Risk Assessment of Traffic Accidents Involving Young Adult Drivers by Identification of Subjective and Objective Factors

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ABSTRACT

Young drivers represent the most vulnerable age group at risk of participating in traffic accidents. In order to reduce the occurrence of traffic accidents involving young drivers, various models for assessing the risk of accidents have been studied. Inexperience, lack of driving skills and risky behaviour in traffic are the main characteristics of traffic accidents involving young adult drivers. On the contrary, traffic accidents involving older adult drivers are characterised by reduced visual and cognitive stimuli and reduced mobility. Based on the data about traffic accidents from the available databases relevant for road traffic safety in the Republic of Kosovo over a four-year period, the road characteristics that caused the majority of traffic accidents involving young adult drivers and the subjective and objective factors that affected the occurrence of traffic accidents the most have been defined. To conclude the research, a correlation has been defined between objective and subjective factors that increase the risk of traffic accidents, as well as the frequency of single safety factors (human, vehicle, road and environment) in traffic accidents involving young adult drivers.

KEYWORDS

traffic safety; traffic accidents; young adult drivers; risk assessment.

1. INTRODUCTION

The safety management system represents an interdisciplinary and comprehensive model for reducing the risk of traffic accidents. The accident risk assessment methods require long-term measurements and analysis of various factors in order to define the strategies and measures that will lead to increased traffic safety.

Driving experience, as well as drivers' physical and mental characteristics, greatly affect the so-called levels of individual risk in traffic. Knowledge of the causes and traffic accident risk assessment contribute significantly to increasing road safety [1]. Vehicle management skills are related to recognising risk in different traffic situations.

The notion of traffic accident is associated exclusively with the negative consequences that are manifested as a result or outcome of a traffic accident. In this sense we distinguish a traffic accident with material damage, a traffic accident with slightly or severely injured persons and a traffic accident with fatalities.

In order to improve road safety, it is necessary to study and identify the main causes of accidents, and one of the key sources of such information are data from police reports made during or after accident investigations.

Given that traffic mortality is recognised as one of the five main societal problems, all state institutions, from ministries in charge of citizens' safety, road management companies to educational institutions, are involved in traffic accident research. The aim of this paper is to use the research conducted on the involvement of young adult drivers in traffic accidents to contribute to the development of strategies and measures that will help in reducing the number of traffic accidents and/or mitigating their consequences.

The most common circumstances leading to accidents are excessive speed, incorrect assessment of traffic situation, performance of improper actions, as well as the psychophysical condition of the driver [2]. This indicates the importance of studying the nature of risky driving behaviour in order to take appropriate measures to increase traffic safety [3]. Although investigating the cause of a traffic accident is a complex process, it may be generally concluded that it primarily depends on driver's characteristics. The level of skill, inexperience and risky behaviour in traffic [4] have been recognised as some of the causes of traffic accidents involving young drivers in comparison to traffic accidents involving other groups of drivers. Police reports and investigations also indicate speeding, recklessness/reckless driving, violation of traffic rules and presence of illicit drugs and alcohol in drivers' blood in traffic accidents with young drivers [5–7]. Furthermore, research has shown, and empirical facts confirm, that young male drivers are more likely than female drivers to take risks such as driving at a speed inappropriate to road conditions and driving under the influence of drugs and alcohol [8]. Unlike young adult drivers, traffic accidents involving older adult drivers more often include driver errors at intersections and when turning, as well as missing the right of way, disregard of traffic signs and lights and mistakes when changing lanes [9, 10]. Such errors by older drivers occur as a consequence of declining visual and cognitive abilities and the use of various medicines with consequent side-effects [11].

