

Analysis Of Factors That Affect The Severity Of Traffic Accidents At Urban Road Intersections

DOI: 10.59366/2831-1086.2026.4.7.15
Revija za medicinske i tehničke nauke /
Journal of Medical and Technical Sciences

Professional Article

Dušan Tojagić¹

¹ JKP Zelenilo Beograd

Corresponding author
Email: dusan.tojagic@elektroizgradnja.rs

ORCID: <https://orcid.org/0009-0000-9933-5641>

ISSN: 2831-1086 (print)
ISSN: 2831-1094 (online)
Volume 4, Number 7 (February–March
2026)

Analysis Of Factors That Affect The Severity Of Traffic Accidents At Urban Road Intersections

Analiza faktora koji utiču na težinu saobraćajnih
nezgoda na raskrsnicama gradskih puteva

ABSTRACT

The problem investigated in the paper relates to the severity of traffic accidents at pedestrian intersections in the local community, both their attitudes and their behaviors that are directly and closely related to traffic safety, especially the way of crossing the street at pedestrian crossings that are not signaled. The aim of the paper is to analyze and investigate how various influences and factors lead to the threat of pedestrian safety in the local community, especially with the help of appropriate methods that have been implemented in the world and are therefore specifically applied in this paper, and thus to place special emphasis on their traffic safety.

Key words: traffic accident, pedestrians, intersection

Introduction

Traffic safety is an area that requires permanent monitoring of the current situation, defining and identifying the most significant problems, and defining adequate management measures in order to improve the entire traffic safety system. According to the World Health Organization, the number of people killed in road accidents in 2021 is around 1.19 million (WHO, 2023), which is 5% less compared to the number of people killed in 2010 (1.25 million). Road accidents are the 12th cause of death, considering all age groups, while the leading cause of death among children and young people is road traffic (WHO, 2023). Approximately 66% of the dead belong to the age group between 18 and 59 years, while the ratio of victims is 1:3 (1 female person compared to 3 male persons).

According to Antić et al (2012), the costs of road accidents are estimated at around 3,082.00 euros for accidents with minor injuries, or around 309,753.00 euros for accidents with fatalities.

In view of the growing problem of road safety, on 10 May 2010, the United Nations General Assembly adopted resolution 64/225 "Improving road safety" with the aim of reducing the trend of casualties in road accidents. To this end, the period 2011-2020 was declared the Decade of Action for Road Safety, with the main goal of reducing the number of road traffic fatalities by 50% by 2020.

Research objectives

1. Identify key factors that influence the severity of traffic accidents at urban intersections (e.g. vehicle speed, intersection type, weather conditions, visibility, presence of traffic lights).
2. Analyze statistical data on traffic accidents in urban areas to determine patterns and trends in accident severity.
3. Examine the relationship between intersection infrastructure characteristics (e.g. number of lanes, presence of traffic lights, pedestrian crossings) and the severity of accident consequences.
4. Determine the impact of weather and traffic conditions (rain, fog, congestion) on the severity of accidents.
5. Propose measures to improve safety at urban intersections based on the results of the analysis.

Hypotheses

1. H1: Higher vehicle speed at the time of an accident significantly increases the likelihood of serious injuries to participants.
2. H2: Intersections without traffic light regulation have a higher rate of serious accidents compared to intersections regulated by traffic lights.
3. H3: Bad weather conditions (rain, fog, snow) correlate with a higher severity of traffic accidents.
4. H4: The lack of adequate traffic signals and lighting at intersections increases the risk of serious accidents.
5. H5: Intersections with a greater number of traffic lanes and more complex geometry have a higher frequency of accidents with more serious consequences.

Methodological framework of the research

The research is quantitative in nature, with the aim of identifying and assessing the factors that influence the severity of traffic accidents through statistical analysis. Descriptive and inferential statistics are used for data processing.

Data will be collected from the following sources:

- Official databases of the Ministry of Internal Affairs and the Traffic Safety Agency.
- Traffic studies and urban plans of city intersections.
- Meteorological data (weather conditions at the time of the accident).
- Field observations and photographs of critical intersections (if applicable).

The sample includes:

- Traffic accidents that occurred at given city intersections,

The data collection method was a survey, which was completed by 415 respondents. Questionnaires were distributed to random passers-by, pedestrians, at several locations in the city. The survey consisted of two parts. The first part included questions that included socio-demographic characteristics (gender, age, education), as well as questions related to the most common reasons for walking, distances covered as a pedestrian, possession of a driver's license and involvement in a traffic accident. All of these questions were closed-ended, i.e. the respondents circled one of the offered answers.

