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THE IMPACT OF SELECTED INDIVIDUAL AND EXTERNAL FACTORS ON THE OCCURRENCE OF SEVERE INJURIES: CASE STUDY OF SLOVENIA

ABSTRACT

The purpose of this paper is to contribute to the understanding of the importance of different determinants and their impact on the severity of injuries of individuals in road traffic accidents, so that measures that are supposed to prevent or reduce severe injury consequences can be developed. In this paper three research models have been built. Model I was built to study the impact of demographic factors (gender and age) on the individual's likelihood to wear a seat-belt while Model II to study the impact of demographic factors (gender and age) and the impact of wearing a seat belt on the likelihood that fatal injuries of individuals in road traffic accidents occur. Model III was formed to study the impact of several environmental factors on the likelihood that the accident involves severe or fatal injuries of road traffic accident participants. Altogether our study revealed that middle-aged individuals (over 25 years and up to 65 years old) are less likely to wear a seat belt and at the same time more likely to suffer fatal injuries in road traffic accidents. This is the result that implies that the targeted policy measures to the population between 25 and 65 years of age are needed to reduce the fatal injuries occurrence in Slovenia.

KEY WORDS

road traffic accidents; seat belt; behavioural determinants; binomial logistic regression;

1. INTRODUCTION

Injuries that are caused by road traffic accidents represent high burden to the health system of a country and are estimated to account for 1-5% of GDP [1-3]. Costs that are associated with these injuries include medical costs, insurance and similar costs, as well as costs associated with the economic effects on family, society and employers. For the European Union it is estimated, that the total costs amount to approximately 2% of annual EU GDP [2]. In Slovenia, in 2010 the estimated GDP lost due to road traffic crashes was 1% [4]. World Health Organization reports that the road traffic injuries are the eighth leading cause of death globally and the leading cause of death for young people aged 15-29; it is alarming that by 2030 road traffic deaths will have become the fifth leading cause of death if the current trends continue [4]. Although the stage of development of a country plays an important role (especially in middle-income countries with the increasing motorization and infrastructure problems) this problem must not be overlooked in any society.

According to the latest data by Eurostat, in 2013 less than 26,000 people died on the roads in the European Union. In comparison with the year 2012, the number of road deaths in the EU in 2013 decreased by 1% [22]. The Global status report on road safety for 2013, presenting the information on road safety from 182 countries, indicates that the total number of road traffic deaths worldwide still remains unacceptably high at 1.24 million per year [23].

Although the Slovenian death rate has been decreasing on the average by 7.07% per year in the last twelve years the deaths due to road traffic accidents are still above the European average.

According to the Ministry of the Interior [21] there were 2,884 individuals severely injured (including death) in road traffic accidents in Slovenia in the first six months of 2014, which is the lowest in comparison with the first six months in previous years, since 2003. *Figure 1* shows that in the last twelve years the number was almost halved from 12,105 in year 2003 to 6,207 in year 2013 (with 2,884 injured individuals in the first half of 2014).

