

## STUDY OF FACTORS RELATED TO THE RISK OF ACCIDENTS WITH PEDESTRIAN<sup>1</sup>

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***Abstract:** The report presents data on serious road accidents, as well as those killed and injured in them. The relationship between these components has been sought. An analysis of the collected information based on the last ten years has been made. A broader comparison has been made of road injuries in pedestrians, covering a ten-year period for the whole country and in particular for the Ruse region. The total percentage of those killed in road accidents with pedestrians in Ruse to the country has been determined. The total number of injured in the country and in the city of Ruse in traffic accidents with pedestrians is compared. Speed has been found to be a determining factor in assessing the severity of possible injuries from a collision of a vehicle with a vulnerable road user. The information gathered supports the claim that many people still lose their lives in road accidents. For this reason, it is imperative to take measures to reduce mortality and injuries.*

***Keywords:** Serious road accidents, Fatalities, Road injuries, Total percentage.*

### INTRODUCTION

A little more than a hundred years have passed since the world has divided into pedestrians and drivers (Orsato, R.J. & P. Wells, 2007). By the standards of history it may seem nothing but it is quite enough to accumulate many claims between them. Adding the cyclist, moto and motorcyclist and in the last few years the ones using electric bicycles, scooters, hoverboards and more, it can be seen that there are many participants in the movement, which creates conflict situations the outcome of which is often difficult to predict.

At this stage drivers have many more advantages given to them by superiority in weight and vehicle size, as well as speed. This is exactly the reason why science always strives to create technologies that allow adequate safety of cars (Wang, Xiao-Yang & Jiang, Yi-Hang & Li, Ren-Bo & Chen, Ming-Zhang, 2018). At the same time, the legislation attempts to bring order to the relations between drivers and vulnerable road users. Pedestrian traffic and driving a bicycle, scooter or other two-wheeled vehicle are modes of transport in which relatively unprotected road users interact with traffic from cars. This makes them extremely vulnerable to transport injuries in conflict situations, and often the outcome of such a collision is fatal or leads to permanent damage, a prerequisite for the deterioration of the quality of life of the victim and his relatives.

Road accidents and road safety are the subject of global public health studies, as they are currently the seventh to tenth leading cause of death worldwide [WHO, 2021]. According to the World Health Organization, road traffic injuries rank sixth in the world in leading to life years with disabilities [WHO, 2021].

There are concomitant factors in road accidents that involve people, vehicles, traffic organization and infrastructure [de Seguridad Vial, O.N. Las Principales, 2019].

In [Useche, S.A. ; Alonso, F. ; Montoro, L., 2020; Savova-Mratsenkova M., Palagachev G. (2020)] is examined the interaction between pedestrians and infrastructure and the possible impacts it has on them.

A study conducted in Italy using data from 2005 to 2015 shows that the risk of accidents including pedestrians increases approximately twice when there is parking on the street [Congiu, T. ; Sotgiu, G. ; Castiglia, P. ; Azara, A. ; Piana, A. ; Saderi, L.; Dettori, M. 2019].

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As indicated in the study [Dinh, D .; Vŭ, N .; McIlroy, R .; Plant, K .; Stanton, N., 2020] the responsibility of pedestrians through their actions could have a corresponding impact on the degree of injuries during a traffic accident, as well as the possibility of generating one through these same actions. Pedestrians proactive safe behavior is crucial in pedestrian involved accidents [Useche, S.; Montoro, L.; Alonso, F .; Oviedo-Trespalacios, O., 2018].

The current study, based on statistical information, assesses road injuries with pedestrians in the country and in particular in the town of Ruse. It identifies the main factors which influence the risk of accidents involving pedestrians and identifies road safety measures in order to reduce the number of deaths of vulnerable road users.

**EXPOSURE**

**Road injuries with pedestrians**

The total number of pedestrians killed for the period 2010-2020 (Fig. 1) is 1513 people, ie. on average, 134 pedestrians die annually on the country's roads (Statistics, Ministry of Interior Bulgaria).