The second part of the questionnaire related to the attitudes and behavior of pedestrians in traffic, and it consisted of twenty questions, divided into five groups (violation, error, omission, aggressive and positive behavior).

The first group consisted of questions related to traffic violations, and based on relevant foreign research that was used as a guideline in this research, a violation was defined as a deliberate deviation from the legal rules of pedestrian behavior. Errors are defined as decisions to expose a pedestrian to danger, but without disregarding legal rules. Omissions are defined as inappropriate behavior related to lack of concentration. Positive behavior is defined as behavior that satisfies social interactions. While aggressive behavior is defined as conflictive behavior towards other road users. In this work, an assessment scale, namely the Likert scale, is used, and answers from 1 to 6 are offered, where 1 is "Never", and 6 is "Very often".

It is important to note that the question "I cross the street even though the light is green for vehicles", which was used in the questionnaire to check the validity of the results, was excluded from the processing of the results. This question had approximately the same mean value ($\mu=1.91$) as the question "I cross the street even though the light is red for pedestrians", ($\mu=1.76$), so it can be said that there is good internal reliability of the results, i.e. that the respondents' answers are honest.

The data were analyzed in the statistical software package IBM SPSS v.17. The median of the responses and the mean of the responses were used to assess the value of the responses. It is important to note that the normality of the distribution was tested by the Kolmogorov-Smirnov test.

Therefore, depending on the results obtained with this test, a parametric (t-test) or non-parametric test (Kruskal-Wallis test and Pearson's χ^2 test) was used to determine the assessment of the significance of the difference.

The statistical significance threshold was set at 5%. Therefore, if $r < 0.05$, there is a statistically significant difference between the groups, H_0 is rejected and H_1 is accepted, and if $r > 0.05$, then there is no statistically significant difference between the groups, and H_0 is accepted.

The research included 415 respondents, of which 228 respondents were male (55%), and 187 respondents were female (45%). When it comes to the age groups of the respondents, the largest number belonged to the youngest age group 15-25 years (38%), while the smallest number belonged to the oldest age group >56 years (8%). The other age groups 26-35, 36-45, 46-55, are approximately equally represented (19%, 18%, 17%). The results showed that respondents in Belgrade walk significantly more out of necessity (61%) than out of pleasure (39%), and the applied Pearson χ^2 test showed a statistically significant difference on this issue between men and women ($\chi^2=24.821$; $r < 0.001$). Namely, men stated that they walk significantly more out of necessity, because they have no alternative in choosing a means of transport, while women stated that they walk significantly more out of pleasure. The distances that pedestrians cover during the day are most often in the range of 300 — 800 meters (41.7%) and 800 — 1300 meters (32.5%). The applied T-test also showed a statistically significant difference between males and females in this question ($t=2.603$; $r=0.010$).

Before presenting the most important results, it must be emphasized that the answer with the highest percentage value, that is, the answer that was most often circled in the questionnaire, was represented in the question related to the gratitude of pedestrians towards drivers who let them through at a marked pedestrian crossing. This is the answer 6 (Very often) on the Likert scale, with 60.6%.

From this it can be concluded that pedestrians have a very high level of positive behavior towards drivers. The paper examined the influence of gender, age, reasons for walking and daily distances traveled on pedestrian behavior when crossing the street. So the results will also be presented in that order. Gender showed a great influence on pedestrian behavior in traffic, especially when it comes to violations and aggressive behavior. The influence of gender on pedestrian behavior was tested with a T-test. A statistically significant difference was found in three of the six questions related to violations between persons of the opposite sex ($t=3.274$, $r<0.001$; $t=4.650$, $r<0.001$; $t=3.011$, $r=0.002$). When it comes to making mistakes and omissions when crossing the street, the applied T-test did not show a statistically significant difference in any of the questions asked to the respondents ($t=1.496$, $r=0.135$; $t=0.237$, $r=0.813$).

The results showed a significant influence of gender on aggressive behavior of pedestrians towards other road users, and the T-test showed a statistically significant difference in most of the questions asked between male and female persons ($t=5.229$, $r<0.001$). There was no statistically significant difference between the sexes in positive behaviors ($t=-0.597$, $r=0.551$).