Apart from drivers' characteristics, the vehicle and road environment can also affect the occurrence of traffic accidents. Changing a vehicle has a major impact on traffic safety. Some studies have shown that drivers' knowledge and practical driver training can improve traffic safety when changing vehicles. Based on the results, it can be concluded that there are two significant factors: the vehicle and the driver, who needs to be trained before starting to drive a new vehicle. When changing the vehicle brand and type within a company, it is necessary to conduct systemic training of drivers which would include theoretical and practical parts and involve at least braking, driver distraction, and active and passive vehicle safety [12].

The risk of accidents involving young adult drivers is particularly high if a large proportion of truck traffic is present on the road. However, it should be noted that the risk of accidents involving trucks is borne not only by truck drivers but also by other road users (especially car drivers) regarding the unique truck performance limitations related to stopping distance, blind spots and manoeuvrability when turning, and all of them have to react in an appropriate way when encountering trucks in traffic [13]. Research shows that in Australia, in 2019, there were 188 people killed in 173 traffic accidents involving trucks, and this number represents an increase of 27.2% compared to 2018. Traffic accidents involving trucks are 2.6 times more likely to result in fatalities, and car passengers are 10 times more likely to suffer serious injuries or deaths than truck passengers [14–16]. In statistical surveys of traffic accidents involving passenger cars and trucks, 78% of deaths and 76% of injuries pertained to car passengers [17]. A detailed analysis of traffic accidents with fatalities in the United States involving trucks and passenger cars found that 67% of such traffic accidents can be attributed to unsafe behaviour of passenger car drivers, the most common of which are the transition of cars to the traffic lane with trucks (19.9%), disregard of the right of way (14.4%), speeding (14.1%) and driver negligence (8.7%) [18]. Surveys show an extremely high proportion of young drivers in the statistics of traffic accidents in Australia (around 19%), especially in the period after obtaining a temporary driving licence where the driver is unsupervised. Considering the fact that young male drivers (under the age of 25) tend to engage in riskier driving behaviour than young female drivers, they are three times more likely to die in a traffic accident than female drivers [19, 20].

Many studies have shown that driver interference, and especially the use of mobile phones while driving, increases the risk of traffic accident [21, 22]. This type of distraction, which includes reaching for various objects in the vehicle, eating and looking at objects along the road, applies not only to young novice drivers but rather also to drivers with a longer driving experience.

2. FACTORS AFFECTING RISK IN ROAD TRAFFIC

Risk is associated with hazards, i.e. the existence of objective and subjective factors in the transport system that can lead to accidents. The elements of road safety are traffic safety management and risk assessment. Traffic safety management consists of a set of measures for prediction and prevention of traffic accidents. Traffic safety risk is defined as a product of combined measures of the probability of a traffic accident and the impact of traffic safety factors.

In professional literature, objective risk is defined as a measurable probability of a traffic accident or concrete consequences, while subjective risk is the assessed risk by the driver through the perception of the road environment. Based on this, these situations are dangerous when subjective risk is lower than the objective one, since the drivers adapt their behaviour according to the subjective, and not according to the objective risk.

The risk of a traffic accident is caused by subjective and objective factors. The subjective factors are: physiological, psychological, social etc., and they have an impact in identification and assessment of risks and hazards of the actual traffic situation on the road. The objective factors depend on the actual adverse events on the observed road or its segment. Identifying and analysing subjective and objective causes that increase the risk of traffic accident is an important tool for detecting hazards while driving and assessing the risk of accidents. The risk of accidents increases if the analysis of factors (subjective or objective) includes young adult drivers. The problem arises when assessing potentially risky situations in traffic, where young adult drivers notice fewer road hazards, spot them more slowly and underestimate their level of danger.

While driving, the driver should be ready to detect immediate road hazards, assess risks and accept risks (understand psychological processes from observing traffic situations, making decisions, reacting and knowing the limits of their capabilities), i.e. choosing actions aimed at avoiding an accident (braking, moving the vehicle etc.).

Risk factors for all drivers include: inexperience; distraction while driving, including the use of mobile phones and messaging; speeding; risky driving and drunk driving; young male drivers, especially those with male passengers, tending to be involved in more traffic accidents than young girls; night driving and social norms [23–28].

