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Analyses and statistics on the frequency and the incidence of traffic accidents within Dolj County

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Abstract. Within the entire territory of the EU Member States, traffic accidents cause yearly over 37,000 deaths and about 1.2 million injured, as well as damages estimated, annually, at 145 billion Euros. Under the circumstances, a series of strategies and measures have been adopted over the past two decades in order to reduce the number of victims caused by traffic accidents, hence preventing some of the worst consequences. Aiming at improving road traffic safety, joint efforts have been carried out to estimate and identify those factors leading to the occurrence of accidents, in order to adopt and implement the most appropriate measures to reduce the risk of collisions. The dynamics of a traffic accident is different from one case to another; thus, safety measures can only be enforced following in-depth analyses on the occurrence of traffic accidents. The main objective of our research study is to design and develop an analysis model on the occurrence and the circumstances leading to traffic accidents, considering at the same time some main characteristics of the driver, such as age, gender, etc.

1. Introduction

Throughout the territory of the European Union Member States, traffic accidents cause each year over 37,000 deaths and about 1.2 million injuries, as well as damages estimated, annually, at 145 billion Euros. Within this context, a series of strategies and measures have been adopted in the past decades to reduce the number of victims caused by traffic accidents, aimed also at preventing some of the worst consequences. The establishment of a European database on the incidence of traffic accidents has secured a higher flexibility and a maximum potential with regard to the analysis of the information contained within the system, and, opened up a whole range of new possibilities in the field of accidents' analysis [1].

As indicated in [6], a research study carried out by NHTSA (National Highway Traffic Safety Administration) set to feature general vehicle traffic crushes that occur at intersections. Accordingly, special attention was paid to such instances triggered by the interdependence between the critical reason and some key crash factors such as drivers' gender and age, traffic control devices, critical pre-crash events, and weather conditions. Further research studies undertaken by NHTSA, as in [7], put forward an overview on traffic accidents incidents to highlight that over the past 10 years, there has been a reduction of nearly 25 percent in the number of fatalities. In [3], Goswami et al. validates another method applied to the analysis and statistics of traffic accidents occurrence. Here the author departs from the premises that accidents are uniformly distributed over the year and over the seasons.

How traffic accidents occur and their consequences stand as a major field of research, both at national and international level. Thus, at national level, various specialists have sought to determine the parameters of the crash tests between a vehicle and a pillar, at a speed of 50 km/h, as in [2]. Another research project, carried out in [4], was to study frontal vehicle collisions using high-speed videos, in order to assess the injury criteria of the occupant. Vehicle-pedestrian collisions, as well as vehicle- bicycle driver collusions have been studied in [5], in order to determine the differences regarding the head injury risk.

In compliance with both global and European-level organisational principles, the databases designed to provide statistics on the incidence of road accidents can be classified according to a number of various factors such as: type of victim, type of road, atmospheric conditions, and type of collision.

A statistical analysis with regard to the number, the type of injury and the frequency rates of traffic accidents was carried out between 2012 and 2016, within Dolj County. Hence, in cooperation with the Dolj County Police Inspectorate – Road Traffic Department, we set up to design and develop a statistical analysis on the incidence of traffic accidents. Special attention was paid both to the steadily increasing incidence rate and the causes that led to traffic accidents within Dolj County during 01.01.2012 - 31.12.2016.

2. Statistical analysis

In line with the official data provided by the Road Traffic Department of the Dolj County Police Inspectorate, during the previous 5 years, an average of more than 800 accidents was recorded per year, of which, approximately 260 accidents had serious consequences. To further develop our statistical analysis, we took into consideration a series of highly influential factors as we aimed to establish a series of traffic accidents particularities.

Table 1. Total number of traffic accidents between 2012 and 2016

	2012	**2013**	**2014**	**2015**	**2016**
Total	882	845	804	810	802
Serious	269	268	265	262	259
Mild	613	577	539	548	543