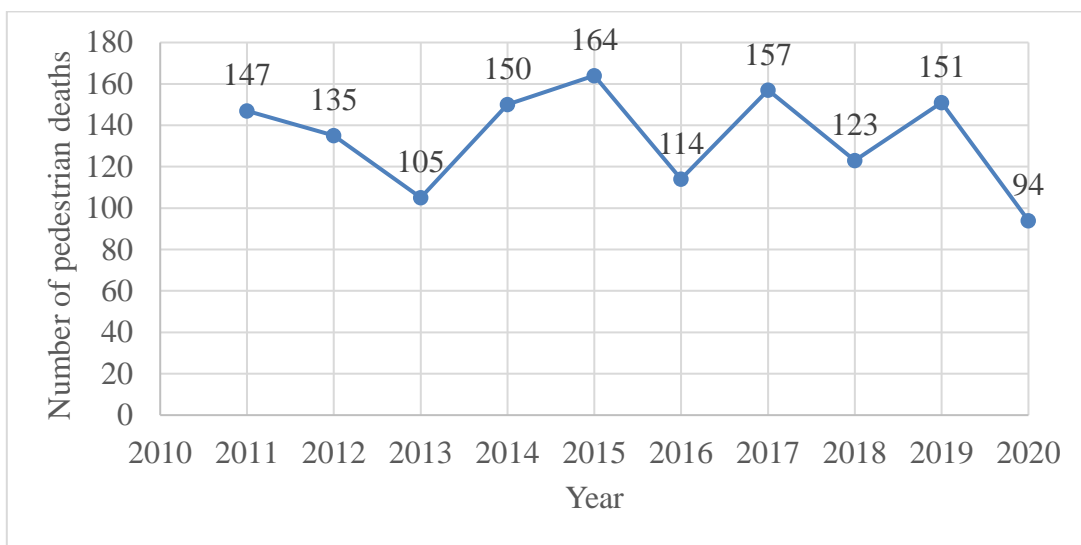


Fig. 1: Number of pedestrian deaths in traffic crashes from 2010 to 2020

The number of severely injured pedestrians in the same period is also high (Fig. 2), the average number for 2011-2020 is 1841.

Of the total mortality for the period 2011-2020 (Table 1), the killed pedestrians are 21.25%, and the injured (mild and severe, Table 1) – 21.77%. Both values which are estimated from the main mortality and injuriesness in road accidents show that the affects of pedestrians are more than 1/5.

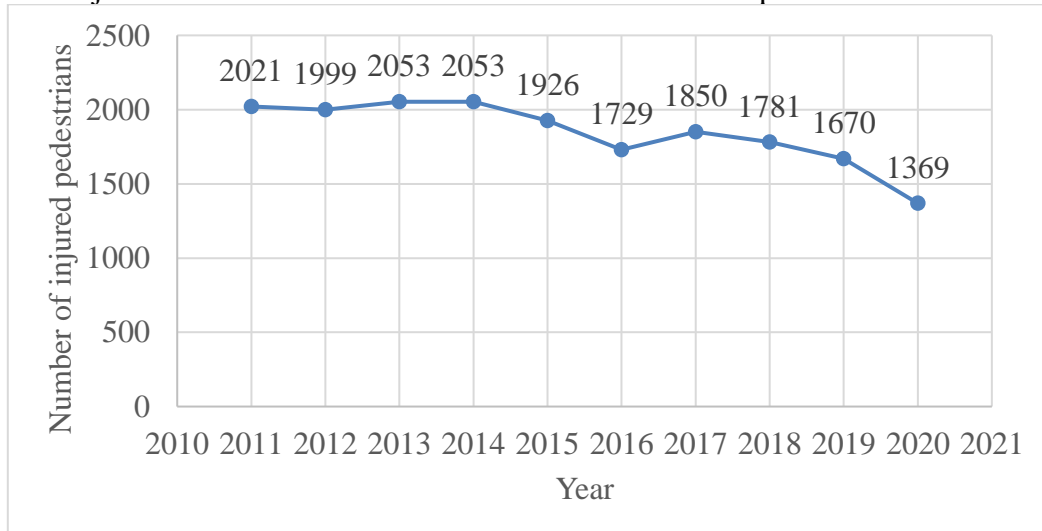


Fig. 2. Number of injured pedestrians in traffic crashes from 2010 to 2020

Chart 1.