The attitude of the driver population is often mentioned as the most important factor for road traffic accidents. However, it is also the most difficult one to measure [29].

A positive factor for young drivers is the presence of an adult passenger while driving, where research shows that traffic accident rates involving young drivers were 75% lower when an adult was in the vehicle [25].

Objective factors that include the vehicle and the road, i.e. the road environment, cause 5 to 20% of traffic accidents. Vehicle deficiencies are the cause of an average of 3 to 5% of road accidents, and studies have found that young adult drivers involved in traffic accidents tend to drive older vehicles [30].

The environment includes climatic conditions, stones on the road, oil and mud on the pavement, landslides, road collapses and other elements. Climatic conditions have a major impact on accident rates for all drivers, although these factors have been found to have a disproportionate impact on young adult drivers. Research shows that young adult drivers driving above the speed limit in adverse weather conditions are most often the victims of accidents [31].

The level of urbanisation is another factor influencing traffic accident rates. A study in Australia looked at different risks of accidents in young drivers who lived in urban, regional and rural areas. According to [32], driving patterns that affect the risks of accidents relate to the length of time spent on the road, as well as the time of day, day in the week etc.

3. SAFETY OF YOUNG DRIVERS

According to a European Commission report [33], traffic accidents in the developed countries are the main cause of death for young people aged 15 to 24. The mortality rate of drivers aged 15 to 24 is twice as high compared to experienced drivers. The accidents involving young drivers were often caused by loss of control or speeding and occurred at night. There are different studies that encourage education, training and development of technology, aimed at improving the safety of young drivers. Most driving errors are caused by bad habits in the way drivers use their eyes [34] to IPDE (Identify, Predict, Decide, and Execute):

I   – Identify – identifying potential dangers in a potential situation while driving;
P   – Predict – predicting where possible conflicts may occur;
D   – Decide – determining which action to undertake, when and where to undertake it;
E   – Execute – driving a car to avoid conflicts.

The specific characteristics of young drivers due to which they are exposed to high risk of accidents include overconfidence, poor risk assessment, underestimation of traffic risk, speeding, drunk driving, not using a seat belt, using a mobile phone while driving and other risk factors [35]. From the above, the most significant traffic accident factors involving young drivers are [33]:

– Inexperience – young people are more likely to underestimate or fail to identify dangerous situations than older drivers. The young are more likely to make critical mistakes in decision-making that lead to tragic consequences of traffic accidents.

– Safety distance – young people are more likely to drive at higher speed and at smaller safety distance than older drivers.

– Safety belt use – compared to other age groups, young people and adults often have the lowest rate of seat belt use. In 2017, only 58.8% of high school students always fastened their seat belts while riding as passengers.

– Alcohol consumption – any amount of alcohol in young drivers increases the risk of traffic accidents compared to older drivers.

Driving under the influence of alcohol and positive for drugs suggests the significance of maintaining the intensity of impaired-driving programs, which are primarily oriented to apprehending drinking drivers because contribution of alcohol to crash risk is much larger than that by other drugs [36]. According to the research in [37–40], the combination of alcohol consumption and the use of psychoactive substances is associated with an increased risk of fatal road accidents.

Traffic safety culture is defined as a variable that can explain risky driver behaviour [24]. It is a factor that supports the acceptance of existing traffic safety policies and programs [25], a variable for defining high-risk driver groups and a new paradigm to support Vision Zero for road safety. The research has been designed around the definition of safety culture as a "social norm, belief and value".

4. DISCUSSION AND RESULTS

In order to identify the subjective and objective factors that increase the risk of traffic accidents, an analysis of the types and causes of accidents with fatalities has been conducted with special emphasis on traffic accidents involving young adult drivers aged between 16 and 24 years.