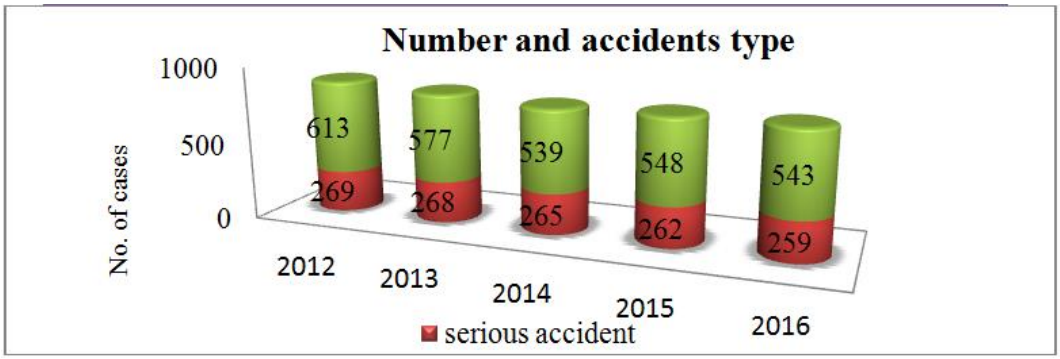

Figure 1. Total number of traffic accidents between 2012 and 2016

2.1. Type of injuries

The first step of our statistical analysis was to outline the total number of the individuals and of the vehicles involved in traffic accidents within the time span under investigation. Then, we established a classification of the two major factors. Also, we developed a categorization of the type of injuries caused, on an incident scale from minor injuries to deaths. An overview of the data provided by the Road Traffic Department, Dolj County Police Inspectorate, indicated that the lowest number of deaths caused by road accidents produced within Dolj County, i.e. 55, was registered in 2013. In 2012, the Road Traffic Department registered 70 deaths, in 2014 another 73 victims were the result of road accidents, in 2015 the number of victims went up to 75, and, last year there were registered 67 deaths.

Table 2. The number and the type of injuries caused in 2014

2014	Vehicle	Dead	Serious injuries	Mild injuries
mild	779	0	0	669
serious	378	73	244	81
total	1157	73	244	750

Of a total number of 804 traffic accidents recorded in 2014, the authorities recorded 1067 injuries. Hence, we could establish that approximately 70% of the individuals involved in a traffic accident suffered minor injuries, 23% were seriously injured, and 7% of the traffic participants involved, died following a traffic accident.

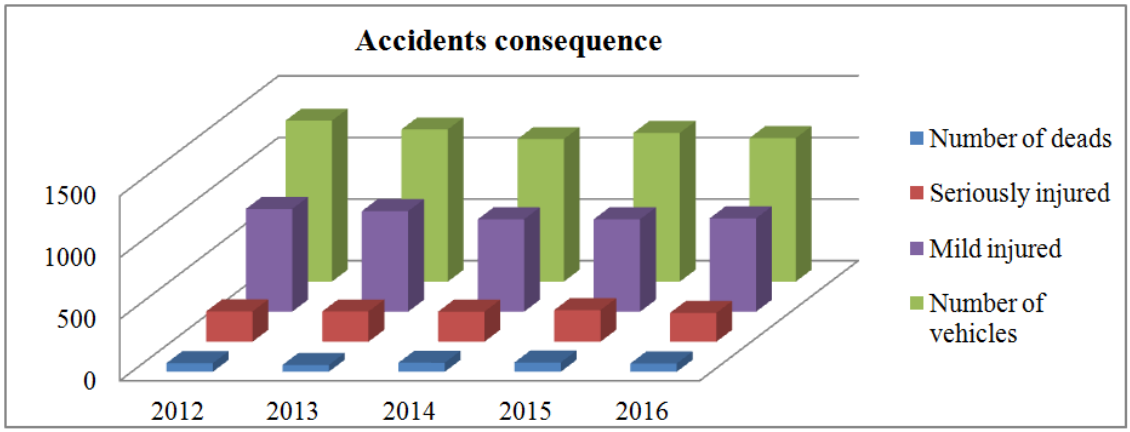

Figure 2. Conse**quences of traffic accidents**

2.2. Areas with higher risks of accidents

By developing a model applied to classify the road accidents recorded within Dolj County between 2012 and 2016, we also aimed at identifying the area where each accident occurred. Hence, we could map those areas with higher risks of accidents, the so-called black spots. Following this pattern, out of the total number of events, we first sought to identify and classify those accidents occurring within localities, and, then, the ones occurring outside localities.

The number of the traffic accidents registered was established in accordance with the type of the road where they occurred, i.e. communal, county and national roads, streets, and other types of roads. Also, within this classification we considered the characteristics of the road, as follows: road in curve, intersection, straight roads, and bridges.

Weather conditions at the time of the collision have a particular influence on the occurrence of traffic accidents, as well as some specific characteristics concerning the adhesion of the road at the moment of collision.