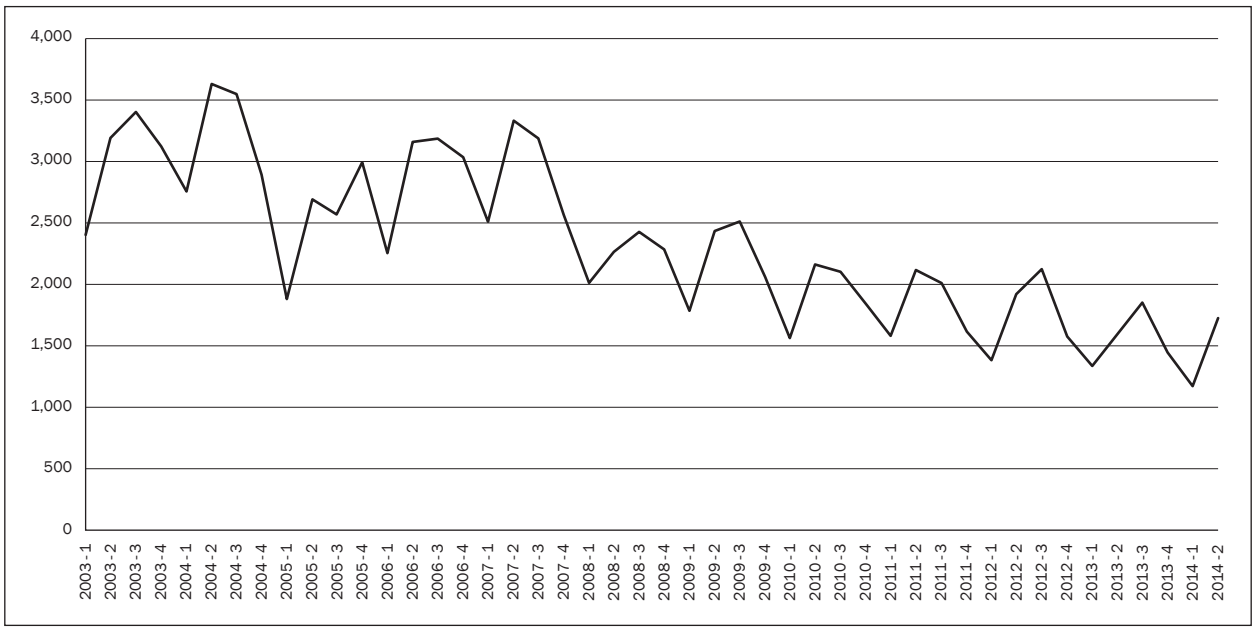

Figure 1 – Number of individuals with severe/death injuries, involved in road traffic accidents, in Slovenia, from 2003 to 2014

Different aspects of injuries that occur in road traffic accidents are often studied in literature. While some studies refer to all the types of road participants others focus on specific ones [5]. Several factors that proved to be significantly influential for the prevalence of road traffic accidents were determined; socio-economic, demographic and behavioural determinants as well as environmental determinants and their effect on the severity of injuries were studied [5-8]. In this paper the demographic (gender and age), behavioural (attitude to wear the seat belt) and several environmental determinants of road traffic accident injuries are studied.

The purpose of this paper is to contribute to the understanding of the importance of different determinants and their impact on the severity of injuries of individuals, involved in road traffic accidents, so that measures that are supposed to prevent or reduce severe injury consequences can be developed.

The aim of this study is threefold. Firstly, Model I was built to study the impact of demographic factors (gender and age) on the individual's likelihood to wear the seat-belt. Secondly, Model II was built to study the impact of demographic factors (gender and age) and the impact of wearing a seat belt on the likelihood that fatal injuries of individuals in road traffic accidents will occur. These two models are tested using the Slovenian Ministry of the Interior database A that records and monitors the characteristics of participants in road traffic accidents (statistical unit in database A is an individual). Thirdly, Model III was formed to study the impact of several environmental factors on the likelihood that the accident involved severe or fatal injuries of traffic accident participants. Model III was tested using the Slovenian Ministry of the Interior database B that records and monitors the characteristics of road traffic accidents (statistical unit in database B is a road traffic accident).

The paper is structured as follows: in the next section, after the literature review, the research models and research hypotheses are presented. After the description of the database, variables and methodology used, the research results are presented. The discussion includes some conclusions and recommendations.

2. LITERATURE REVIEW AND RESEARCH MODEL

The determinants of accident rates and severity of injuries in road traffic accidents have been the focus of several previous studies. In their investigations the researchers usually study demographic, behavioural as well as environmental and other factors.

The demographic factors that have proven to have a significant effect on the likelihood of accidents as well as on the severity of injuries are especially gender and age [8, 11, 12]. The World Health Organization reports that in 53 countries of the WHO European region, road crashes injure more than 2.4 million people each year and that this problem is especially severe for the age group of 15-29 years, for whom the death traffic injuries represent the leading cause of death [3]; at the same time males are more likely to die than females from road traffic injuries – they account for 75% of road traffic deaths. Al-Balbissi [8] found that gender differences in accident rates were significant only in normal driving conditions, while in more complicated weather or road surface conditions this was not the case. It was also proved, that age groups over 50 had lower accident rates for both genders. Some research results are partly contradictory to these findings. Mc-

Cartt et al. [13] report that the weight of evidence is that age and experience have important, independent effects on crash risk, even after differences in driving mileage are accounted for. But nevertheless, they found that teenage drivers had significantly higher crash rates than older drivers, particularly drivers older than 25 years.

Not only differences in accident rates, but also gender and age differences that contribute to influential factors, especially behavioural ones, causing differences in accident rates as well as in the severity of injuries from road traffic accidents are the focus of several studies. Several studies revealed that the two genders are significantly different regarding attitudes and behaviours. More responsible attitude was found among females (observing the yield sign, adhering to stop sign, proper overtaking, using appropriate traffic lane etc.) in comparison to males [8, 12]. In their research Tuokko et al., [7] studied the relations among driving-related psychosocial measures (e.g., driving comfort, attitudes toward driving) and measures of self-reported health in the context of driver's age and gender. Older men reported significantly higher levels of driving comfort than older women. When analyses including health were controlled for age and gender, significant relations with health status were evident for most of the psychosocial measures. Responsible attitudes in traffic activities include also the usage of seat belt. Besides, the vast literature reporting gender differences in risk perception, as well as in risk behaviour, some research results report also that women are in general significantly more likely to wear a seat belt than men [14].