The survey methodology was based on an analysis of data on drivers killed in traffic accidents in the Republic of Kosovo between 2014 and 2018 and on an analysis of on-site surveys carried out in 2019, where 371 drivers under 24 completed a questionnaire survey and made known their views on traffic accidents.

The analysis of the data collected was carried out using statistical methods and observation methods, thus establishing a link between the risk assessment of driving, the attitudes of drivers, the training elements of young adult drivers with accident risks and identified some subjective and objective factors affecting accident risk assessment. The non-parametric hi-square test methods were used to check the likelihood of accidental occurrence of a difference between the values of the survey conducted, i.e. the observed frequencies and the theoretical frequencies. A correlation between identified subjective and objective factors from all traffic accidents and accident accidents in young adult drivers was examined, and the results were found to be statistically significant. The results obtained are shown using correlation coefficients and are analysed and tabulated below.

4.1 Correlation: traffic accidents – basic characteristics of young adult drivers

In order to determine the correlation between the basic safety factors which include humans, vehicles, road and environment and the identified subjective and objective factors of young adult drivers, a correlation analysis was conducted. A statistical analysis was performed between the input variables defined as gender, age and driving experience, and an output fixed variable, which was defined as traffic accident. The results are shown in *Table 1*.

Table 1 – Results of the correlation test of the basic characteristics of young adult drivers

	Traffic accident			Gender			Age			Driving experience		
	Pearson correlation	Sig. (2-tailed)	N	Pearson correlation	Sig. (2-tailed)	N	Pearson correlation	Sig. (2-tailed)	N	Pearson correlation	Sig. (2-tailed)	N
Traffic accident	1		371	-.220**	.000	371	.251**	.000	371	-.244**	.000	371
Gender	-.220**	.000	371	1		371	.220**	.000	371	.335**	.000	371
Age	.251**	.000	371	.220**	.000	371	1		371	.724**	.000	371
Driving experience	-.244**	.000	371	.335**	.000	371	.724**	.000	371	1		371

** Correlation is significant at the 0.01 level (2-tailed).

Table 1 shows that there is a statistical significance of the correlation coefficients between the variables. The most pronounced correlation between the traffic accident variable and the basic characteristics, i.e. young adult driver variables, pertains to age (r`=.251, p <.000), whereas in relation to driving experience (r`=.-244, p<.000) and gender (r`=.-220, p<.000) the correlation is negative, which means that with increasing age, i.e. longer driving experience, the probability of traffic accidents decreases.

4.2 Correlation: traffic accidents – driving in different traffic conditions and circumstances

The results of the correlation analysis between input variables defined as speed, driving in dry conditions, road surface condition, driving out of town, driving on straight road sections, driving on weekends, driving at night, and dependent output fixed variables – traffic accident, are shown in *Table 2*.

Table 2 – Results of correlation test traffic accidents – driving in various conditions

		Traffic accident	Speed	Driving in dry conditions	Driving out of town	Driving on weekends	Driving on straight road sections	Driving at night
Traffic accident	Pearson correlation	1	.744**	.703**	.283**	.320**	.659**	.412**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000
	N	371	371	371	371	371	371	371
Speed	Pearson correlation	.744**	1	.598**	.399**	.456**	.565**	.547**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000
	N	371	371	371	371	371	371	371
Driving in dry conditions	Pearson correlation	.703**	.598**	1	.215**	.197**	.982**	.269**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000
	N	371	371	371	371	371	371	371
Driving out of town	Pearson correlation	.283**	.399**	.215**	1	.681**	.225**	.693**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000
	N	371	371	371	371	371	371	371
Driving on weekends	Pearson correlation	.320**	.456**	.197**	.681**	1	.200**	.895**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000
	N	371	371	371	371	371	371	371
Driving on straight road sections	Pearson Correlation	.659**	.565**	.982**	.225**	.200**	1	.267**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000
	N	371	371	371	371	371	371	371
Driving at night	Pearson correlation	.412**	.547**	.269**	.693**	.895**	.267**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
	N	371	371	371	371	371	371	371

** Correlation is significant at the 0.01 level (2-tailed).

The table shows that traffic accidents have the highest correlation value with the input variable of speed (r`=.744 p<.000), whereas the lowest correlation values are with the variable of driving out of town (r`=.283 p<.000).