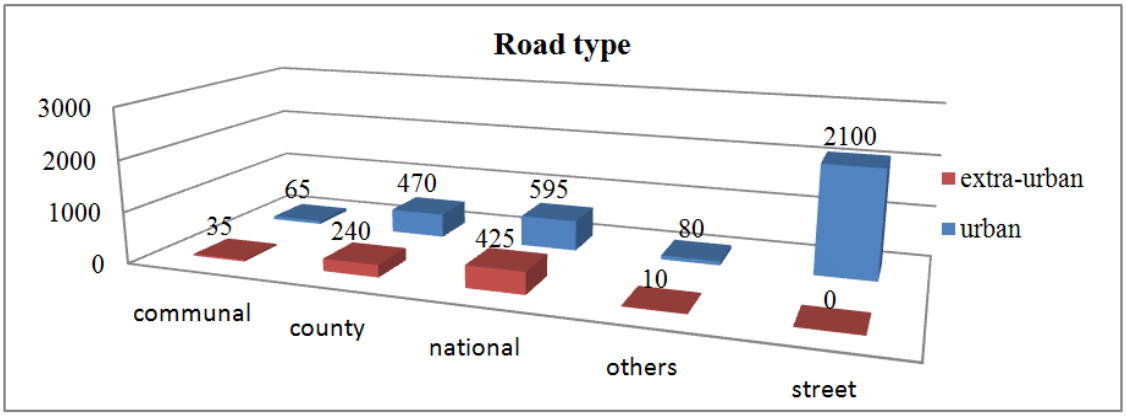

Figure 3. Road type - traffic events from 2012 to 2016

Our statistical analysis indicates that out of the total number of traffic accidents recorded over a calendar year, more than two thirds represent mild accidents. Thus, a first conclusion following our research study shows that the impact speed of the vehicles has been reduced in recent years, being adapted to the conditions of travel within localities. Figures 3 and 4 below validate our results, taking into account the fact that traffic accidents occur in the highest percentage within localities.
As far as road characteristics are concerned, we reached the conclusion that most traffic accidents occur on straight roads, without bumps, both within and outside localities.

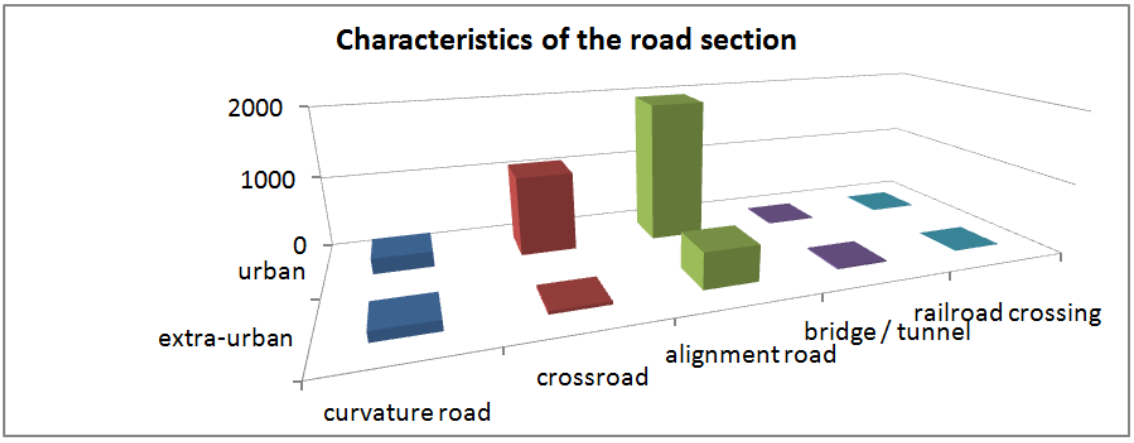

Figure 4. Traffic accidents localization within 2012 - 2016

2.3. Driver characteristics influence

Road traffic safety is influenced by three major categories of factors: the technical condition of the vehicle, the behaviour and the characteristics of the driver, road and visibility conditions. The data provided by the Road Traffic Department - Dolj County Police Inspectorate did not contain information about the technical condition of the vehicles involved in the accidents, thus we could not input and consider this criterion to our analysis. However, following the results of our analysis, we could establish the influence of the driver's characteristics and the road conditions on the risk of accidents incidence.