Legislation on wearing seat belts in the European Union defines that wearing seatbelts has been compulsory in all vehicles throughout the EU, since 2006. Although the seat belt law varies throughout Europe, most countries state that the use of seat belts is compulsory for occupants of all seats equipped with a seat belt, but there are many important exceptions. In Slovenia, mandatory wearing of seat belt is defined by the Law on rules about road traffic [20]; besides, all children must be in a safety seat which is suitable for their age. Children over 12 years of age can wear an adult seat belt. Children under 12 years of age may not travel in the front seat of a vehicle. Harper et al. [15] report that mandatory seat belt laws significantly increase reported seat belt use, especially among disadvantaged socioeconomic groups, but although women were in general more likely to always wear a seat belt, the gender difference was not significant.

It is therefore hypothesized that the legislation with high penalties for not wearing a seat belt in Slovenia may have important positive effect on individual's decision to fit the seat belt. This is why hypothesis H1 is formed. But on the other hand, gender and age differences may contribute to influential factors, especially behavioural, causing differences in the severity of injuries, which is included in hypothesis H2.

H1: Age and gender are not influential factors and have no significant effect on the individual's decision to wear a seat belt.

H2: Gender and age are important influential factors that have significant effect on the death injuries occurrence in road traffic accidents.

Wearing a seat belt is estimated to reduce the risk of death injury in road traffic accidents by 40-50%, which holds for front seats and between 25-75% for rear seat occupants [4]. Also, Eluru and Bhat [16] report that seat belt use is very likely to be the endogenous factor that affacts the severity of injuries. Hypothesis H3 was formed:

H3: Wearing a seat belt has significant effect on the death injuries occurrence in road traffic accidents.

The environmental (external) factors have significant impact on injury and even death at the road traffic accidents when more difficult driving conditions occur. Olmus and Erbas [17] report that severe injuries in road traffic accidents are two times as likely to occur during nighttime, in comparison with the holiday time. Controlling over the gender showed [8] that in difficult driving conditions (rainy or night conditions) female accident rate was significantly higher than male, but in extremely difficult conditions an extremely cautious driving by females was found, where the female accident rates dropped to zero (it is also probably due to the fact that females may not choose to drive at all). As already pointed out, some contradictory results were also found in literature [13]. In the model by Abdel-Aty et al. [18] it was also found that there are significant relationships and interactions between environmental factors, such as average daily traffic and roadway character, influencing traffic accident involvement.

Since the environmental factors that influence the driving conditions may have a significant impact on the severity of injuries, hypothesis H4 was formed:

H4: Environmental (external) conditions have significant effect on the severe or fatal injuries occurrence in road traffic accidents.

Research models of our research are presented by *Figures 2-4*. Three models have been built:

- Model I, to study the impact of demographic factors (gender and age) on the individual's likelihood to wear the seat-belt in the time of road traffic accidents, is presented in *Figure 2*.
- Model II, to study the impact of demographic factors (gender and age) and the impact of wearing the seat belt on the likelihood that fatal injuries of individuals in road traffic accidents occur, is presented in *Figure 3*.
- Model III, to study the impact of several environmental factors on the likelihood that the accident involved severe or fatal injuries of road traffic accident participants, is presented in *Figure 4*.

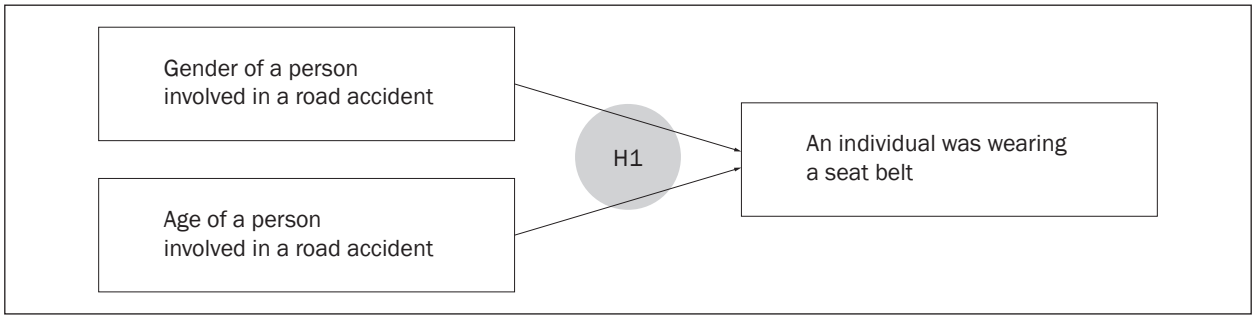

Figure 2 – Model I: the impact of gender and age on the individual's likelihood to wear the seat-belt

