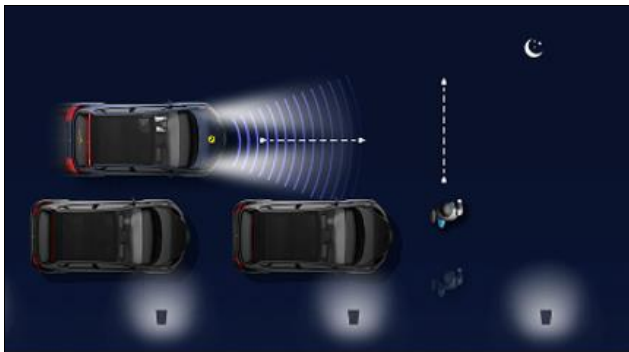


Fig 14: Child running from behind parked vehicles (euroncap.com, 2024) ^[7]

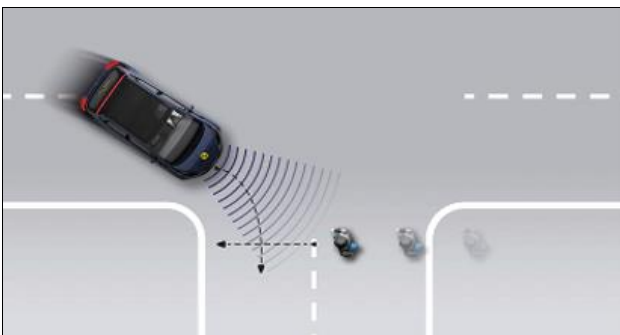


Fig 15: Pedestrian crossing a road into which a car is turning (euroncap.com, 2024) ^[7]

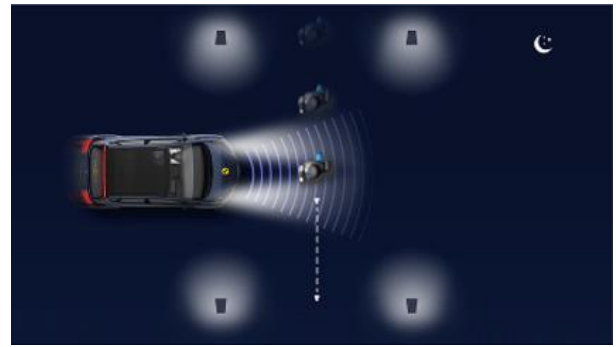


Fig 16: Adult crossing the road (euroncap.com, 2024) ^[7]

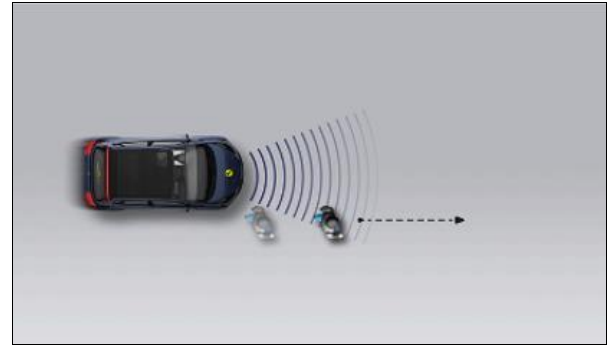


Fig 17: Adult along the roadside (euroncap.com, 2024) ^[7]

In the following, we will present in pictures the tests carried out by Euro NCAP, as follows (euroncap.com, 2024) ^[7]:

a) On pedestrians

- Car reversing into pedestrian (Fig 13). The test was introduced in 2020 and upgraded in 2023;
- Child running behind parked vehicles (Fig 14). The test was introduced in 2020 and upgraded in 2023;
- Pedestrian crossing a road into which a car is turning (Fig 15). The test was introduced in 2020 and upgraded in 2023;
- Adult crossing the road (Fig 16). The test was introduced in 2020 and upgraded in 2023;
- Adult along the roadside (Fig 17). The test was introduced in 2020 and upgraded in 2023;

b) On pedestrian and cyclists



Fig 18: Head impact (euroncap.com, 2024) ^[7]

- **Head impact** (Fig 18). As well as assessing how well cars protect their occupants, Euro NCAP tests how well they protect those vulnerable road users – pedestrians and cyclists – with whom they might collide. In these tests, the potential risks of injuries to a pedestrian's head, pelvis, upper and lower leg are assessed. Cars which perform well can gain additional points if they have an Autonomous Emergency Braking (AEB) system which recognises pedestrians and cyclists. About 14% of all road fatalities in Europe are pedestrians. With children and the elderly being at greatest risk.