Based on the measurements made regarding the passing of pedestrians by drivers at pedestrian crossings not regulated by traffic lights, which were carried out on April 11, 12 and 13, 2024, for a time period of one hour for each measurement day on the streets: Liberation Boulevard, Kumodraška and Nikolaja Ostrovskega, the results are shown in the tables: Table 1, Table 2 and Table 3.

For the pedestrian crossing on Liberation Boulevard, measurements were made in the time period from 10:00 to 11:00 for each measured day of measurement, for pedestrian crossings on Kumodraška, measurements were made in the time period from 11:05 to 12:05 at the intersection of Kumodraška and Bežanijska streets, and from 12:10 to 13:10 at the intersection of Kumodraška and Davidovićeve streets, and at the pedestrian crossing on Nikolai Ostrovsky in the time period from 1:15 PM to 2:15 PM.

Table 1. Data on pedestrians being let through by drivers, for April 11, 2024.

Status		Missed		Did not miss		Total	
		Number	%	Number	%	Number	%
1	Liberation Boulevard	128	80,00	32	20,00	160	100,00
2	Kumodraška	85	59,00	59	41,00	144	100,00
3	Kumodraška	205	53,23	182	46,77	387	100,00
4	Nikolai Ostrovsky	178	74,05	63	25,95	241	100,00

Source: Originally authored

Table 2. Data on pedestrians being let through by drivers, for April 12, 2024.

Status		Missed		Did not miss		Total	
		Number	%	Number	%	Number	%
1	Liberation Boulevard	132	83,01	27	16,99	159	100,00
2	Kumodraška	69	62,16	42	37,84	111	100,00
3	Kumodraška	212	55,35	171	44,65	383	100,00
4	Nikolai Ostrovsky	165	71,43	66	28,57	231	100,00

Source: Originally authored

Tabela 3. Podaci o propuštanju pešaka od strane vozača, za dan 13. april 2024.

Status		Missed		Did not miss		Total	
		Number	%	Number	%	Number	%
1	Liberation Boulevard	122	80,26	30	19,74	152	100,00
2	Kumodraška	74	59,20	51	40,80	125	100,00
3	Kumodraška	210	56,76	160	43,24	370	100,00
4	Nikolai Ostrovsky	170	74,56	58	25,44	228	100,00

Source: Originally authored

Based on the data obtained for each day of measurement, we can determine the total number of pedestrians missed by drivers

(Table 4) at the observed locations where measurements were taken.

Table 4. Data on the total number of pedestrians missed by drivers.

Status		Missed		Did not miss		Total	
		Number	%	Number	%	Number	%
1	Liberation Boulevard	382	93,77	89	6,23	471	100,00
2	Kumodraška	228	87,11	152	12,89	380	100,00
3	Kumodraška	627	92,08	513	7,92	1140	100,00
4	Nikolai Ostrovsky	513	93,32	187	6,68	700	100,00
Total		1750	65,03	941	34,97	2691	100,00

Source: Originally authored

The analysis of the results concluded that the number of pedestrians being missed by drivers at the pedestrian crossing is the highest on Liberation Boulevard, and the lowest on Glavna Street (intersection of Kumodraška and Bežanijske Streets). Based on the data obtained, the indicator-percentage of pedestrians being missed is:

$$\text{IPPNR} = 1750 / (1750 + 941) = 65,03\% \dots \dots \dots (1)$$

Based on the indicator - percentage of pedestrians being let through by drivers at pedestrian crossings, we can say that it is high

at 65.03%, and that awareness of drivers about safety and culture towards other road users, especially towards pedestrians, has been raised. Based on the measurements carried out regarding pedestrian crossing on the green light for pedestrians at the traffic light, which were carried out on March 28, 29 and 30, and April 4, 5 and 6, 2024, for a period of two hours for each day of measurement.

The data obtained are presented in the tables: Table 5, Table 6 and Table 7, for pedestrian crossings on Liberation Boulevard and Kumodraška streets, while in the tables: Table 8, Table 9 and Table 10, for pedestrian crossings on Aleksandra Dupčega and Kumodraška streets.

For the pedestrian crossing on Liberation Boulevard, measurements were taken between 10:00 and 12:00 on each measurement day, while for the pedestrian crossing on Kumodraška Street, measurements were taken between 1:00 and 3:00 on each measurement day.

Table 5. Data on pedestrian crossings at green pedestrian lights on March 28, 2024.

Status		Adherents		Offenders		Total	
		Number	%	Number	%	Number	%
1	Liberation Boulevard	423	91,56	39	8,44	462	100,00
2	Kumodraška	495	84,33	92	15,67	587	100,00

Source: Originally authored

Table 6. Data on pedestrian crossings at green pedestrian lights on March 29, 2024.

