TRANSPORT PROBLEMS 2022 Volume 17 Issue 2
PROBLEMY TRANSPORTU DOI: 10.20858/tp.2022.17.2.12

**Keywords:** safety; measures; crash prevention; road traffic

**Francisco ALONSO[1], Sergio A. USECHE[2]*, Mireia FAUS[3], Cristina ESTEBAN[4]**

# ASSESSING USERS' PERCEPTIONS OF FOUR TYPES OF ROAD SAFETY MEASURES

**Summary.** Road crashes remain an important public health issue. This study aimed to assess the perceived importance of four types of measures for reducing traffic crash rates. For this cross-sectional study, data were obtained from a national sample of 1,200 Spanish drivers responding to a telephone-assisted survey. The most valued types of road safety measures were those related to users' training/education and infrastructural improvements. Further, individual perceptions were influenced by both demographic and trip-related factors. The results of this study support the idea that user features remain a relevant issue to consider when developing and implementing road safety measures.

## 1. INTRODUCTION

Recent studies have contributed to the understanding of the association of road users' behavioral and psychological features with their risk for traffic crashes [1]. In fact, users' crash likelihood is considered to be influenced by many factors such as distraction, cognition, personality, and social matters. This suggests that, just like the multidimensional issue of traffic crashes, possible solutions should be addressed from different spheres. However, this integrative approach materializes very infrequently, and the problem of traffic crashes continues to have a global impact on public health.

According to the World Health Organization [2], approximately 1.35 million people die each year as a result of road traffic crashes, and between 20 and 50 million more people suffer non-fatal injuries; such incidents have increased the most in metropolitan areas [3, 4]. In the European Union, 1.2 million crashes occur every year, leading to more than 40,000 fatalities [5,6]. Moreover, their economic cost is estimated to be over US$8.37 billion [7, 8], which is unacceptably high and should call for increasing the overall investment in safety measures of different natures and scopes [7].

As a relevant fact, some studies [Błąd! Nie można odnaleźć źródła odwołania.] suggest that the a nalysis of traffic crashes should include not only crashes and the conditions directly related to them but also the set of socioeconomic and legislative conditions and interventions surrounding the problem, such as education, quality of life, healthcare, and law enforcement. Indeed, in countries such as Iran, traffic crashes with fatalities are the most essential concern in society today, regardless of one's social status [10].

This problem has been extensively studied in developed countries, and almost all scientific approaches related to it come from America, Australia, and Europe [12]. In countries such as the United States (69%) and the United Kingdom (21%), the percentage of technology-related distractions, such as

[1] University of Valencia, INTRAS (Research Institute on Traffic and Road Safety); Carrer del Serpis 29, 3rd Floor, DATS. 46022 Valencia, Spain; email: francisco.alonso@uv.es; orcid.org/0000-0002-9482-8874
[2] ESIC Business & Marketing School; Avenida de Blasco Ibañez 55. 46021 Valencia, Spain; email: sergioalejandro.useche@esic.edu; orcid.org/0000-0002-5099-4627
[3] University of Valencia, INTRAS (Research Institute on Traffic and Road Safety); Carrer del Serpis 29, 3rd Floor, DATS. 46022 Valencia, Spain; email: mireia.faus@uv.es; orcid.org/0000-0002-8107-7637
[4] University of Valencia, INTRAS (Research Institute on Traffic and Road Safety); Carrer del Serpis 29, 3rd Floor, DATS. 46022 Valencia, Spain; email: cristina.esteban@uv.es; orcid.org/0000-0002-4066-1319
* Corresponding author. E-mail: sergioalejandro.useche@esic.edu

using a cell phone while driving, increases every year [13], affecting many road users besides car drivers (e.g., motorcyclists, pedal cyclists, and pedestrians) [13].

Moreover, traffic crashes are often preceded by many psychosocial factors, such as stress or fatigue [15-17], adverse health conditions, personality issues, and individual differences [18, 19]. The mechanisms by which all these factors influence risky behaviors remain largely understudied, and more research is still needed [20, 21]. Nevertheless, it is known that traffic causalities systematically impair quality of life at the individual, family, and social levels [22-24].

As a response to this challenging panorama, road safety measures are usually developed with the primary aim of decreasing traffic crash rates in consideration of, for example, high accident concentration locations, user-related risk profiles, crash trends, and (with a lesser frequency) very specific contextual features. Previous studies emphasize several factors that are frequently considered in traffic safety interventions.

Firstly, the severity of an injury caused by a motor vehicle traffic crash is determined by a number of factors related to the type of user, vehicle, place, environment, and safety conditions. According to many studies, the age and sex of the driver are considered risk factors that affect accident severity. For instance, male drivers usually have a higher probability of being involved in serious or fatal crashes [25]. Secondly, a simple intervention focused on protecting the most vulnerable road users based on law enforcement, behavioral changes, and environmental modifications might result in a significant reduction of mortalities in road traffic crashes [26]. Thirdly, the design of streets provided with sufficient traffic signals and stop signs, as well as an overall organization of road traffic controlled by traffic police, could be implemented in urban areas [27].

Crash rate estimations require not only police reports or hospital data (which can be inconsistent or underreported) [28] but also statistical models addressing subjective victimization rates [29].