Concerning the type of traffic participants involved in traffic accidents within Dolj County, our statistical analysis indicated that a considerable frequency rate of victims was registered among vehicle drivers. The age and gender group of the participants in relation to the occurrence of the traffic accidents registered in Dolj County between 2012 and 2016 was also a key criterion input in our statistical analysis. Thus, we classified and further investigated 8 age groups.

Table 3. Traffic accidents victims on age groups

2012	0->10	11->20	21->30	31->40	41->50	51->60	61->70	over 70	total
mild	53	213	376	263	189	146	79	48	1367
serious	20	90	154	124	78	83	38	37	624
total	73	303	530	387	267	229	117	85	1991
2013	**0->10**	**11->20**	**21->30**	**31->40**	**41->50**	**51->60**	**61->70**	**over 70**	**total**
mild	58	152	328	286	185	136	79	64	1288
serious	20	89	157	106	86	77	57	34	626
total	78	241	485	392	271	213	136	98	1914
2014	**0->10**	**11->20**	**21->30**	**31->40**	**41->50**	**51->60**	**61->70**	**over 70**	**total**
mild	54	171	314	217	184	132	95	43	1210
serious	16	57	145	100	116	83	59	41	617
total	70	228	459	317	300	215	154	84	1827
2015	**0->10**	**11->20**	**21->30**	**31->40**	**41->50**	**51->60**	**61->70**	**over 70**	**total**
mild	51	189	335	237	188	141	87	45	1273
serious	15	63	158	98	107	87	64	42	634
total	66	252	493	335	295	228	151	87	1907
2016	**0->10**	**11->20**	**21->30**	**31->40**	**41->50**	**51->60**	**61->70**	**over 70**	**total**
mild	63	183	329	226	191	137	93	39	1261
serious	11	53	143	97	113	88	53	43	601
total	74	236	472	323	304	225	146	82	1862

The most vulnerable age group registered following the traffic accidents that occurred within the period 2012-2016 in Dolj County ranges from 21 to 30 years. The result of our statistical analysis in relation to the distribution of the number of victims by age can be explained by the lack of experience of the drivers.

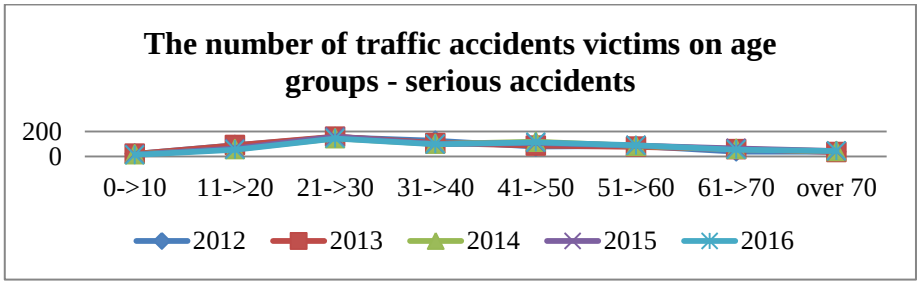

Figure 5. The age group of the victims caused by serious traffic accidents

Also, following the statistical analysis carried out we could note that the percentage of male victims was over 70% of the total number of injured persons, within the time interval under investigation. Thus, the results of our statistical analysis with regard to the victims' frequency rates in relation to the gender of the participants indicate the higher frequency of larger number of male drivers compared to a relatively low number of female drivers.

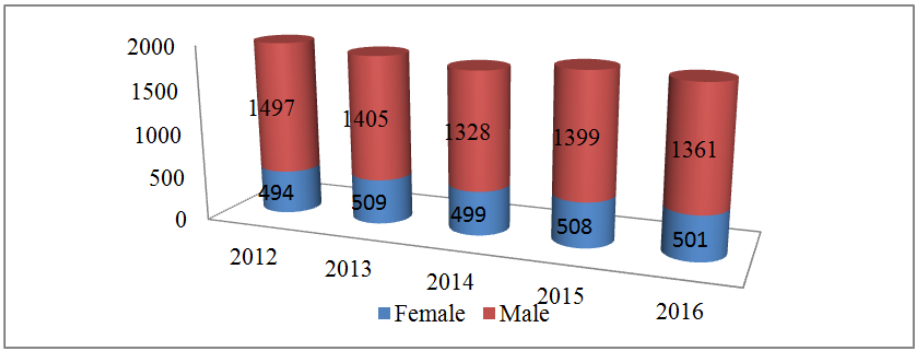

Figure 6. Traffic accident participants distributed on gender within 2012-2016

2.4. Type of collision

Furthermore, another important criterion that was considered in the classification of the traffic accidents was the type of collision. The most common types of collisions we have identified are: front-rear collisions, front collisions, lateral collisions, skidding, vehicle-pedestrian collisions, overturning, vehicle-obstacle collisions, and collision on straight-roads. Then, we sought to establish the frequency rate for each type of collision.