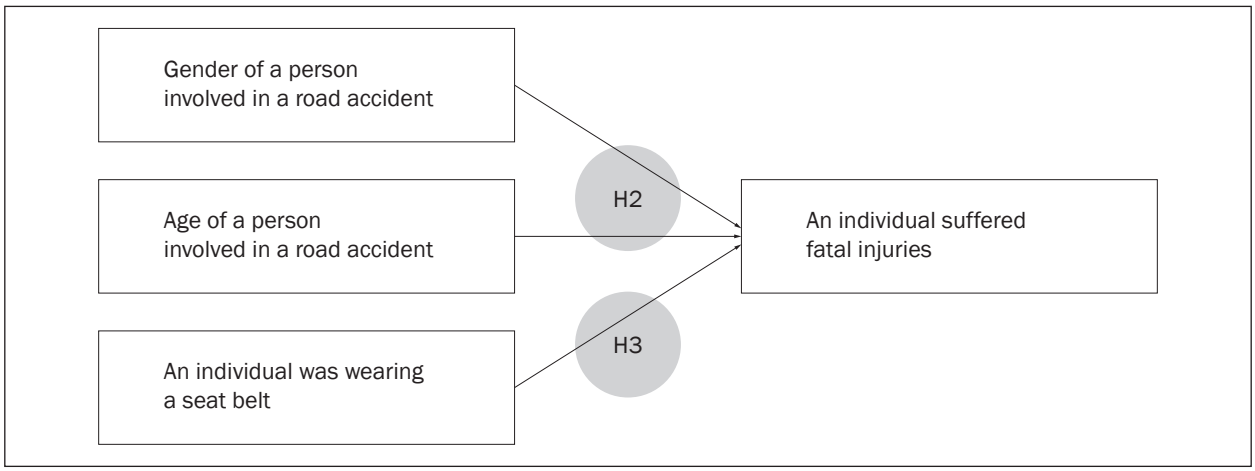

Figure 3 – Model II: the impact of gender and age and the impact of wearing the seat belt on the likelihood that the fatal injuries of individuals in road traffic accidents occur

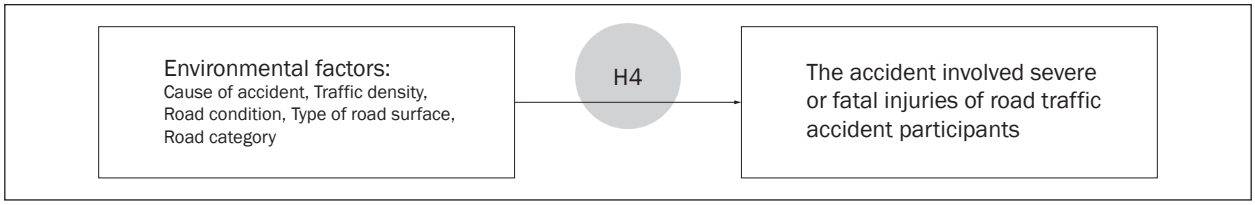

Figure 4 – Model III: the impact of several environmental factors on the likelihood that the accident involved severe or fatal injuries of road traffic accident participants

Detailed characteristics of databases and variables used are described in the next section.

3. METHODOLOGY

In Model I the dependent variable "an individual was wearing a seat belt at the time of a road traffic accident" was the dichotomous nominal variable with yes (0) and no (1) values. The predictor variables were variables describing demographic factors: "gender" (dichotomous variable, males were assigned value 0 and females value 1) and "age" (in years). Model I was used to test Hypothesis H1, since, as described, we wanted to know, how demographic determinants impact the risky behaviour, e.g. not wearing the seat belt. The model was tested with the binomial logistic regression. In Model II the dependent variable "an individual suffered fatal injuries" was the dichotomous nominal variable with yes (1) and no (0) values. The predictor variables were "an individual was wearing the seat belt" (to test H3) with "age" and" gender" included as control variables (to test H2). The model was tested with the binomial logistic regression. Two binomial logistic regressions were run; Model IIa including only predictor variable, Model IIb including the predictor variable and control variables.

To test the above Models I, IIa and IIb the first out of two available databases was utilized, which are collected and compiled by the Slovenian Ministry of the Interior; database A, that includes individuals who were involved in road traffic accidents as passengers or drivers of a passenger car in road traffic accidents in Slovenia in 2013, as parties responsible for the accident as well as other participants in accidents. All individuals

(statistical units) with missing data on age, gender, information about wearing the seat belt or information about the severity of injuries were omitted, thus resulting in N = 31,287 individuals in database A.