Finally, as a whole, the literature highlights the following: (*i*) the need to develop road safety measures in consideration of emerging road safety problems (e.g., increasing mobile phone use) [18, 30]; (*ii*) the safety potential of empirically based actions, as long as they are properly evaluated [31]; and (*iii*) sufficient knowledge of community transportation habits, strengths, and shortcomings [32].

Considering the aforementioned considerations, the core aim of this cross-sectional study was to examine the perceived importance of four types of measures to reduce traffic crashes. In addition, the possible different perceptions among road users according to their sociodemographic variables were studied. Our hypothesis is that the sociodemographic variables analyzed could influence the perceived importance of these measures. In other words, we hypothesize that age and education are positively associated with one's appreciation of the proposed measures. Additionally, the insights provided by reviewed studies lead us to expect regular drivers to have a greater valuation of road safety measures than those who drive less frequently. In this regard, the present research constitutes a preliminary study.

## 2. METHODS AND MATERIALS

### 2.1. Sampling

The full sample of this study was composed of 1,200 individuals (48.4% males and 51.6% females) aged over 14 years. Given that their behavioral repertoires are clearly different, this study comprised three types of road users: drivers, cyclists, and pedestrians. Additional information about the basic study sample features is available in Table 1.

The sample was proportional to the general population of road users (drivers and non-drivers) in Spain in terms of age and sex. The number of participants represents an error margin for the general data of ±2.9 with a 95.5 % confidence interval in the most unfavourable case of $p=q=50\%$.

### 2.2. Design, procedure, and instrument

In this cross-sectional research, data were collected through a telephone survey conducted by the company EMER-GfK. The method used for random sampling was applied according to age, sex, the

Spanish region where the participant lives, and habitat (rural or urban). A pilot version was previously applied to 50 subjects in order to adjust the length, understanding, and proper operation of the interview. These participants did not account for the overall sample. The average duration of the survey was 27 minutes, and the response rate was about 65%, with approximately 1,850 survey requests made.

The questionnaire was structured in two different sections. Firstly, we used an exclusion/inclusion question to narrow the field of application (over 14 years old). The demographic data (sex, marital status, type of user, educational level) were collected at the end of the interview. Second, all users were asked about the importance of different social and health-related problems—specifically, their opinions about road safety, traffic crashes, and their social importance. These data can be of greater interest than objective data, as previously mentioned in the research framework.

Specifically, the variables considered for this study were split into two blocks:

- *Sociodemographic factors:* Sex, age, educational level (no studies, primary school, secondary school, technical studies, university studies), current job (working, unemployed, retired, student, householding), and marital status (single, married/living with a partner, divorced/separated, widowed). Complementarily, participants were asked about their frequency of vehicle/transportation mode use (every day, almost every day, a few days per week, a few days per month, less than once per month).
- *Measures to reduce road crashes*: Respondents were asked to provide their assessment of the degree of perceived importance of four different types of measures commonly developed for reducing traffic crashes: (*i*) to train and educate drivers and other road users, (*ii*) to improve the quality of roads and streets, (*iii*) to increase police presence/supervision, and (*iv*) to improve vehicles. For this purpose, a semantic differential scale was designed; responses ranged from 0 (nothing) to 10 (very important).

## 2.3. Statistical analyses

Statistical analyses were carried out using the Statistical Package for the Social Sciences (SPSS) version 23 (IBM, Armonk, NY, USA) and its different modules and features (ONEWAY, UNIANOVA, GLM, and CROSSTABS). In addition to the descriptive analyses (means, frequencies, and aggrupation by categorical variables), mean values were compared, and normality tests were carried out and assessed. Once these basic parameters (logarithmically transformed for comparative analyses) were met, basic one-way ANOVAs were performed to compare the mean scores of the study variables according to the categorical factors, with a significance criterion of $\alpha$=0.05.

## 2.4. Ethics

This study was granted ethical transparency by the Research Ethics Committee for Social Science in Health of the University Research Institute on Traffic and Road Safety at the University of Valencia (IRB HE0001041119). This study was deemed to be in accordance with the ethical principles of the Declaration of Helsinki. Further, we used an informed consent statement containing ethical principles, data treatment details, explanations of the objective of the study, the mean duration of the survey, personal data treatment, and the voluntary nature of the study. It was presented to participants before they started the questionnaire. The informed consent statement also stated that sensitive data would not be used, as participation was anonymous.

# 3. RESULTS

## 3.1. Type of user

Drivers were aged between 14 and 75. The largest groups were 50-64 years (18.9%) and over 65 (18.6%). The age group of 14-17 years was the smallest (5.2%). Regarding the type of user, the majority of respondents were current drivers (60.5%), as presented in Table 1. Among them, drivers with between 26 and 30 years of driving experience represented the highest percentage of respondents (17.6%). The

rest of the participants were (non-driving) pedestrians (34.6%), 74.6% of whom made most of their urban movements on foot. Although they made up a lower proportion of the sample, there were also some cyclists (4.9%). Most of these non-driving participants have never been involved in a crash. This condition represents 81.4% of cyclists and 85.8% of drivers.

Table 1

Full-sample distribution according to type of road user and sex

| Type of Road User | Male | Female | Total |
|---|---|---|---|
| Drivers | 451 | 279 | 730 |
| Cyclists | 38 | 21 | 59 |
| Pedestrians | 95 | 322 | 417 |
| Total | 584 | 622 | 1206 |
| | 48.4% | 51.6% | 100% |

Overall, and as shown in Fig. 1, the importance of the proposed measures is positive (on a scale of 0-10). However, there are significant differences in the degree of importance given to each (F=169.11; df=3; $p$<.001).