Table 4. Type of collision for the mild accidents occurred between 2012 and 2016

	Collision type	*2012*	*2013*	*2014*	*2015*	*2016*
Mild accidents	front - rear	68	61	39	65	57
	frontal	18	30	18	23	34
	lateral	152	132	127	129	133
	skidding	22	10	6	15	17
	pedestrian	216	218	221	193	201
	rollover	44	45	32	34	23
	obstacle	48	46	54	51	36
	snap	15	9	7	13	19
	others	30	26	35	25	23

As indicated by the diagram illustrated in Figure 7, we reach the conclusion that car-pedestrian collisions represent a considerable share of the total number of accidents occurring within the period 2012 - 2016 in Dolj County. The second place is occupied by lateral collisions, followed by front - rear collisions.

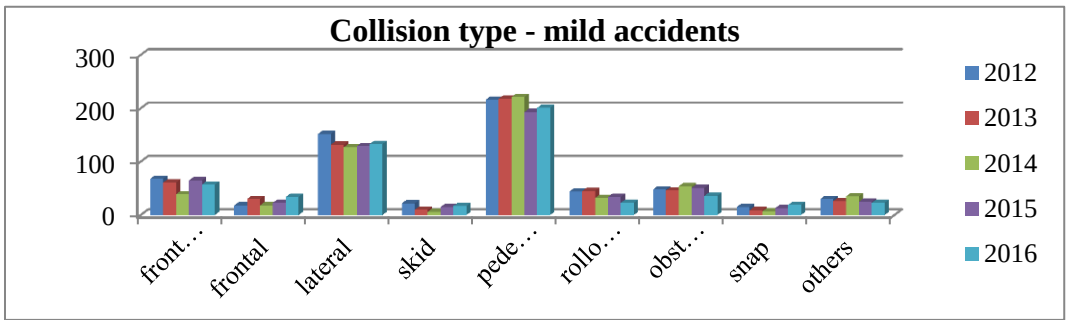

Figure 7. Type of collision for the mild accidents occurred between 2012 and 2016

Table 5. Type of collision for the serious accidents occurred in 2013

2013	**Type of collision**	**No. of accidents**	**Serious injuries and deaths**
SERIOUS	front - rear	17	16
	frontal	19	23
	lateral	41	51
	skidding	4	4
	pedestrian	115	117
	rollover	25	31
	off-road obstacles	35	43
	snap	3	3
	others	9	10

We can see that the distribution of severe injuries and deaths is directly proportional to the number and type of collision. The less frequent accidents are caused due to skidding, thus, generating a considerably reduced number of server injuries or deaths. An account of serious bodily injuries and deaths in 2013 indicates that most accidents, i.e. 115 cases, were due to car-pedestrian-type collisions. A high number of serious injuries occurred due to lateral-type collisions - 51, followed by collisions caused mainly by crushing against an obstacle outside the roadway - 43. For 2013, the distribution of serious injuries and deaths is similar to the one registered in 2012, though with some variations.

Thus, in 2013 the lowest number of deaths and serious injuries occurred in the case of collisions caused due snapping and skidding. For 2014, the distribution of the number of serious injuries and deaths among car-pedestrian-type collisions, i.e. 119, is maintained. This time, however, the second place is occupied by collisions caused mainly due to crushes against off-road obstacles - 48, followed by injuries and deaths following frontal collisions - 31. In 2015 there were registered 122 serious injuries and deaths due to car-pedestrian collisions, 45 collision injuries occurred due to vehicles crushing against off-road obstacles and 41 collisions due to lateral collisions. For the year 2016, there were 113 serious injuries and deaths due to car-pedestrian collisions. The second place, in terms of injury number, with 45 cases, is occupied by collisions following vehicles overturning, and, 38 cases of serious injuries and deaths were the result of lateral collisions.