Total number of deaths and injured in traffic crashes from 2010 to 2020

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Deaths	657	601	601	601	708	708	682	611	628	463
Slightly injured	5935	5989	6472	6465	6676	6871	6737	6478	6562	5565
Severely injured	2366	2204	2303	2174	2295	2503	1943	1988	1937	1556
Total number of injured	8301	8193	8775	8646	8760	9179	8814	8466	8499	7121

23% of the serious accidents have occurred in a collision with a pedestrian. This is the second reason (after a collision between vehicles – 36%) for serious accidents (National Strategy for Road Safety in the Republic of Bulgaria 2021-2030)

The analyzes show that the characteristics of the region affect the accidents. In this regard, in addition to the information on the country, it is necessary to study the monitoring of traffic safety in the individual regions. The comparison of the data for the country with the one in the specific region, allows us to evaluate the work in the given region in terms of traffic safety (Pencheva V., As. Asenov, 2019; Pencheva V., As. Asenov, S. Penev, 2019)

Chart 2.

Total number of injured and death pedestrians in traffic crashes both in Bulgaria and Ruse from 2011 to 2020

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total number of deaths in traffic crashes, Bulgaria	657	601	601	601	708	708	682	611	628	463
Death pedestrians	147	135	105	150	164	114	167	123	151	94
Total deaths in traffic crashes, Ruse	28	13	29	28	26	29	17	15	19	14
Death pedestrians, Ruse	5	0	2	6	6	3	5	4	6	3
% death pedestrians to total deaths in traffic crashes, Ruse	17,86	0,00	6,90	21,43	23,08	10,34	29,41	26,67	31,58	21,43

The total number of deaths for the period 2011-2020 is 218 and the number of pedestrians killed is 40. The number of deaths of pedestrians is 18.35% of the total number of deaths. This percentage is lower than the total for the country (21.25%), but from the 10-year period in 6 years the percentage is higher than the national average. It is worrying that in recent years 2017-2020 the percentage is high, as the deviation from the national average is as follows:

- 2017 year-8,16%;
- 2018 year -5,42%;
- 2019 year -10,33%;

2020 year -0,18%.

Similarly, the same parameters can be determined for injured pedestrians (Table 3).

Chart 3.

Total number of injured and death pedestrians for Bulgaria and Ruse, from 2011 to 2020

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total number of injured in traffic crashes, Bulgaria	8301	8193	8770	8635	8971	9374	8680	8466	8499	7121
Injured pedestrians	2021	1999	2053	2053	1926	1729	1850	1781	1670	1369
Total number of injured in traffic crashes, Ruse	410	437	479	464	505	511	438	419	427	369
Injured pedestrians, Ruse	96	89	104	97	102	80	73	67	85	53
% injured pedestrians to total number of injured in traffic crashes, Ruse	23.4	20.4	21.7	20.9	20.2	15.7	16,7	15,9	19,9	14,4

The total number of injured pedestrians in Ruse for the period 2011-2020 is 846 people. We see that the difference between 2011 and 2020 is 9%, while in previous years the percentage was between two and seven percent. 2016-2020 marks a serious reduction in the number of injured. The low rate in 2020 can logically be explained by the imposed lockdown due to the Covid 19 pandemic. Another factor is the actions taken this year in improving infrastructure, prevention and control.

### Factors influencing the risk of a pedestrian accident

A number of factors can affect the risk and / or severity of a pedestrian involved accident. They are mainly related to: pedestrians themselves, drivers, vehicles, road infrastructure, traffic organization and a number of social / demographic factors (Fig. 3). Each of these factors can cause death or injury of varying severity to a pedestrian.