The variable that stands out the most is "train and educate drivers and other road users" ($\bar{x}$=8.36), followed by "improve the quality of roads and streets" ($\bar{x}$=7.85), "increase police presence/supervision" ($\bar{x}$=7.0), and, finally, "improve vehicles" ($\bar{x}$=6.843).

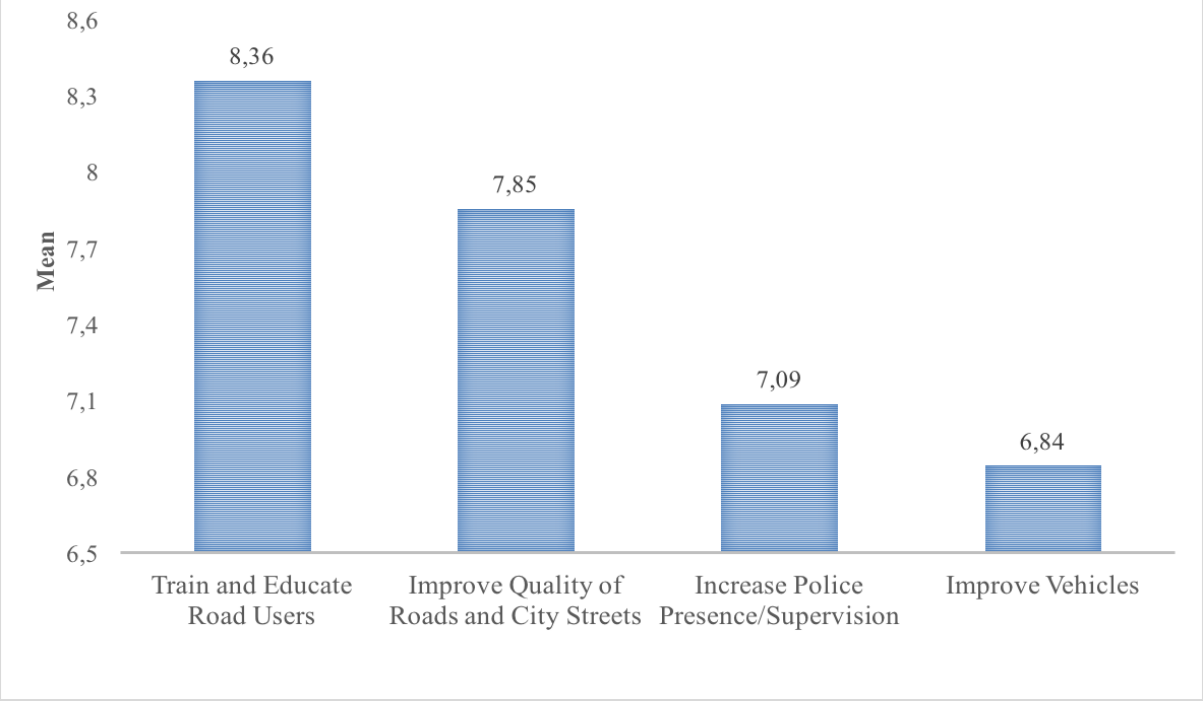


Fig. 1. Users' assessments of four different types of measures to reduce road traffic crashes

### 3.2. Age

Considering age, three of the four types of measures to reduce road crashes addressed in this study have shown significant differences, namely "improve vehicles" ($F_{(6,1194)}$=5.147, $p$<.001), "increase police presence/supervision" ($F_{(6,1194)}$=10.470, $p$<.001), and "train and educate drivers and other road users" ($F_{(6,1194)}$=6.667, $p$<.001), that was also the most valued overall. It was followed by "increase police presence/supervision" and "improve vehicles." As shown in Fig. 2, the scores of "train and educate drivers and other road users" showed a general trend in the level of importance as the

respondents' age increased. Only in the youngest and oldest age groups (14-17 and over 65) was a minimal variation in the trend detected. Meanwhile, regarding measures related to "improve vehicles," the highest scores were found in the oldest age groups (50-64 and over 65). Finally, for the last one ("increase police presence/supervision"), there was a tendency for scores to be higher among older subjects, with the exception of respondents aged 14-17 (Table 2).

Table 2

Assessment of measures according to age group

| Age Group/Measure | Improve Vehicles | Increase Police Presence/Supervision | Train and Educate Drivers and Other Road Users |
|---|---|---|---|
| 14-17 | $\bar{x}$=6.32<br>*SD*=2.375 | $\bar{x}$=7.24<br>*SD*=2.014 | $\bar{x}$=7.75<br>*SD*=1.778 |
| 18-22 | $\bar{x}$=6.59<br>*SD*=2.450 | $\bar{x}$=6.41<br>*SD*=2.636 | $\bar{x}$=7.71<br>*SD*=2.130 |
| 23-29 | $\bar{x}$=6.34<br>*SD*=2.253 | $\bar{x}$=6.46<br>*SD*=2.373 | $\bar{x}$=8.08<br>*SD*=1.940 |
| 30-39 | $\bar{x}$=6.53<br>*SD*=2.427 | $\bar{x}$=6.68<br>*SD*=2.583 | $\bar{x}$=8.31<br>*SD*=1.931 |
| 40-49 | $\bar{x}$=6.82<br>*SD*=2.533 | $\bar{x}$=6.94<br>*SD*=2.277 | $\bar{x}$=8.54<br>*SD*=1.612 |
| 50-65 | $\bar{x}$=7.36<br>*SD*=2.486 | $\bar{x}$=7.44<br>*SD*=2.457 | $\bar{x}$=8.68<br>*SD*=1.636 |
| <65 | $\bar{x}$=7.26<br>*SD*=2.689 | $\bar{x}$=8.00<br>*SD*=2.400 | $\bar{x}$=8.64<br>*SD*=1.893 |