Table 1 – Database A structure – individuals who were involved in road traffic accidents as passengers or drivers of a passenger car in Slovenia in 2013

Characteristics	Frequency	Ratio (%)
Gender: male	20,277	64.8%
female	11,010	35.2%
Age (years):		
≥ 25	6,233	19.9%
26 – 35	7,817	25.0%
36 – 45	6,230	19.9%
46 – 55	5,123	16.4%
56 – 65	3,326	10.6%
< 65	2,558	8.2%
Severity of injuries:		
No injuries/minor injuries	30,956	98.9%
Severe injuries	273	0.9%
Fatal injuries	58	0.2%
Wearing the seat belt:		
Yes	25,055	80.1%
No	6,232	19.9%
Number of individuals in the database: N=	31,287	100%

Database of persons involved in a car accident in the year 2013 covers 29,589 individuals. The database comprises 64.8% male and 35.2% female persons. Most participants involved in road traffic accidents are aged between 26 and 35 years (25.0%) followed by persons between 36 and 45 years of age (19.9%) and persons who were up to 25 years old (19.9%). The smallest share of persons involved in a car accident are over 65 years old (8.2%), followed by persons from the age group between 46 and 55 years (16.4%) and persons between 56 and 65 (10.6%). Approximately 1% of individuals involved in road traffic accidents as drivers or passengers in a passenger car, suffered severe or fatal injuries (1.1%), while almost 20% of them did not wear the seat belt at the time of the accident (19.9%).

In Model III hypothesis H4 about the impact of "environmental/external conditions" on the likelihood that the accident involved severe or fatal injuries of road traffic accident participants was tested. The dependent variable "an accident involved severe or fatal injuries of road traffic accident participants" was the dichotomous nominal variable with yes (1) and no (0) values. "Environmental/external conditions" were all categorical variables, as described in *Table 2*.

To test Model III, the second database, database B from the year 2012 was utilized. The reason that data from different time periods were used is the quality of the data available on the website of Slovenian Ministry of the Interior. Namely, database B for 2013 was not arranged in a way that would enable the transcript of records into the file appropriate for processing and analysis.

Database B contains information on the characteristics of road traffic accidents (for all types of vehicles involved) in Slovenia in 2012. All road traffic accidents (statistical units) with missing data on the external/environmental conditions that represented explanatory variables in the model or with missing information regarding the involvement of participants with severe or fatal injuries in road traffic accident were omitted, thus resulting in N = 21,071 road traffic accidents in database B.

Table 2 – Database B structure – road traffic accidents regarding the occurrence of severe or fatal injuries of road traffic accident participants and data about the environmental/external characteristics on time and place of the accident, Slovenia, 2012

Environmental/external conditions	Variable categories	Frequency	Ratio (%)
Cause of accident	Unadaptable speed	3,514	83.3%
	Other causes	17,557	16.7%
Traffic density	Normal traffic density	18,242	86.6%
	Heavy/congestion	2,829	13.4%
Road conditions	Dry	15,458	73.4%
	Wet/slippery (snow covered, icy, muddy)	5,613	26.6%
Type of road surface	Smooth asphalt or concrete	7,758	36.8%
	Rough asphalt or concrete/ Uneven asphalt or concrete/ Macadam	13,313	63.2%
Road category	Regional/local road	19,305	91.6%
	Motorway	1,766	8.4 %
Severity of injuries	No or minor injuries	20,312	96.4%
	Severe or fatal injuries	759	3.6%
Number of road traffic accidents	N =	21,071	100%

Table 2 presents data about road traffic accidents regarding the occurrence of severe or fatal injuries of road traffic accident participants and data about the environmental/external characteristics of time and place of accident.

The binomial logistic regression [19] estimates the probability of an event happening, which in our case were: (i) "an individual was not wearing the seat belt at time of road traffic accident" (Model I); (ii) "an individual suffered severe or fatal injuries" (Model IIa, IIb) and (iii) "an accident involved severe or fatal injuries of road traffic accident participants" (Model III). Maximum likelihood estimations were used to estimate the coefficients of logistic regression function, which denote changes in the log odds of the dependent variable. The goodness of fit of the model was assessed by the Model χ^2-test, the rate of correct classifications and the Nagelkerke R^2. In order to test whether the inclusion of control variables led to statistically significant improvements of the model the Block χ^2-test was used. In order to test the significance of the regression coefficient the Wald test was used. The 0.05 (two-tailed) significance level was used.