Pedestrians comprise one of the main categories of vulnerable road users, which also include cyclists and motorcyclists. Most pedestrian accidents occur within city areas where speeds are moderate. The head, the lower body and the legs are amongst the most frequently injured body regions. To estimate the potential risk of head injury in the event of a vehicle striking an adult or a child, a series of impact tests is carried out at 40 km/h using an adult or child head form impactor. Impact sites are then assessed and the protection offered is rated as good, adequate, marginal, weak or poor. The procedure promotes energy absorbing structures, deformation clearance and deployable protection systems such as pop-up bonnets and external airbags (euroncap.com, 2024) ^[7]. The test was introduced in 1997 and upgraded in 2023.



Fig 19: Pelvis impact (euroncap.com, 2024) ^[7]

- **Pelvis impact** (Fig 19). The shape of the hood or bonnet leading edge can play a critical role in the outcome of a vehicle impact with a pedestrian and contribute to injuries to the pelvis. To estimate the potential risk of pelvis injuries in the event of a vehicle striking an adult, a series of impact tests is carried out at 40 km/h using an adult upper leg form impactor. Impact sites are then assessed, and the protection offered is rated as good, adequate, marginal, weak or poor. The procedure promotes energy absorbing structures and a more forgiving geometry that mitigates injuries. The test was introduced in 1997 and upgraded in 2023.



Fig 20: Leg impact (euroncap.com, 2024) ^[7]

- **Leg impact** (Fig 20). Typical injuries resulting from leg-to-bumper impacts include fractures to the femur, tibia, knee and ligaments. These leg injuries are rarely fatal however are often associated with permanent medical impairment. To estimate the potential risk of leg injuries in the event of a vehicle striking an adult, a series of impact tests is carried out at 40 km/h using an adult leg form impactor. Impact sites are then assessed, and the protection offered is rated as good, adequate, marginal, weak or poor. The procedure promotes energy absorbing structures and a more forgiving geometry that mitigates injuries to the leg. The test was introduced in 1997 and upgraded in 2014.

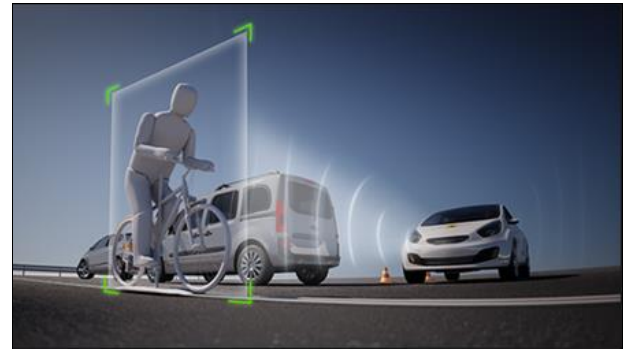


Fig 21: AEB Cyclist (euroncap.com, 2024) ^[7]

- **Autonomous Emergency Braking (AEB) Cyclist** (Fig 21). For cyclist detection, Euro NCAP tests several scenarios in which a cyclist is crossing the path of the test vehicle: the cyclist is ahead of the car and approaching from its nearside, and would be struck if the car takes no action to avoid the collision; a similar situation but where the cyclist is initially obscured by vehicles parked on the nearside; and where the cyclist is approaching from the far-side of the test vehicle, towards its path. In addition, two different tests are done where the cyclist is travelling in the same direction as the test vehicle. These scenarios represent typical situations in which potentially fatal accidents might occur between cars and cyclists, and each one presents particular challenges to the AEB system in terms of its range of 'view' and speed of response. For this reason, manufacturers may design their systems to avoid collisions, or to reduce their severity, purely by braking or they may also utilise Autonomous Emergency Steering (AES). Like AEB, AES intervenes only when a collision is otherwise unavoidable. A small but rapid steering input is applied, normally in conjunction with braking, to try to avoid the collision.