### 3.3. Marital status

The observed trend is again very similar to the one described in previous analyses (e.g., with age intervals). Therefore, considering the marital status of respondents, the most important type of measure to reduce traffic crashes was to "train and educate drivers and other road users" ($F_{(3,1202)}$=9.686, $p$<.001). In this case, subjects who assigned more importance to this measure were those whose marital status was divorced/the most, followed by those who were married/living with a partner and widowed. The lowest scores came from single people. The data are analyzed more in detail in

Fig. 3 below. In the case of "improve vehicles" ($F_{(3,1202)}$=3.060, $p$<.027) and "increase police presence/supervision" ($F_{(3,1202)}$=10.854, $p$<.001), there was a similar trend in the results. In the first case, the subjects who gave a greater value to this type of measure were divorced/separated individuals. In the second case, this position was occupied by widowed people (Table 3).

### 3.4. Current job situation

Considering the occupations of the respondents, the valuations of measures to reduce road crashes showed significant differences. The most valued type of measure was "train and educate drivers and other road users" ($F_{(4,1201)}$=9.520, $p$<.001), followed by "improve the quality of roads and streets" ($F_{(4,1201)}$=3.388, $p$<.009), "increase police presence/supervision" ($F_{(4,1201)}$=22.999, $p$<.001), and, lastly, "improve vehicles" ($F_{(4,1201)}$=7.545, $p$<.001). All scores were considerably high, as seen in

Table **4** and Fig. 4. In all cases, householders considered these measures as the most valuable. For two measures ("improve vehicles" and "increase police presence/supervision"), the same pattern of responses was observed. Students gave the lowest importance to these measures for reducing traffic crashes. From lowest to highest value assigned, the groups were working people, unemployed, retired, and householders.

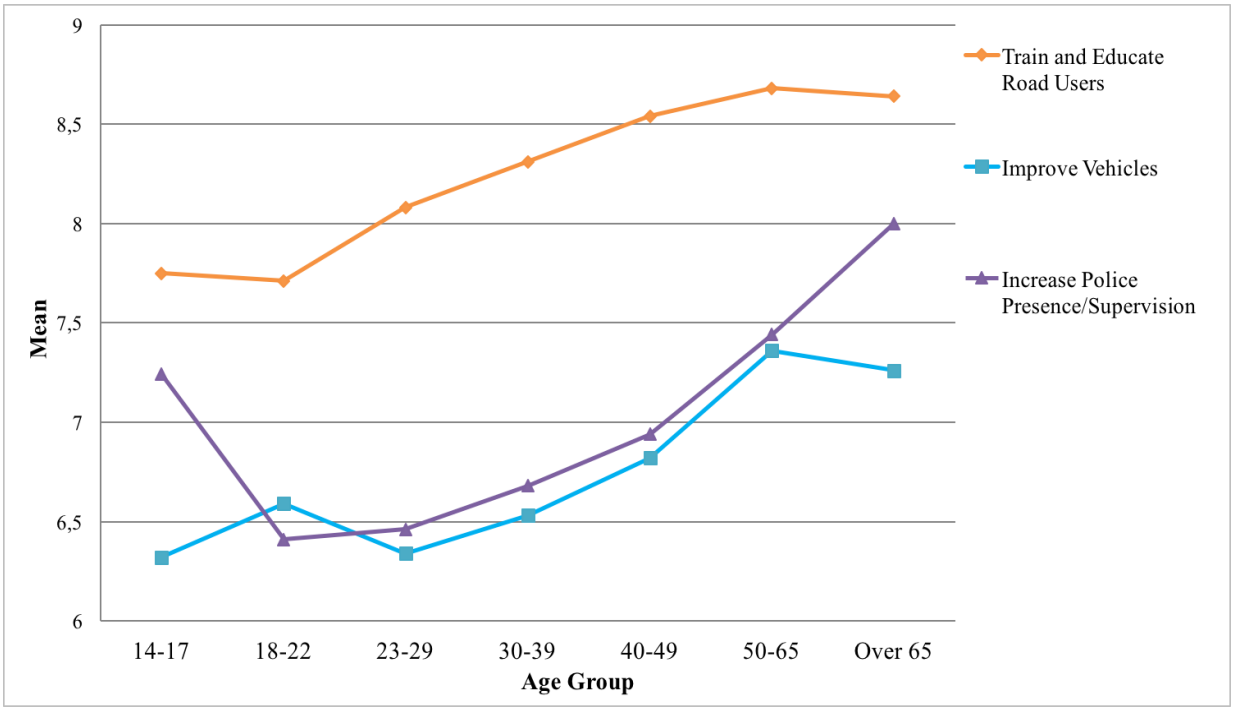


Fig. 2. Measures to reduce road traffic crashes perceived as most important according to age