4. RESEARCH RESULTS

Results for Model I are presented in *Table 3*. For each variable included, the maximum likelihood estimates (β), the significance of the estimates and the estimates of standard errors of estimated coefficients, the Wald Statistics and the odds ratio (Exp(β)) are reported.

From *Table 3* it can be seen that "gender" is not significantly related to the likelihood that an individual was wearing a seat belt ($p>0.05$). The effect of "age" on wearing a seat belt is significant for all age groups, except for the youngest age group (up to 25 years old). To show the effect of age on the log odds of the use of seat belt in comparison with the reference category (we decided that the reference category is an age group of individuals who are over 65 years old) the "indicator coding" was used. This coding in the logistic regression allows us to compare individuals in all age groups against those in the age group over 65 years old. For each age group the dummy variable was constructed. The significant positive coefficients show that individuals in all age groups (except for those up to 25 years of age) are more likely not to wear the seat belt, as compared to those in the age group over 65. Individuals that are up to 25 years old are (although not significantly) similarly likely not to wear the seat belt as compared to the reference category.

The whole model is significant (Model $\chi^2=57.649$, $p<0.001$) but the fact that other factors also influence the individual's decision on wearing the seat belt is obvious, since Nagelkerke $R^2 = 0.003$, which is on the low side (near zero) and points to the lesser quality of the model.

The results mean that hypothesis H1 that states that "gender" and "age" do not have significant effect on individual's decision to wear a seat belt is partly supported; while "gender" was found to have no impact, the effect of "age" is significant, meaning that

Table 3 – Results of logistic regressions (Model I, dependent variable: "An individual was wearing the seat belt at the time of accident", 0 – yes, 1 – no)

Variable	Variable categories	Model I		
		Coefficient β S.E.	Wald	Exp(β)
Gender	0 – Female 1 – Male	0.019$^{n.s.}$ (0.030)	0.418	1.019
Age (years)	≥ 25	0.080$^{n.s.}$ (0.063)	1.603	1.083
	26 – 35	0.292*** (0.060)	23.566	1.339
	36 – 45	0.325*** (0.062)	27.807	1.384
	46 – 55	0.255** (0.064)	16.101	1.291
	56 – 65	0.279** (0.068)	16.621	1.321
	< 65 (the reference category)		55.357	
Constant		-1.627***	912.656	0.1197
Model χ^2(df)		57.649***(1)		
Nagelkerke R^2		0.003		
% of corr. pred.		80.1		

Notes: ** Significant at *p*-value ≤ 0.01, *** Significant at *p*-value ≤ 0.001, $^{n.s.}$ Non-significant

for all age groups (except for those up to 26 years old) the likelihood that an individual is not wearing a seat belt is significantly higher as compared to age group of individuals who are over 65 years old.

From *Table 4* it can be seen that Model IIb including both control and predictor variable is significant at 0.001 level (Model χ^2=60.417, p<0.001). Since Block χ^2 is also significant (Block χ^2=24.914, p<0.001), the inclusion of variables "gender" and "age" into the model leads to significant improvement of the model as compared to Model IIa.

In Model IIb variable "gender" is significant: in the year 2013 males and females in Slovenia were equally likely to suffer death injuries (β=-0.007, p>0.05), as well as older individuals (β=0.033, p<0.05). It means that hypothesis H2 can be partly supported. "Gender" was found to have no impact on the likelihood of severe or fatal injuries of individuals who were involved in road traffic accidents as passengers or drivers of a passenger car. The effect of "age" is significant for age groups of individuals who are from 25 to 55 years old – for them the likelihood of an individual suffering from severe or fatal injuries is significantly higher as compared to age group of individuals who are over 56 while the relationship with age for those who are up to 25 years old is not significant.

In Model IIb also the relationship between the "an individual was not wearing a seat belt" and the likelihood of severe or fatal injuries occurrence is significant (β=0.755, p<0.001), indicating that those individuals who were not wearing a seat belt were more likely to suffer severe or fatal injuries as compared to those who did wear the seat belt. It means that the support for hypothesis H3, that "wearing a seat belt" has significant effect on the severity of injuries of individuals involved in road traffic accidents was found.