The steering input cannot be enough to put the car in the opposite lane, in the path of oncoming traffic. Similar systems, known as Emergency Steering Support (ESS) exaggerate the steering action taken by the driver in the case of an emergency, to try to avoid a collision. Autonomous Emergency Steering (AES) applies a small but rapid steering input to avoid the collision. A specially designed cyclist target is used for the tests. A bicycle is mounted on a moving platform and the dummy cyclist is articulated to recreate the pedalling action of a human. Detecting cyclists is technically challenging compared to pedestrians as their speeds are higher: vehicle manufacturers must use sensors with wider fields of view and there is less processing time in

which to make a decision whether to brake or not. Euro NCAP gives the greatest reward where a collision is completely avoided. In some cases, however, the AEB system will be unable to stop the vehicle completely, and some points are given because any reduction in the speed of impact can have a significant benefit for injury outcome. The test was introduced in 2018 and upgraded in 2023.



Fig 22: Cyclist Dooring Prevention (euroncap.com, 2024) ^[7]

- *Cyclist Dooring Prevention* (Fig 22). “Dooring” is an accident type where an occupant inadvertently opens the door of a parked car into the path of a cyclist approaching from behind. From 2023, Euro NCAP rewards cars which have systems designed to prevent such accidents. Some points are awarded to systems which simply inform the car’s occupants of the presence of an approaching cyclist. Points are also available to systems which actively warn the occupants not to open the door because a cyclist is approaching. But maximum points are reserved for systems which physically prevent the door from being opened until the cyclist has passed safely. Cars require rearward-looking sensors to detect approach cyclists in good time. Tests are conducted using Euro NCAP’s cyclist target moving at 15km/h on a path which is one meter from the side of a stationary car. The test was introduced in 2023.



Fig 23: Autonomous Emergency Braking (AEB)/ Lane Support Motorcyclist (euroncap.com, 2024) ^[7]

- *Autonomous Emergency Braking (AEB)/ Lane Support Motorcyclist* (Fig 23). Compared to other road users, Motorcyclists are particularly vulnerable. On the basis of average mileage, motorcyclists have four times more risk of being involved in a crash than all other road users. The accident rate, based on the number of casualties per billion kilometres driven, is seven times as high. From 2023, Euro NCAP introduces a first-ever

Car-to-Motorcyclist safety framework into the programme, rewarding vehicle manufacturers that fit as standard systems effective at avoiding or mitigating crashes with this particular Vulnerable Road User (VRU). There are seven scenarios considered, representing the most common crashes in Europe involving a passenger car and a resulting killed or severely injured (KSI) motorcyclist:

- Car-to-Motorcyclist Rear Stationary;
- Car-to-Motorcyclist Rear Braking;
- Car-to-Motorcyclist Turn Across Path;
- Car-to-Motorcyclist Oncoming;
- Car-to-Motorcyclist Overtaking;
- Blind Spot;
- Car-to-Motorcyclist Crossing Straight Crossing Path (to be introduced in 2026).

An all new motorcyclist target is used for the tests. A motorcycle dummy resembling the appearance of a motorcycle of >500 cc is mounted on a specially designed self-propelled platform, able to steadily travel at speeds up to 80 km/h. Furthermore, the dummy features a spinning disc aimed at replicating the wheel spin and give radar systems the necessary signature for target classification. The high speed attribute of the target present across scenarios, along its reduced volume when compared to a passenger vehicle, makes a particularly challenging combination for state-of-the-art on-board sensors in detecting and classifying early enough to avoid or mitigate a collision. The test was introduced in 2023.