Table 3

Descriptive results based on marital status

| Measure | Marital Status | | | |
|---|---|---|---|---|
| | Single | Married | Divorced | Widowed |
| Increase Training and Road Safety Education for Drivers | $\bar{x}$=7.97 *SD*=1.969 | $\bar{x}$=8.54 *SD*=1.769 | $\bar{x}$=8.53 *SD*=1.769 | $\bar{x}$=8.54 *SD*=1.851 |
| Improve Vehicles | $\bar{x}$=6.61 *SD*=2.279 | $\bar{x}$=6.90 *SD*=2.551 | $\bar{x}$=7.52 *SD*=2.343 | $\bar{x}$=7.36 *SD*=2.697 |
| Increase Police Presence/Supervision | $\bar{x}$=6.61 *SD*=2.421 | $\bar{x}$=7.24 *SD*=2.486 | $\bar{x}$=7.41 *SD*=2.171 | $\bar{x}$=8.12 *SD*=2.338 |

### 3.5. Frequency in the use of vehicles

Considering this variable as the core of the analysis of respondents' valuations of various measures to reduce traffic crashes, two exhibited significant differences. These were "improve vehicles" ($F_{(4,725)}$=2.603, $p$<.035) and "increase police presence/supervision" ($F_{(4,725)}$=3.541, $p$<.007) (Table 5). In general, the subjects assigned similar values to both measures. As can be observed in Fig. 5, the subjects who only used their car a few times a year reported the lowest scores. In both cases, the respondents who used their vehicles every day provided the lowest valuations.

### 3.6. Frequency in the use of vehicles

Considering this variable as the core of the analysis of respondents' valuations of various measures to reduce traffic crashes, two exhibited significant differences. These were "improve vehicles" ($F_{(4,725)}$=2.603, $p$<.035) and "increase police presence/supervision" ($F_{(4,725)}$=3.541, $p$<.007) (Table 5). In general, the subjects assigned similar values to both measures. As can be observed in Fig. 5, the subjects who only used their car a few times a year reported the lowest scores. In both cases, the respondents who used their vehicles every day provided the lowest valuations.

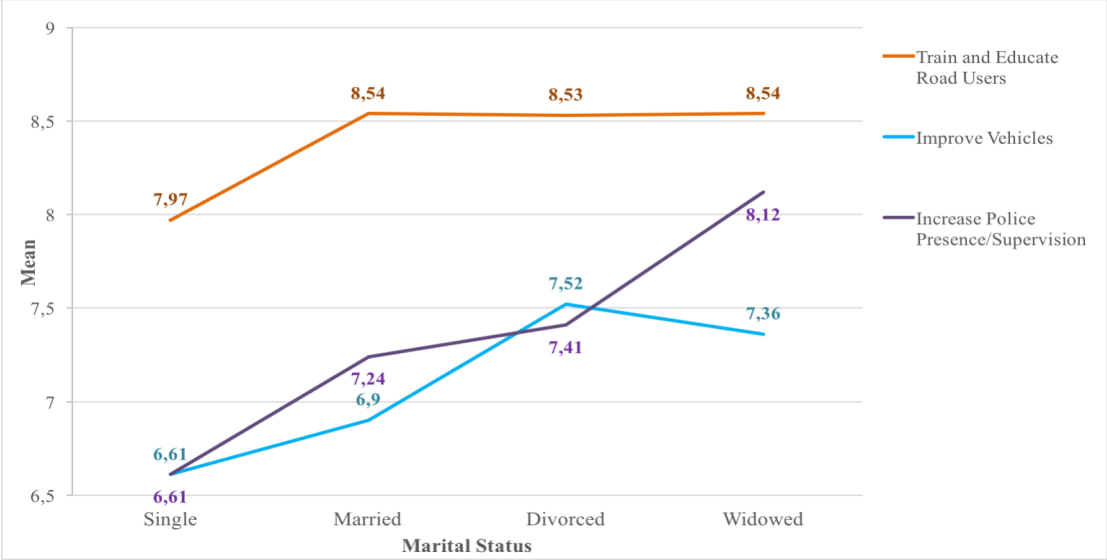


Fig. 3. Main measures to reduce road traffic crashes according to marital status

Table 4

Descriptive results based on current employment status

| Measure | Current Job Situation | | | | |
|---|---|---|---|---|---|
| | Occupied | Unemployed | Retired | Student | Householder |
| Train and Educate Drivers and Other Road Users | $\bar{x}$=8.30 *SD*=1.874 | $\bar{x}$=7.95 *SD*=2.315 | $\bar{x}$=8.49 *SD*=1.909 | $\bar{x}$=7.85 *SD*=1.666 | $\bar{x}$=8.91 *SD*=1.593 |
| Improve the Quality of Roads and City Streets | $\bar{x}$=7.82 *SD*=1.986 | $\bar{x}$=8.18 *SD*=1.727 | $\bar{x}$=7.71 *SD*=2.414 | $\bar{x}$=7.52 *SD*=1.584 | $\bar{x}$=8.19 *SD*=2.19 |
| Increase Police Presence/Supervision | $\bar{x}$=6.64 *SD*=2.498 | $\bar{x}$=6.67 *SD*=2.683 | $\bar{x}$=7.54 *SD*=2.558 | $\bar{x}$=6.63 *SD*=2.019 | $\bar{x}$=8.30 *SD*=2.117 |
| Improve Vehicles | $\bar{x}$=6.64 *SD*=2.413 | $\bar{x}$=6.74 *SD*=2.693 | $\bar{x}$=7.03 *SD*=2.782 | $\bar{x}$=6.38 *SD*=2.097 | $\bar{x}$=7.56 *SD*=2.391 |