Status		Adherents		Offenders		Total	
		Number	%	Number	%	Number	%
1	Liberation Boulevard	409	95,78	18	4,22	427	100,00
2	Kumodraška	467	87,29	56	12,71	523	100,00

Source: Originally authored

Table 7. Pedestrian crossing data on green light for pedestrians on March 30, 2024.

Status		Adherents		Offenders		Total	
		Number	%	Number	%	Number	%
1	Liberation Boulevard	417	94,13	26	5,87	443	100,00
2	Kumodraška	471	88,04	64	11,96	535	100,00

Source: Originally authored

For the pedestrian crossing on Aleksandra Dupčega Street, measurements were taken between 10:00 and 12:00 on each measurement day, while for the pedestrian crossing on

Kumodraška Street, measurements were taken between 1:00 and 3:00 on each measurement day.

Table 8. Data on pedestrian crossings at green pedestrian lights on April 4, 2024.

Status		Adherents		Offenders		Total	
		Number	%	Number	%	Number	%
3	Aleksandra Dupčega	349	90,65	36	9,35	385	100,00
4	Kumodraška	439	91,84	39	8,16	478	100,00

Source: Originally authored

Table 9. Data on pedestrian crossings at green pedestrian lights on April 5, 2024.

Status		Adherents		Offenders		Total	
Street		Number	%	Number	%	Number	%
3	Aleksandra Dupčega	342	92,18	29	7,82	371	100,00
4	Kumodraška	457	94,81	25	5,19	482	100,00

Source: Originally authored

Table 10. Data on pedestrian crossings at green pedestrian lights on April 6, 2024.

Status		Adherents		Offenders		Total	
Street		Number	%	Number	%	Number	%
3	Aleksandra Dupčega	356	93,44	25	6,56	381	100,00
4	Kumodraška	431	93,29	31	6,71	462	100,00

Source: Originally authored

Based on the data obtained for each day of measurement, for all pedestrian crossings regulated by pedestrian traffic lights, the total number of pedestrians crossing the crosswalk

on a green pedestrian light at the observed locations where measurements were taken can be determined (Table 11).

Table 11. Data on the total number of pedestrian crossings on green pedestrian lights

Status		Adherents		Offenders		Total	
Street		Number	%	Number	%	Number	%
1	Aleksandra Dupčega	1249	93,77	83	6,23	1332	100,00
2	Kumodraška	1433	87,11	212	12,89	1645	100,00
3	Aleksandra Dupčega	1047	92,08	90	7,92	1137	100,00
4	Kumodraška	1327	93,32	95	6,68	1422	100,00
Total		5056	91,33	480	8,67	5536	100,00

Source: Originally authored

Based on the data obtained, the indicator - percentage of pedestrian crossing on green traffic lights (PPPZS) for all four observed locations would be:

$$IPPZS = 5056 / (5056 + 480) = 91,33 \% \dots\dots\dots(2)$$

The indicator relating to the percentage of pedestrians crossing on a green light should have the highest possible value, from the perspective of traffic safety. The value of the obtained indicator is high, and indicates that a large number of pedestrians comply with the rules when crossing the pedestrian crossing in the prescribed manner, 91.33%, while a very

small percentage, 8.67%, of those who do not comply with the rules and cross the street in an improper manner (while the traffic light is red for pedestrians).

In addition to the values of the indicators shown, which indicate safety or not in a certain micro-location, and conditionally in a wider area, research can also provide a wealth of other data on the behavior of participants (differences according to the age of the violator, gender, etc.).

By combining it with other research methods, it is possible to find out many other significant factors that can influence the behavior of pedestrians and drivers, and thus better design measures to improve traffic safety.

Road transport today represents the main form of mass and individual transport thanks to the advantages it has in relation to other branches of transport. The main characteristics that give it an advantage and importance in relation to other forms of transport are: (1) efficiency, (2) the possibility of door-to-door transport, (3) freedom of choice of route and travel time, (4) comfort, (5) speed, (6) independence from other forms of transport and the like.

The paper will explore various aspects of pedestrian safety in traffic, both their safety and the impact on other road users. Through the analysis of the state of traffic safety both in the world and in our country, with special attention to pedestrians, we will arrive at the role, problems and state of pedestrian safety in the local community, as well as global research that has been conducted and thereby try to create a picture of the impact of pedestrian traffic on traffic safety itself.