7. KilometerGood. Case study

In the capital of Romania, Bucharest, on May 9, 2024

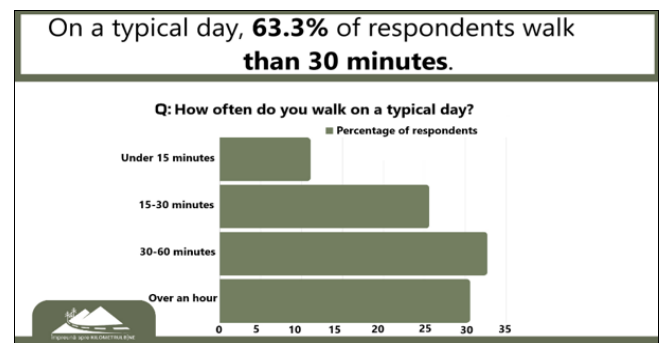


Fig 24: Answer to the question: How often do you walk on an every day? (kilometrulbine.ro, 2024) ^[9]

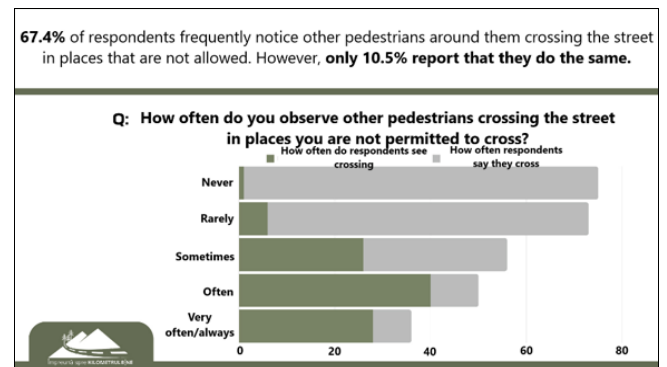


Fig 25: Answer to the question: How often do you observe other pedestrians crossing the street in places you are not permitted to cross (kilometrulbine.ro, 2024) ^[9]

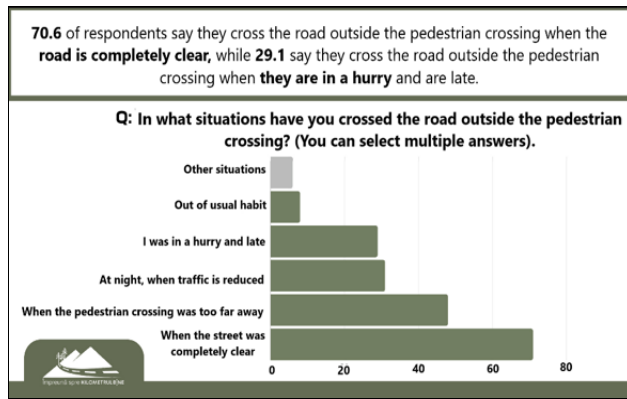


Fig 26: Answer to the question: In what situations have you crossed the road outside the pedestrian crossing? (kilometrulbine.ro, 2024) ^[9]

kilometerGood (kilometrulbine.ro, 2024) ^[9], the social responsibility platform of the Dacia brand, has launched an extensive research study that aimed to bring to the forefront information about pedestrian road safety in Romania. KilometruBine is the digital education and sustainability platform launched by Dacia in 2021. The Kilometrulbine.ro platform reflects all Dacia's corporate social responsibility initiatives. Editorial, through permanent sections and headings, readers can select information from the two strategic axes: environment and social inclusion through education. The website hosts monthly interviews with employees, civil society representatives, authorities, opinion leaders, journalists, bloggers (kilometrulbine.ro, 2024) ^[9]. The analysis focused on pedestrians' behavior and perceptions of road and pedestrian safety compliance in the specific context of the local community. On a general level, the survey results showed that almost 60% of the respondents walk for more than 30 minutes every day (Fig 24), but only 12% of them feel safe as pedestrians in their home town. At the same time, more than 30% of participants said they felt partly or not at all safe. The survey revealed irregular behavior by both pedestrians and drivers. Over 60% of respondents noticed drivers breaking the rules of the road, and half of them also noticed careless pedestrian behavior, such as crossing the street despite a red or yellow light. The statistics also show that jay crossing ranks among the top negative behaviors, with 67.7%. Among the reasons for pedestrians to jaywalk are the presence of a completely clear street (in more than 70% of cases), the long distance to the pedestrian crossing (47.5%) and time pressure (29%), (Fig 25). According to respondents, the main cause of road accidents is pedestrian inattention (80.4%), followed by excessive vehicle speed and careless behaviour of drivers (Fig 29). According to the study, although some Romanians are aware of the statistics and the risks to which they are exposing themselves, many of them still choose, out of haste or convenience, not to obey the rules for crossing the street. At the same time, 36.3% consider risk awareness campaigns to be effective and say that they would be motivated to obey the rules more strictly, along with more pedestrian crossings and higher fines. Fig 26 show the answer to the question: In what situations have you crossed the street outside a pedestrian crossing?