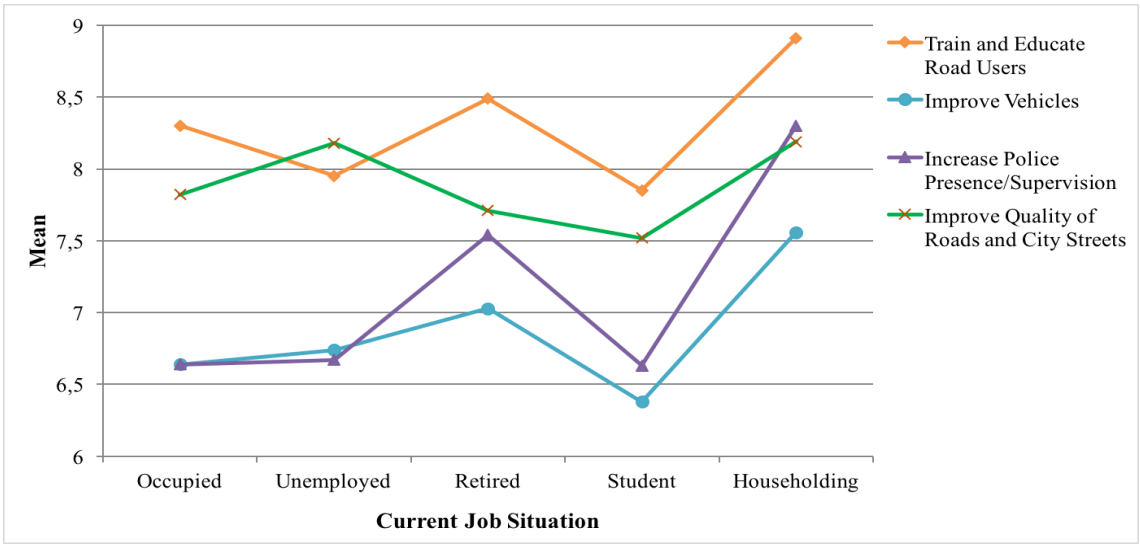


Fig. 4. Main measures to reduce road traffic crashes according to current employment status

### 3.7. Educational Level

The analysis of the survey was completed by also considering participants' educational level as a differentiating factor for the valuation of the analyzed measures. The results were significant for one factor only ("increase police presence/supervision") ($F_{(4,1194)}$=17.152, $p$<.001). Specifically, the results were as follows: no studies ($\bar{x}$=7.96, $SD$=2.779), primary ($\bar{x}$=8.09, $SD$=2.161), secondary (1st Grade) ($\bar{x}$=7.21, $SD$=2.565), secondary (2nd Grade) ($\bar{x}$=6.72, $SD$=2.470), and college ($\bar{x}$=6.40, $SD$=2.226). As shown in Fig. 6, there is a trend: the higher the level of education, the lower the value given to each measure. The exception is that respondents with primary education gave the most value to "increase police presence/supervision."

Table 5

Descriptive results based on driving frequency

| Measure | Frequency of driving | | | | |
|---|---|---|---|---|---|
| | Every day | Almost every day | A few days a week | A few days a month | A few days a year |
| Improve vehicles | x̄=6.47 SD=2.541 | x̄=6.71 SD=2.502 | x̄=6.86 SD=2.383 | x̄=6.59 SD=2.121 | x̄=7.93 SD=2.018 |
| Increase police presence/supervision | x̄=6.35 SD=2.526 | x̄=7.17 SD=2.201 | x̄=6.79 SD=2.572 | x̄=6.55 SD=2.458 | x̄=7.41 SD=2.422 |

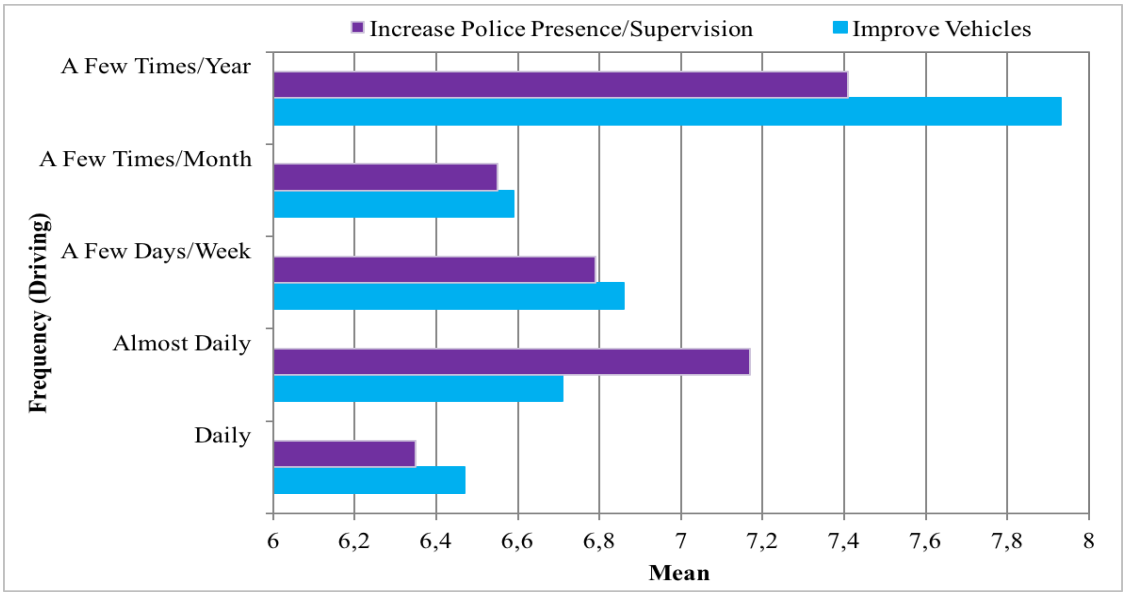


Fig. 5. Main measures to reduce road traffic crashes according to driving frequency