Model III supports hypothesis H4, that several environmental and external factors have a significant impact on the likelihood that individuals suffer from severe or fatal injuries in road traffic accidents (*Table 5*). The impact of unadaptable speed is the strongest: if excessive speed is the cause of accident, individuals involved in accident are almost 4.4 times as likely to suffer from severe injuries as compared to those accidents where no excessive speed was observed (β=1.484, (Exp(β)=4.410, p<0.001). Road traffic accidents that occur on regional or local roads lead to more severe injuries of individuals involved – individuals are 0.7 times as likely to suffer severe injuries if the road accident happens on motorway as compared to regional or local road (β=-0.301, (Exp(β)=0.740, p<0.01), and over 1.2 times as likely to suffer from severe injuries if the accident happens on rough or uneven asphalt or concrete or macadam as compared to smooth one (β=0.207, (Exp(β)=1.220, p<0.01).

Table 4 – Results of logistic regressions (Model IIa and Model IIb, dependent variable "an individual suffered severe or fatal injuries", 0 – no, 1 – yes)

Variable	Variable categories	Model IIa			Model IIb		
		Coefficient β S.E.	Wald	Exp(β)	Coefficient β S.E.	Wald	Exp(β)
Wearing a seat belt	0 – Yes 1 – No	0.730** (0.117)	38.919	2.075	0.755*** (0.117)	41.477	2.128
Gender	0 – Female 1– Male				-0.007n.s. (0.117)	0.004	0.993
Age (years)	≥ 25 26 – 35 36 – 45 46 – 55 56 – 65 < 65 years				-0.160n.s. (0.196) -0.484** (0.199) -0.871** (0.224) -0.572** (0.220) -0.160n.s. (0.221)	0.664 5.933 15.092 6.768 0.526 23.942***	0.852 0.617 0.418 0.565 0.852
Constant		-4.731*** (0.068)	4,858.847	0.009	-4.335 (0.168)	667.241***	0.013
Model χ^2(df)		35.503***(1)			60.417***(7)		
Block χ^2(df)					24.914***(6)		
Nagel. R^2		0.010			0.017		
% of corr. pr.		98.9			98.9		

Notes: * Significant at *p*-value < 0.05; ** Significant at *p*-value < 0.01; *** Significant at *p*-value < 0.001; n.s. Non-significant

Table 5 – Results of logistic regressions (Model III, dependent variable "Individuals with severe or fatal injuries are involved in road traffic accident", 0 – no, 1 – yes)

Variable	Variable categories	Model III		
		Coefficient β S.E.	Wald	Exp(β)
Cause of accident	1 – Unadaptable speed 0 – Other causes	1.484*** (0.081)	336.072	4.410
Traffic density	0 – Normal 1 – Heavy/congestion	-0.531*** (0.141)	14.177	0.588
Road conditions	0 – Dry 1 – Wet/slippery (snow covered, icy, muddy)	-0.760*** (0.096)	62.641	0.468
Type of road surface	0 – Smooth asphalt or concrete 1 – Rough or uneven asphalt or concrete/ Macadam	0.207** (0.080)	6.631	1.220
Road category	0 – Regional/local road 1 – Motorway	-0.301** (0.140)	4.610	0.740
Constant		-3.562 (0.074)	2,328.499	0.020
Model χ^2 (df)		350.631***(5)		
Nagelkerke R^2		0.062		
% of correct pred.		96.4		

Notes: * Significant at *p*-value < 0.05; ** Significant at *p*-value < 0.01; *** Significant at *p*-value < 0.001; n.s. Non-significant

On the other hand, the traffic density and bed road conditions (wet and slippery road) lead to more cautious driving – individuals involved in an accident, where heavy traffic or wet and slippery road is the cause of accident, are approximately only half as likely to suffer from severe injuries as compared to those accidents where normal traffic density and dry road have been observed (β=-0.531, Exp(β)=0.588, p<0.001 and β=-0.760, Exp(β)=0.468, p<0.001, respectively).

5. DISCUSSION AND CONCLUSIONS

In this paper the databases of the Ministry of the Interior of the Republic of Slovenia were used. Three binomial logistic regression models were estimated. Model I studied the impact of demographic determinants – "gender" and "age" – on the likelihood that an individual is not wearing a seat belt. The important result that was found is that "age" is significantly important, which holds for all age groups, except for those who are up to 25 years old. The regression coefficients for all age groups are significant and odds ratios (Exp(β) suggest that individuals who are less than 65 years old are much more likely not to wear a seat belt as compared to older individuals. Individuals who are between 36 and 45 years old are almost 1.4 times as likely not to wear a seat belt as compared to those over 65. Therefore, individuals in the middle age population are on the average less likely to wear a seat belt as well as more likely to be involved in road traffic accidents. Although some research results suggest that women are more likely to wear a seat belt [14], our research does not support this and gender differences were not found to be significant.

On the other hand, it was found that the likelihood to suffer from severe or fatal injuries in road traffic accident for those who do not wear a seat belt is more than 2.1 times as high as compared to those who wear a seat belt. It was also found that severe or fatal injuries of individuals involved in road traffic accidents are more likely to occur, especially if the unadapted speed is the cause of accident.