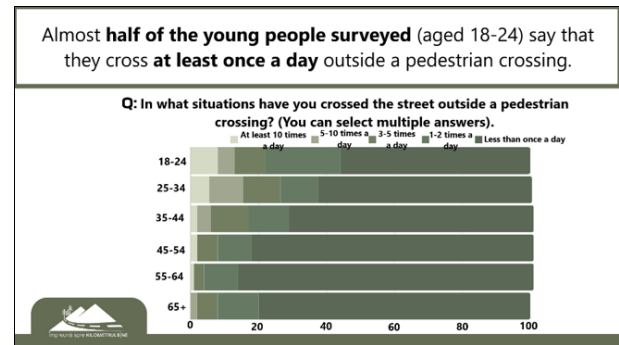


Fig 27: Answer to the question: In what situations have you crossed the street outside a pedestrian crossing? (kilometrulbine.ro, 2024) ^[9]

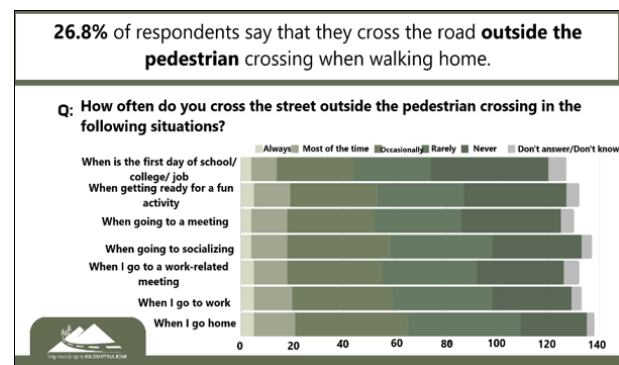


Fig 28: Answer to the question: How often do you cross the street outside the pedestrian crossing in the following situations? (kilometrulbine.ro, 2024) ^[9]

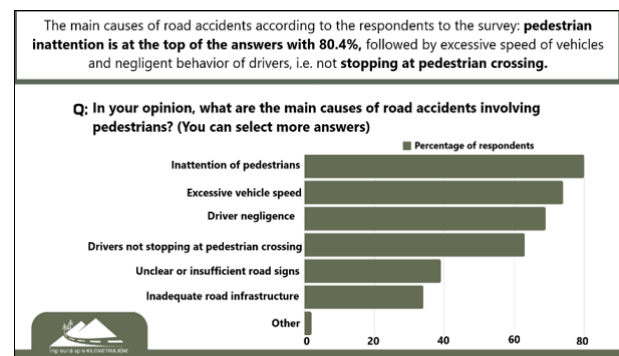


Fig 29: Answer to the question: In your opinion, what are the main causes of road accidents involving pedestrians? (kilometrulbine.ro, 2024) ^[9]