## 4. DISCUSSION

This study aimed to assess the perceived importance of four types of measures to reduce traffic crash rates. Overall, our findings support the existence of a relationship between road users' characteristics and their assessments of various measures for reducing traffic crashes. Previous studies have shown that, in addition to being scarce, road safety measures are often reduced to improve roads and traffic signalling, shortening their potential scope and effectiveness [8, 10, 28].

In other words, there are many factors that apparently may hinder road users' behavior, but some of them remain slightly encompassed by road safety interventions, especially those related to road safety

education and training [33, 34]. Curiously, this type of measure was the most valued among the group of road users participating in this study, with a significantly greater average than measures related to infrastructure, vehicles, and supervision. Additionally, the overview of different previous approaches used to prevent road injuries allows us to state that each type of intervention can be effective under some circumstances. In other words, there does not seem to be one best way par excellence to prevent crashes and injuries while contextual knowledge remains a crucial need to develop, thus endorsing the value of this study [8, 35]. Although the results obtained reflect self-reported perceptions, they may imply that all measures may acquire an important role in the task of reducing road crashes, albeit to different degrees. In this regard, we found how measures related to the infrastructure, vehicles, and human factors are valued by Spanish road users as highly involved in the improvement of road safety. These factors, in order of relevance, were "train and educate drivers and other road users," "improve the quality of roads and streets," "increase police presence/supervision," and "improve vehicles."

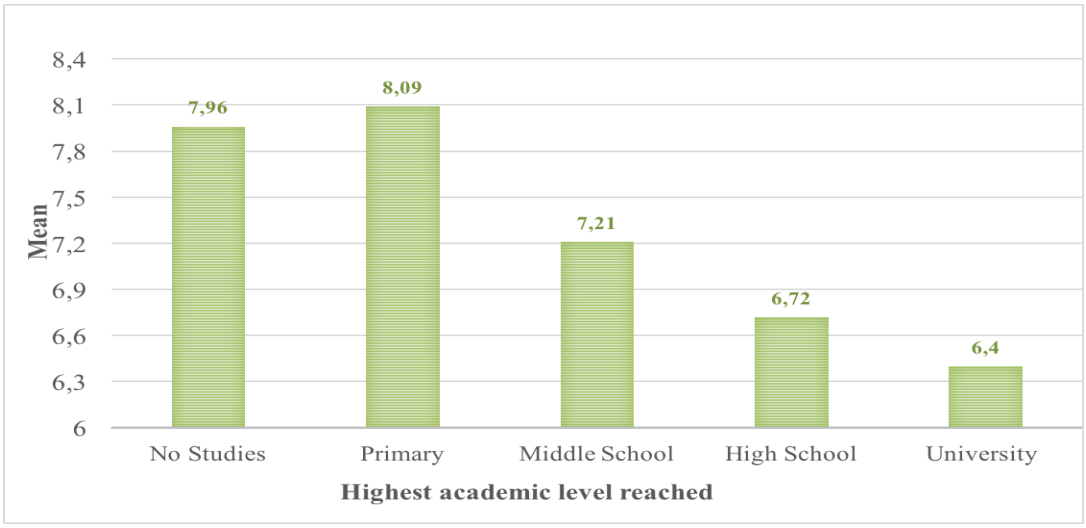


Fig. 6. Assessment of police supervision as a measure to reduce road traffic crashes according to education level

### *User-related differences in the valuation of road safety measures*

Another key issue addressed by this study was the fact that there are demographic differences in the valuation of road safety measures. When comparing age groups, we found how measures related to road users' training and education ("train and educate drivers and other road users"), infrastructural advances ("improve the quality of roads and streets"), and enforcement actions ("increase police presence/supervision") differ among them. Namely, age was positively correlated to users' assessments, as these measures were valued more by older road users. This relationship is also coherent with previous studies addressing attitudes towards road safety issues, such as that conducted by Scott-Parker and Oviedo-Trespalacios [18], where younger users tended to report more negative outcomes than their older counterparts.

Also, depending on the frequency in which they use their vehicles (for example), all subjects had a similar way of valuing the factors "improve vehicles" and "increase police presence/supervision." In particular, individuals who used vehicles a few times a year assigned more value to both measures. Consequently, the lowest scores were given by people who used their vehicles every day (i.e., more frequent drivers). Lastly, considering the level of education of road users, only the "increase police presence/supervision" factor implied a significant difference between individuals. The subjects with the highest level of education registered the lowest mean scores.