There are no negative correlations between input variables.

Increasing speed and underestimating risk (subjective factors) when driving in dry conditions and road surface condition (objective factor – road) on a straight road segment (ideal conditions for fast driving) as well as driving at night (objective factor – environment) increase the probability of traffic accidents.

It is concluded that there is a connection between the main traffic safety factors on the roads, human-road-environment and the subjective ones (underestimating risk in traffic) and objective causes of accidents (straight road section, driving in dry conditions and road surface condition, environment – driving on weekends, driving at night).

4.3 Correlation: traffic accidents – driving technique – vehicle actions on the road

The results of the correlation analysis between input variables (driving technique, manoeuvring while driving, merging into traffic and overtaking) and the dependent outlet fixed variable – traffic accident, are presented in *Table 3*.

Tables 3 and 4 show that traffic accidents have the highest correlation value with the input variable overtaking (r`=.689, p<.000), whereas the lowest correlations are with the variable of lane changing (r`=.091, p<.025). The negative correlation between the variable traffic accident and the input variable of mileage (r`=-.094, p<.070) explains that with the increase of travelled mileage, considering here primarily the gained driving experience, the probability of traffic accident decreases.

Underestimation of risk (subjective cause), which in most cases causes mistakes among young novice drivers, at the same time increases the probability of traffic accidents.

Table 3 – Results of correlation test traffic accident – vehicle actions on the road

		Traffic accident	Travelled mileage	Driving technique	Manoeuvring while driving
Traffic accident	Pearson correlation	1	-.094	.301**	.331**
	Sig. (2-tailed)		.070	.000	.000
	N	371	371	371	371
Travelled mileage	Pearson correlation	-.094	1	-.019	.304**
	Sig. (2-tailed)	.070		.712	.000
	N	371	371	371	371
Driving technique	Pearson correlation	.301**	-.019	1	.268**
	Sig. (2-tailed)	.000	.712		.000
	N	371	371	371	371
Manoeuvring while driving	Pearson correlation	.331**	.304**	.268**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	371	371	371	371
Merging into traffic	Pearson correlation	.091	.380**	.374**	.490**
	Sig. (2-tailed)	.078	.000	.000	.000
	N	371	371	371	371
Lane changing	Pearson correlation	.116*	.309**	.312**	.187**
	Sig. (2-tailed)	.025	.000	.000	.000
	N	371	371	371	371
Overtaking	Pearson correlation	.689**	-.113*	.165**	.227**
	Sig. (2-tailed)	.000	.029	.001	.000
	N	371	371	371	371

Table 4 – Results of correlation test traffic accident – vehicle actions on the road

		Merging into traffic	Lane changing	Overtaking
Traffic accident	Pearson correlation	.091	.116*	.689**
	Sig. (2-tailed)	.078	.025	.000
	N	371	371	371
Travelled mileage	Pearson correlation	.380**	.309**	-.113*
	Sig. (2-tailed)	.000	.000	.029
	N	371	371	371
Driving technique	Pearson correlation	.374**	.312**	.165**
	Sig. (2-tailed)	.000	.000	.001
	N	371	371	371
Manoeuvring while driving	Pearson correlation	.490**	.187**	.227**
	Sig. (2-tailed)	.000	.000	.000
	N	371	371	371
Merging into traffic	Pearson correlation	1	.180**	-.012
	Sig. (2-tailed)		.000	.824
	N	371	371	371
Lane changing	Pearson correlation	.180**	1	.244**
	Sig. (2-tailed)	.000		.000
	N	371	371	371
Overtaking	Pearson correlation	-.012	.244**	1
	Sig. (2-tailed)	.824	.000	
	N	371	371	371

Increases in the values of errors (subjective cause) during vehicle manoeuvring in traffic (turning, merging, lane changing, loss of vehicle control) and overtaking as the major cause of traffic accidents, increase the risk of probability of traffic accidents. These errors are mainly due to the fact that young adult drivers have not yet sufficiently mastered the driving technique during their practical training at driving schools.