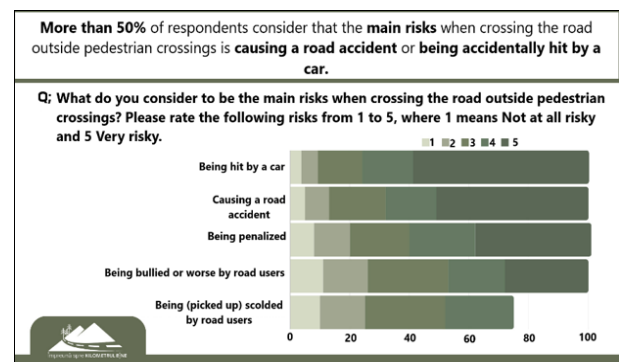


Fig 30: Answer to the question: What do you consider to be the main risks when crossing the road outside pedestrian crossings? (kilometrulbine.ro, 2024) ^[9]

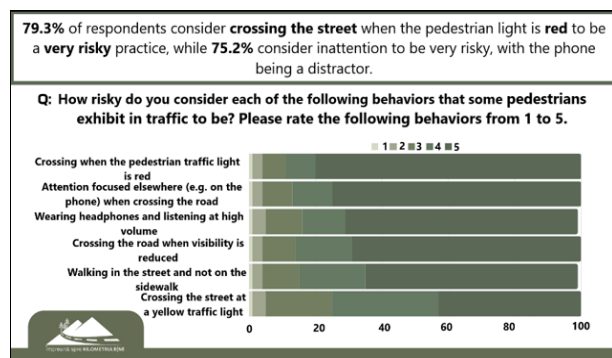


Fig 31: Answer to the question: How risky do you consider each of the following behaviors that some pedestrians exhibit in traffic to be? (kilometrulbine.ro, 2024) ^[9]

The results of this survey provide a clear insight into the current situation and are an essential starting point for initiatives to improve traffic safety. Fig 27 show the answer to the question: In what situations have you crossed the street outside a pedestrian crossing?

Thus, the social responsibility platform KilometrulBine, with the support of Dacia, is launching the awareness and road responsibility campaign "*First Step Counts*", which aims to draw attention to unsafe behavior in traffic and encourage pedestrians to adopt responsible behavior by consciously choosing to respect pedestrian safety rules. Fig 29 show the answer to the question: In your opinion, what are the main causes of road accidents involving pedestrians?, Fig 30 show the answer to the question: What do you consider to be the main risks when crossing the road outside pedestrian crossings?, and Fig 31 show the answer to the question: How risky do you consider each of the following behaviors that some pedestrians exhibit in traffic to be?

The responses were collected from 808 respondents in Romania between April 24, 2024.

The results have a maximum error of 3.4% for a 95% confidence interval.

8. Conclusions

Worldwide, road crashes are the main way in which drivers meet their end. They cause more deaths than HIV/AIDS or tuberculosis and are the most common cause of death among children and young people. Every 24 seconds, one person dies in a road accident. Nearly 3,700 people die on public roads in road accidents.

Road safety is both an EU and a member state competence. However, it is the full responsibility of national authorities to implement actions that have a direct effect on reducing the number of deaths and road serious injuries.

It is necessary to adopt the National Road Safety Strategy and the Action Plan for its implementation at national and European level.

Pedestrians represent a significant proportion of urban traffic and ensuring their safe movement safe pedestrian movement requires a consistent and well organized network of pedestrian crossings.

In order to avoid undesirable events, it is very important that the authorities of large cities consider the construction of separate lanes for cyclists (bicycle lanes), so that users of this means of transportation can move safely.

In Romania, both pedestrians and drivers violate road and pedestrian safety rules, according to the case study.

In Romania, crossing the street irregularly is the top negative behavior, with a share of 67.7%.

In Romania, 70.6% of respondents, according to the case study, say that they cross the street outside the pedestrian crossing when the street is completely clear;

The kilometrulBine project, with the support of Dacia, launches the "First Step Counts" road awareness and responsibility campaign.

There is a need for a generalization of road user protection facilities, particularly in urban and extra-urban areas where the infrastructure permits, to protect vulnerable road users (traffic calming, pedestrian overpasses, cycle lanes, etc.).

Road safety is both an EU and a Member State competence; however, it is the full responsibility of national authorities to implement actions that have a direct effect on reducing fatalities and serious injuries. The Commission's role is to coordinate activities at EU level, especially those with a cross-border effect.