### Road safety measures to reduce the number of pedestrian deaths

The selection and implementation of road safety measures should seek for the implementation of solutions with significant potential, and work on road safety should focus not only on death cases but also on injuries.

For both, reducing the speed of vehicles can be seen as one of the most promising road safety measures. Implementing the Vision Zero approach, it is recommended to introduce speed limits of 30 km / h on roads where pedestrian flows and traffic intersect, for example in urban areas. Although some municipalities have recently started to implement it, areas with a speed limit of 30 km / h are still quite rare in Bulgaria. For roads with speed limits up to 50 km / h, it is recommended for a physical separation between road users to be built. Reducing the speed limit up to 30 km / h at

intersections and, where necessary, building physical obstacles (fences) etc.). When driving at higher speeds, it is recommended to build a special space for pedestrians with dividing levels for crossing. In Bulgaria, there are roads that pass through settlements, such as areas where walking is common, as well as near urban areas, must be identified and prioritized.

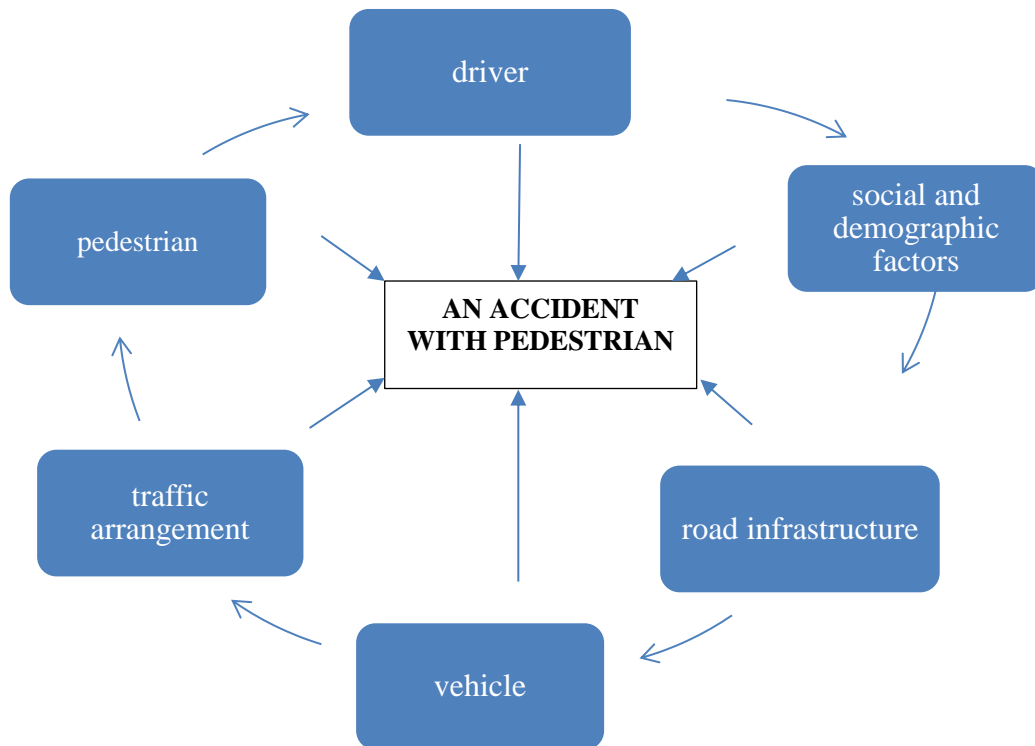


Fig. 3. Factors related to the risk and / or severity of a pedestrian accident

In addition to reducing the speed limit, measures aimed at complying with the speed limit (eg enforcement, driver assistance systems and physical measures) do matter in order to reduce fatalities and injuries in road accidents. Given the death cases prevention, additional measures to be taken are the physical separation of road users into high-speed zones and monitoring of the dead-zones and/or automatic emergency braking, especially for heavy goods vehicles. With regard to preventing serious injuries cases, additional measures to be taken are the improvement of pedestrian facilities (eg pedestrian islands, raised intersections, curb extensions and signal control) and the replacement of three- and four-way intersections with roundabouts, where appropriate.