There are correlations between the basic traffic safety factors on the roads: human environment and subjective and objective causes of traffic accidents that have been identified with a special emphasis on overestimating the driving technique and on errors during vehicle manoeuvring.

5. CONCLUSION

Young drivers represent one of the specific risk groups of traffic participant categories. Scientific research and statistical analyses show that traffic accidents are one of the leading factors of injuries and deaths among young people under the age of 24. The rate of traffic accidents in young drivers is the highest during the first year upon obtaining a driver's licence, and then decreases gradually over a period of about two years on average. Therefore, many countries, including the Republic of Kosovo, have introduced in their road safety laws restrictions and bans for drivers over a period of two years from the date of issuance of driver's licence.

Skills are necessary for adequate risk identification in traffic, and young drivers often lack the necessary perception of danger and risk assessment on the road. Also, young drivers are more represented in risky situations, such as speeding and driving at insufficient distance. The most significant elements of risky behaviour by young drivers relate to driving under the influence of alcohol and use of mobile phones while driving (talking or writing/reading messages).

By identifying the subjective and objective factors and conducting the correlation analysis of the basic road traffic safety factors, which include humans-vehicle-road-environment, and subjective and objective causal factors that influence the occurrence of traffic accidents with fatalities the most, independent input variables were determined in correlation with dependent fixed output variables (traffic accidents).

Based on the conducted research, it is possible to develop a risk assessment model that would in the future provide a significant contribution in defining the recommendations and strategies to increase road safety for young adult drivers. Speaking of young adult drivers, it was found that the most effective strategies in preventing traffic accidents are incentive and reward programs, provided they are thoroughly planned in advance and carried out systematically. Certainly, one should bear in mind that there are also certain limitations in the general application of such measures, in relation to various social, economic, political and administrative differences between countries.

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Procjene rizika nastanka prometnih nesreća mladih vozača identifikacijom subjektivnih i objektivnih čimbenika

Sažetak

Mladi vozači predstavljaju najugroženiju dobnu skupinu izloženosti riziku sudjelovanja u prometnim nesrećama. U cilju smanjenja nastanka prometnih nesreća u kojima sudjeluju mladi vozači izučeni su različiti modeli za procjenu rizika nastanka prometnih nesreća. Neiskustvo, nedostatak vozačkih vještina i rizično ponašanje u prometu glavne su karakteristike prometnih nesreća u kojima sudjeluju mladi vozači. Nasuprot tome, prometne nesreće sa starijim vozačima karakteriziraju smanjeni vizualni i kognitivni podražaji te smanjena pokretljivost. Na temelju podataka o prometnim nesrećama iz dostupnih baza podataka relevantnih za sigurnost cestovnog prometa u Republici Kosovu u četverogodišnjem razdoblju definirana su obilježja cesta koja su uzrokovala najveći broj prometnih nesreća u kojima su sudjelovali mladi vozači te subjektivni i objektivni čimbenici koji su u najvećem postotku imali utjecaj na nastanak prometnih nesreća. Kao zaključak provedenog istraživanja definirana je korelacija između objektivnih i subjektivnih čimbenika koji povećavaju rizik nastanka prometnih nesreća te učestalosti pojedinih čimbenika sigurnosti (čovjek, vozilo, cesta i okolina) u prometnim nesrećama u kojima su sudjelovali mladi vozači.

Ključne riječi

sigurnost prometa; prometne nesreće; mladi vozači; procjena rizika.