It requires ownership and proper involvement of all relevant institutions at national and European level.

The European Commission has put in place a comprehensive road safety framework (the EU's 'safe system' approach), together with ambitious targets for 2030 and 2050. In the light of current progress and without further efforts by the EU and its Member States, the Court considers that these strategic targets of halving the number of deaths and serious injuries between 2020 and 2030 and reaching close to zero by 2050 are unlikely to be achieved.

The European Commission faces challenges in monitoring Member States' progress. In addition, EU actions did not cover all risk areas and were not sufficiently integrated. Finally, the achievement of EU road safety targets was not among the key criteria against which EU co-funded projects with road safety objectives were selected and monitored in the 2014-2020 spending period, which is likely to be the case in 2021-2027.

It is necessary to develop and adopt a National Road Safety Education Program at both European and national level.

The European Commission should place greater emphasis on the causes of accidents and introduce additional guidelines covering all risk areas. To this end, the European Commission should: promote detailed investigation in Member States of the causes of accidents, particularly in hotspots, and their harmonized reporting; provide additional guidance to Member States to more effectively address the main risk factors (including speed and infrastructure design for roads where most fatal accidents occur), with a particular focus on vulnerable road users.

90% of road accidents on European roads are due to human error. For all production cars built in the European Union, from January 1, 2022, a number of safety and driver assistance systems will be introduced in the basic construction variants. They are currently being researched in order to develop and take them to the next level of automation. It is believed that in the near future they will lead to the proposed target of full automation of road vehicles, helping to reduce fatalities and injuries.

Today's cars are safer than ever, equipped with a suite of technologies that protect both passengers and other road users. A good example is automatic braking with pedestrian detection.

It is estimated that the safety systems to be fitted in cars will save more than a quarter of a million lives and prevent around 150,000 serious injuries by 2038. They will

contribute to the EU's long-term "Vision Zero" goal of zero deaths and serious injuries by 2050.

The new safety systems will protect pedestrians, cyclists and other road users by supporting the driver. But they will have to get used to them gradually. The advanced automation of road vehicles will eliminate driver errors in traffic and help elderly and disabled people by improving their comfort and mobility. All this will make automated vehicles more attractive in the future. The European Commission has issued a briefing with reference to connected and automated mobility. The aim of this communication is to make Europe a world leader in the safety of autonomous mobility systems.

Îmbătrânirea parcului național de vehicule s-a accentuat în țara noastră de la an la an. La această dată România are cel mai învechit parc de autovehicule din Uniunea Europeană.

In its 2018 Communication "Europe on the Move", the EU set current targets to halve the number of deaths and serious injuries caused by accidents by 2030 and almost zero by 2050. Finally, the Commission EU *Road Safety Policy Framework 2021-2030 - Next steps towards "Vision Zero"* introduced a set of key performance indicators against which to track member states' progress towards the achievement of the targets.