Including paying more attention to the prevention of injured pedestrians cases after accidents in traffic safety work, will transfer more responsibility to municipalities. Traffic safety measures must be adapted to local conditions, as the road environment and travel behavior generally vary depending on the size and location of the municipalities.

## CONCLUSIONS

The current research supports the statement that still a lot of people lose their lives in road accidents in the country. The death pedestrians are 21.25% of the total number of killed in crashes. Also, 21.77% of the total number of injured (mild and severe) are pedestrians. The two values show that the total number of pedestrians killed and injured in traffic accidents in the country is more than 1/5. For Ruse, it is worrying that in recent years 2017-2020 the percentage is higher than the average for Bulgaria. A number of factors, mainly related with pedestrians themselves, drivers, vehicles, road infrastructure, traffic arrangement and a number of social/demographic factors can affect the risk and / or severity of traffic accident with pedestrians. When we select and implement pedestrian safety measures, the should search for solutions with significant potential, decreasing the speed can be considered as one of the most promising and appropriate measures for pedestrian safety. Traffic

safety measures must be adapted to local conditions, because the road environment and travel behavior generally vary depending on the size and location of the municipalities.

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## REFERENCES

Congiu, T.; Sotgiu, G.; Castiglia, P.; Azara, A.; Piana, A.; Sadleri, L.; Dettori, M. Built environment features and pedestrian accidents: an Italian retrospective study. *Sustainability* 2019, 11, 1064. [Google Scholar]

De Seguridad Vial, O.N. Las Principales.Cifras de la Siniestralidad Vial. España 2019; Dirección General de Tráfico: Madrid, España, 2019.

Dinh, D.; Vũ, N.; McIlroy, R.; Plant, K.; Stanton, N. Effect of attitudes towards traffic safety and risk perceptions on pedestrian behaviours in Vietnam. *IATSS Res.* 2020, 44, 238–247.

Savova-Mratsenkova M., Palagachev G. (2020), Graph-analytic approach to determine the position of the initial impact in the event of pedestrian accidents, *TechSys 2020*, IOP Publishing doi:10.1088/1757-899X/878/1/012042

National Strategy for Road Safety in the Republic of Bulgaria 2021-2030 (Оригинално заглавие: Национална стратегия за безопасност на движението по пътищата в Република България 2021-2030)

Orsato, R.J. & P. Wells. (2007). U-turn: the rise and demise of the automobile industry. *Journal of Cleaner Production*, Volume 15, Issues 11–12, 2007, Pages 994-1006.

Pencheva V., As. Asenov. (2019). Road safety policies and training of candidates for drivers. University of Ruse. pp.260. 260 с. ISBN 978-954-712-761-6 – 2019 (Оригинално заглавие: Пенчева В., Ас. Асенов, Политики за пътна безопасност и обучение на кандидати за водачи на МПС. Академично издателство Русенски университет. Русе. 2019)

Pencheva V. As. Asenov, S. Penev (2019). Assesment of Time Irregularities of Road Accidents in Bulgaria. *Proceedings of University of Ruse - 2019, volume 58, book 4*, ISBN 978-954-712-793-7 (Оригинално заглавие: Пенчева В., Ас. Асенов, С. Пенев, Оценка на времевата неравномерност при ПТП. Научни трудове на Русенски университет, том 58, кн. 4, ISBN 978-954-712-793-7)

Statistics, Ministry of Interior Bulgaria (Оригинално заглавие: Статистика, Министерство на вътрешните работи на Р. България), <https://www.mvr.bg>

Useche, S.A.; Alonso, F.; Montoro, L. Validation of the Walking Behavior Questionnaire (WBQ): A tool for measuring risky and safe walking under a behavioral perspective. *J. Transp. Health* 2020, 18, 100899. [Google Scholar] [CrossRef]

Useche, S.; Montoro, L.; Alonso, F.; Oviedo-Trespalacios, O. Infrastructural and human factors affecting safety outcomes of cyclists. *Sustainability* 2018, 10, 299.