Aiming to provide a highly reliable comparative analysis, we input in the diagram illustrated in figure 8 additional data with regard to the type of collision, the number of serious injuries and the deaths according to the type of collision for the entire period of time investigated, i.e. the period 2012-2016.

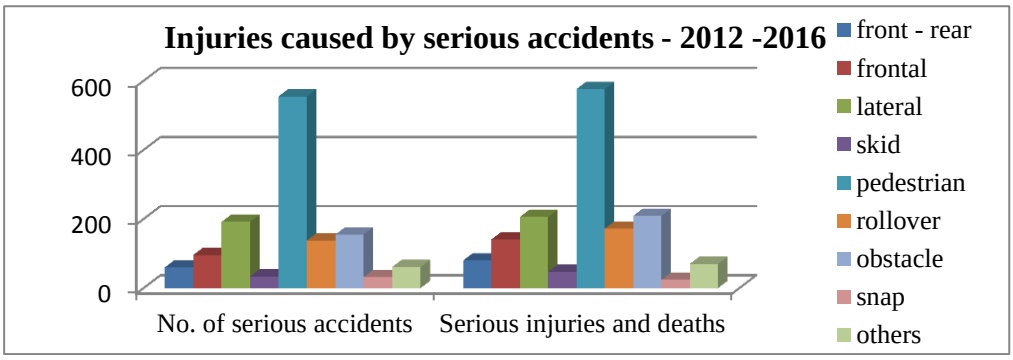

Figure 8. Time of collision and serious injuries produced during 2012-2016

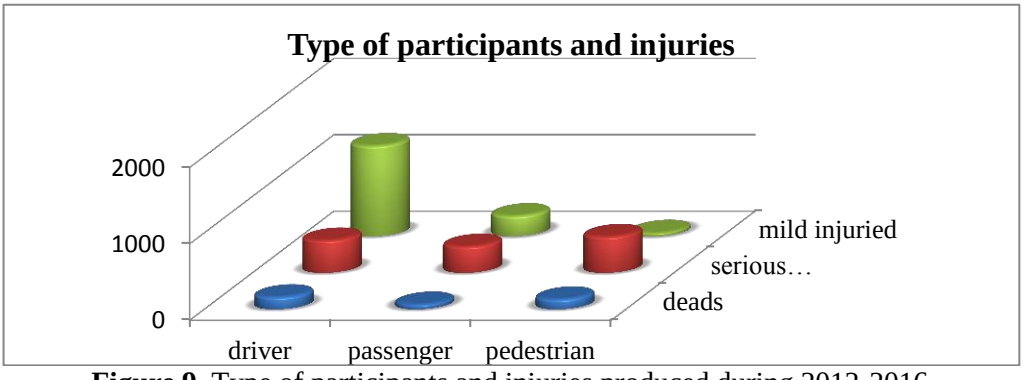

Figure 9. Type of participants and injuries produced during 2012-2016

The rate indicating the most frequently mild injuries, i.e. 1187 cases, as well as the highest number of deaths (160), within the time period under investigation, was recorded among vehicle drivers, while the most serious injuries occurred among pedestrians, i.e. 473 cases of serious injuries.

4. Results

Embarking upon the analysis of traffic accident incidence we carried out a statistical analysis regarding the number, injury types and frequency rates of the traffic accidents occurred between 2012 and 2016, in Dolj County. According to our investigation, we highlight the following main conclusions:

- ✓during the period analysed, i.e. 2012-2016, we registered an average of more than 800 accidents per year, of which approximately 260 accidents had serious consequences;
- ✓most traffic accidents occur, especially, in localities (highest rates), on straight roads, with no bumps;
- ✓a survey concerning serious injuries and deaths registered indicates that most accidents occurred due to vehicle-pedestrian-type collisions;
- ✓an average of more than 90% of road accidents within a year occur under normal weather conditions;
- ✓more than 1100 victims registered annually are drivers;
- ✓the most vulnerable age group involved in mild traffic accidents, registered between 2012-2016 in Dolj County, ranges from 21 to 30 years;
- ✓the victims rate according to the participants gender indicates a percentage of over 70% among male participants of the total number of injured persons

5. Conclusions

Identifying and assessing the factors that contribute to traffic accident occurrence is of particular importance in drafting and implementing effective measures to increase road safety. Based on the statistical analysis carried out within Dolj County, we can further determine the areas prone to increased accident-risks, and, also, we can identify and feature those categories of drivers that exhibit higher risks to traffic accidents.

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