9. References

1. Auditors EC. EU Road Safety Targets - Time to accelerate their achievement. European Court of Auditors. European Court of Auditors, 2024. Retrieved October 09, 2024, from: <https://www.eca.europa.eu/ro/publications/SR-2024-04>
2. Călinescu T. Safety of pedestrians and cyclists in urban traffic. Preluat pe October 09, 2024, de pe Webinar CIVINET Romania, April 21, 2021. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://civitas.eu/sites/default/files/webinar_siguranta_pc_tc_final.pdf
3. Commission E. Saving lives: Improving vehicle safety in the EU. Brussels: European Parliament, December 12, 2016. Preluat pe October 09, 2024, de pe <https://secure.ipex.eu>
4. Commission E. Press release. Preluat pe September 09, 2024, de pe Road safety: Commission welcomes agreement on new EU rules that help save lives, March 26, 2019. https://ec.europa.eu/commission/presscorner/detail/ro/ip_19_1793
5. digi24.ro. Romanian Police: Most road accidents in 2023 occurred on Fridays in June. The causes remained unchanged, March 19, 2024. Preluat pe October 09, 2024, de pe digi24.ro: <https://www.digi24.ro/stiri/politia-romana-cele-mai-multe-accidente-rutiere-din-2023-au-avut-loc-in-luna-iunie-vinerea-cauzele-au-ramas-neschimbate-2728205>
6. eur-lex.europa.eu. eur-lex.europa.eu. (E. Parliament, Editor), November 27, 2019. Retrieved September 09, 2024, from Regulation (EU) 2019/2144 of the European Parliament and of the Council: Regulamentul Parlamentului European și al Consiliului (PE-CONS 82 din 18.10.2019) de modificare a Regulamentului (UE) 858 din 30 mai 2018
7. euroncap.com. Vulnerable Road User (VRU) Protection, October 2024. Retrieved October 2024, 2024, from AEB Pedestrian: <https://www.euroncap.com/en/car-safety/the-ratings-explained/vulnerable-road-user-vru-protection/aeb-pedestrian/>
8. hotnews.ro. Assential. Preluat pe October 09, 2024, de pe Grim statistic: Thousands of serious road accidents occurred in Romania in 2023, resulting in 1 545 deaths and 3 535 injured, January 28, 2024. <https://hotnews.ro/statistica-sumbra-mii-de-accidente-rutiere-grave-s-au-produs-n-romnia-si-n-2023-soldate-cu-1-545-de-morti-si-3-535-de-raniti-20375>
9. kilometrulbine.ro. Together towards the kilometer Good by Dacia. Preluat pe October 09, 2024, de pe Every dream starts with the first step. Choose pedestrian crossing safety, May 09, 2024. https://kilometrulbine.ro/boaba-de-siguranta/studiul-kilometrulbine-despre-siguran%C8%9B-arutier%C4%83-pietonal%C4%83-%C3%AEn-rom%C3%A2nia?_gl=1*1t7apbe*_up*MQ..&gclid=Cj0KCQjw05i4BhDiARIsAB_2wFB4i5ph8hpLjAydMiaS0ffDTqK-7pdWyKjNFxamvpV1YoVGq7J6v1MaAj2iEAL
10. Neamțu G. Contributions on the integration of knowledge management in the sustainable development of road transport. (N. U. Bucharest, Ed.) Bucharest, Romania: National University of Science and Technology Politehnica Bucharest, 2023.
11. Neamțu G, Țițu A, Pop A, Bogorin-Predescu A. Road safety in the European road transport system and correlation with sustainable development. EAEC MVT 2022, The 17th European Automotive Congress, The 32nd SIAR International Congress of Automotive and Transport Engineering, 26-28 October 2022 (p. 1311). Timisoara: IOP Publishing; IOP Conf. Series: Materials Science and Engineering, 2024. Doi: 10.1088/1757-899X/1311/1/012047
12. politiaromana.ro. Statistics. Preluat pe October 09, 2024, de pe The dynamics of serious road accidents 2019-2023, October 09, 2024. <https://www.politiaromana.ro/ro/structura-politiei-romane/unitati-centrale/directia-rutiera/statistici>
13. Popa D. Hotnews.ro. Preluat pe October 09, 2024, de pe Road deaths: Romania tops EU, August 3, 2024. <https://hotnews.ro/mortalitatea-rutiera-romania-pe-primul-loc-in-ue-1763815>
14. t-times.ro. Transport Times. Accessed October 09, 2024, at the European Commission has published a list of 19 life-saving safety technologies that will be mandatory for new cars from 2017, January 5, 2017. <https://t-times.ro/categorii/rutier/comisia-europeana-a-publicat-o-lista-de-19-tehnologii-de-siguranta-de-salvare-care-vor-fi-obligatorii-pentru-autovehiculele-noi-din-2017>
15. Tuvel E. What is Vision zero. (visionzeronetwork.org), 2024. Retrieved October 09, 2024, from <https://visionzeronetwork.org/about/what-is-vision-zero/>
16. Union Co. Council Conclusions on road safety - adopting the Valletta Declaration of March 2017, June 8, 2017. Accessed: October 09, 2024, at the <chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://data.consilium.europa.eu/doc/document/ST-9994-2017-INIT/ro/pdf>