Altogether our study revealed that middle-age individuals (over 25 years and up to 65 years old) are less likely to wear a seat belt and at the same time more likely to suffer from severe or fatal injuries in road traffic accidents. This is an important result; it is very likely that the targeted policy measures to the population between 25 and 65 years old are needed to reduce the death injuries occurrence in Slovenia. This is especially important because the past study showed that the prevention characteristics of measures included into the road safety law had an important impact on the reduction of the average number of individuals, severely injured in road traffic accidents [9]. As expected, seat belt use is likely to be influential for injury severity.

Although the databases of our research do not allow us to study the broader driving habits of drivers when analysing the usage of seat belts, it is very likely that intrinsically unsafe drivers do not wear seat belts

and are therefore more likely to be involved in traffic accidents with severe injuries [16]. Together with excessive speed not wearing a seat belt largely contributes to severe injury accidents. This also means that continuous education of drivers and other individuals that are involved in road traffic is needed. Education is absolutely vital in trying to change the attitudes towards not wearing a seat belt (although compulsory by the Slovenian law) and speeding. Speeding in interaction with the attitude of not wearing a seat belt is a very dangerous driving attitude, since driving too fast without fastening the seat belt significantly increases the probability that the consequences of traffic road accident will be serious or even fatal. Since individuals over 25 years old on the average more often fail to wear a seat belt as compared to older ones, it seems that the combination of fines to lower the number of those who do not wear a seat belt with mandatory enrolment into a defensive driving course should be implemented.

There are also several extensions of our research that could enrich the discussion. Although we were limited regarding the databases, the intermediate effects of the demographic variables and "not wearing the seat belt" variable were also analysed. Research results revealed no statistical significance. These results are therefore only partly consistent with some previously published studies showing that there are several interactions and patterns of interaction among influential factors when analysing the severity of injuries. The research of Olmus and Erbas [17] that analysed the interaction effects of gender, time of accident (day, night, holiday) and driver's fault and carelessness, found that several interactions do exist. Since the databases of the Ministry of the Interior of the Republic of Slovenia contain a very limited number of variables, a more detailed interaction analysis for the Slovenian case study was not possible.

The data, unfortunately, do not allow us either to establish the intermediate effects of environmental/external determinants analysed and demographic and other factors. Namely, the databases used in our study track accidents and individuals separately: database I contains information about persons who were involved in a traffic accident together with information about the use of the seat belt and the severity of injuries, while database II contains information on the characteristics of traffic accidents.

Overall, our study suggests that demographic, behavioural and environmental determinants matter when analysing the severe injuries. The important component of extensions of our study would be also the introduction of country effect. Unfortunately, there were no databases in the comparable form for other countries available.

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VPLIV IZBRANIH INDIVIDUALNIH IN ZUNANJIH DEJAVNIKOV NA POJAV TEŽKIH POŠKODB: ŠTUDIJA PRIMERA SLOVENIJE

POVZETEK

Namen tega članka je prispevati k razumevanju različnih determinant in njihovega vpliva na pojav težkih poškodb pri udeležencih cestnih prometnih nesreč, z namenom, da bi lahko bolje oblikovali ukrepe za njihovo zmanjšanje ter preprečevanje njihovih posledic. V tem prispevku smo oblikovali tri regresijske modele. Model I smo oblikovali z namenom analize vpliva demografskih dejavnikov (spol in starost) na verjetnost, da posameznik uporablja varnostni pas v osebnem avtomobilu, Model II pa z namenom preučiti vpliv demografskih dejavnikov (spol in starost) in vpliv uporabe varnostnega pasu, na verjetnost, da se cestna prometna nesreča konča s smrtnim izidom udeležencev. Model III smo oblikovali za analiziranje vpliva različnih dejavnikov v okolju na verjetnost, da udeleženci prometne nesreče utrpijo težje poškodbe ali poškodbo s smrtnim izidom. Rezultati med drugim kažejo, da je za posameznike iz srednje starostne skupine (nad 25 pa do 65 let starosti) v povprečju bolj verjetno, da ne uporabljajo varnostnega pasu, hkrati pa je za njih bolj verjetno, da kot udeleženci prometnih nesreč utrpijo hude poškodbe. Rezultati tako kažejo, da je smiselno ciljne mere za zmanjšanje števila prometnih nesreč s težkimi poškodbami, usmeriti na to starostno skupino v Sloveniji..

KLJUČNE BESEDE

cestne prometne nesreče; varnostni pas; vedenjski dejavniki; binomska logistična regresija;

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