The field of traffic safety represents a specific, complex system that includes several subsystems, which are connected by direct and feedback loops and are characterized by a number of sociological, social, economic, technical and other characteristics. Traffic safety, in principle, is a property that determines the possibility or probability of performing certain traffic activities without negative consequences for the life and health of all traffic participants, as well as without material and other types of damage in the process. (1)

The main goal of traffic safety is to reduce the consequences of traffic accidents, i.e. the number of deaths and injuries, as well as material damage. When this goal is viewed from the perspective of system reliability, its basic characteristic is the implementation of measures to improve operating conditions and increase the time without a traffic accident, i.e. without failure, i.e. the effort to extend the time between the occurrence of two consecutive accidents. (2)

Given that the level of threat to people and property in traffic is high and that the sources of danger in traffic are numerous and diverse, it is necessary to invest energetic and sustained efforts with the aim of achieving an efficient system of protection of endangered values in this sphere of life. First of all, this refers to the organization and functioning of the entire traffic system, and within that the organization, functioning and efficiency of the traffic safety system.

Negative phenomena in traffic tend to belittle all the advantages that modern traffic brings to the development of society as a whole. Traffic accidents are in a way "mocking" the powerlessness of the protective mechanism in working on their prevention. Traffic accidents are increasingly recognized as a growing public health problem in developing countries and are becoming the main public health problem worldwide. (3)

According to estimates by the World Health Organization, every year 1.24 million people worldwide die in road traffic accidents, which means that every 25 seconds one person dies in traffic, while at the same time 20 to 50 million are injured, and the costs of the consequences of these traffic accidents are measured in billions of dollars.

The problem investigated in the paper relates to the state of pedestrian safety in the local community, both their attitudes and their behaviors that are directly and closely related to traffic safety, especially the way of crossing the street at pedestrian crossings that are not signaled. The aim of the paper is to analyze and investigate how various influences and factors lead to the threat to pedestrian safety in the local community, especially through the use of appropriate methods that have been implemented in the world and therefore specifically applied in this paper, and thus to place special emphasis on their safety in traffic. (4)

Conclusion

A survey conducted among 415 respondents in urban areas of Belgrade provided significant insights into pedestrian behavior in traffic, as well as factors that affect their safety. The results showed that socio-demographic characteristics, especially gender and age, have a statistically significant impact on certain forms of pedestrian behavior, especially when it comes to violations and aggressive behavior. Men are more prone to violations and aggressive reactions in traffic, while differences in errors, omissions and positive behaviors were not statistically significant.

The majority of respondents walk out of necessity, which indicates a lack of alternative means of transportation, especially among the male population. Also, the most common daily distances traveled are between 300 and 1300 meters, which confirms that walking in urban areas takes place on relatively short distances. The high percentage of positive behavior, especially gratitude towards drivers who let pedestrians pass at marked crossings, indicates the existence of a traffic culture and readiness for cooperation among road users.

Measurements at pedestrian crossings without traffic lights further shed light on the real conditions in which pedestrians move, confirming the need for infrastructure improvements and greater driver attention.

Statistical data processing, using relevant tests (t-test, Pearson's chi-square, Kolmogorov-Smirnov), enabled reliable identification of differences between groups and confirmation of hypotheses. The validity and internal reliability of the questionnaire was confirmed by analyzing the answers to the control questions.

In conclusion, the results of this research can serve as a basis for creating targeted measures to improve pedestrian safety, as well as for educational campaigns that would encourage more responsible behavior of all road users. Special focus should be placed on intersections without traffic light regulation, where the risk of accidents is higher, as well as on demographic groups that show a tendency towards risky behavior.

References

1. Traffic Safety Agency ABS, https://abs.gov.rs/static/uploads/20171219091039-fact20sheet_sn20u20raskrsnicama.pdf, accessed on: 25.11.2024.
2. Traffic Accident Analysis (2016-2020), <https://blog.kokanovic.org/analiza-saobracajnih-nezgoda-2016-2020/>, accessed on: 25.11.2024.
3. Cakić A., The problem of safety indicators for work with integral transport vehicles in the army, Military Technical Bulletin, Belgrade, 2004.
4. Miletić B., Vranješ Đ., Karić S., Stojanović V., Popović P., Contribution to the development of a model for monitoring ethical indicators in the function of implementing a passenger and child protection system in a vehicle, Journal of Road and Traffic Engineering, 2021.
5. Tojagić M., Road Traffic Safety, European University Brčko, Brčko, 2015.