Other demographics have also shown interesting results. For instance, regarding marital status, divorced subjects assigned a high value to "train and educate drivers and other road users" and "improve vehicles." Meanwhile, widowed individuals assigned a high value to "increase police presence/supervision." In relation to current occupation, householders reported the highest scores in all

significant factors. Overall, all these results are in line with the proposed by other studies. Firstly, road safety education and training stand out as a relevant measure [34]. Secondly, the role of road/vehicle improvements remains latent, as does the emerging need to introduce intelligent transport systems to potentially increase road users' safety [36, 37]. In this sense, the importance of intervening on human factors is reflected in improvements in the road behavior of users and their performance (e.g., telephone use, distractions, lack of attention, bad decisions, fatigue, alcohol consumption, intoxication, aggression, stress, driving over the speed limit) [19, 38, 39].

Meanwhile, there remains a clear need to keep increasing awareness about the role of law enforcement as a way to mitigate deliberately risky behaviors among all types of road users [8]. According to previous research, a potentially suitable way to do this is to develop more informative actions and campaigns targeted at raising social awareness based on the fact that crashes can be avoided through safer road behaviors [38]. Although such studies are still scarce, some studies dealing with all types of users—principally drivers but also pedestrians and cyclists—highlight the need to improve communication strategies (especially campaigns) to invigorate the effect of road safety measures [8, 39]. Finally, regarding the value given to the different types of measures addressed in this study, it is worth remarking that measures related to road users' training and education were ranked first by approximately 90% of respondents, above from infrastructural measures, law enforcement, and vehicle improvements. However, it remains pending to assess the external validity of our results in further countries, given their potentially different states-of-affairs in terms of, e.g., transportation dynamics, road safety education, users' road behaviors and law enforcement [9, 34].

### *Limitations of the study and further research*

Although our sample was considerably large and proportional to the demographic settings of the population, this cross-sectional study has some key technical limitations worth acknowledging. Firstly, the data were gathered just before the COVID-19 pandemic, which could explain crucial changes in terms of transport dynamics and policymaking, social perceptions, and safety outcomes.

Secondly, the assessments mentioned in this article give us a prevalence of people's opinions about the importance of different measures as a way of reducing road traffic crashes. Especially in the case of cross-sectional studies, the assessment of perceptions and self-reported behaviors and attitudes is often linked to the influence of (e.g.) non-responder bias, social desirability, and other common method biases [40]. Therefore, the findings of this study should be interpreted in consideration of their potential influence over participants' responses. Thirdly, and regarding future research, it is also worth suggesting the use of complementary research tools to perform in-depth analyses of public perceptions of these matters. For instance, qualitative information-gathering strategies (i.e., interviews and focus groups) would allow for a deeper understanding of key aspects of public awareness of, acceptance of, and reluctance to accept certain types of measures applicable to road safety.

## 5. CONCLUSIONS

The first conclusion of this study is that, even though they still play a secondary role in traffic safety research and policymaking, educational and training-related measures were the measures valued the most by road users overall.

Secondly, from a practical point of view, this study supports the need to consider accounting for demographic factors when assessing the valuation of road safety measures, as there are several significant differences according to key factors such as the user's age, occupation, and educational level.

Finally (although this is not a conclusion rigorously derived from the study data), it is worth highlighting how the current literature reviewed in this study emphasizes the need to develop road safety measures based on sufficient contextual knowledge that consider emerging dynamics and phenomena related to transport to increase their contributions to traffic safety and crash prevention.

**Acknowledgments**

The authors want to especially thank Runa Falzolgher for the editorial proof of the final version of the paper and Raquel Richart for the revisions.

**Funding**

The authors would like to thank the Audi Corporate Social Responsibility "Attitudes" program (AUDI) for supporting this basic research macro-project in recent years.

**References**

1. Rowe, R. & Roman, G. & McKenna, F. & Barker, E. Measuring errors and violations on the road: A bifactor modeling approach to the Driver Behavior Questionnaire. *Accident Analysis & Prevention*. 2015. Vol. 74. P. 118-125. DOI: 10.1016/j.aap.2014.10.012.
2. World Health Organization. *Road safety*: *Measuring Progress Towards Universal Health Coverage.* 2020. DOI:10.1787/26b007cd-en.
3. Cioca, L. & Ivascu, L. Risk indicators and road accident analysis for the period 2012-2016. *Sustainability*. 2017. Vol. 9. P. 1530. DOI:10.3390/su9091530.
4. Singh, R. & Singh, HK & Gupta, SC & Kumar, Y. Pattern, severity and circumstances of injuries sustained in road traffic crashes: a tertiary care hospital-based study. *Indian Journal of Community Medicine*. 2014. Vol. 39. No. 1. P. 30-34. DOI:10.4103/0970-0218.126353.
5. Al-Harbi, M. & Yassin, M.F. & Bin Shams, M. Stochastic modelling of the impact of meteorological conditions on road traffic crashes. *Stochastic Environmental Research and Risk Assessment*. 2012. Vol. 26. No. 5. P. 739-750. DOI: 10.1007/s00477-012-0584-y.
6. Al-Masaeid, H. & Al-Mashakbeh, A. & Qudah, A. Economic costs of traffic crashes in Jordan. *Accident Analysis & Prevention*. 1999. Vol. 31. No. 4. P. 347-357. DOI: 10.1016/S0001-4575(98)00068-2.
7. Sanjeev, S. Road Traffic Safety: Cost of Government Neglect. *Economic and Political Weekly*. 2005. Vol. 40. No. 16. P. 1598-1602. Available at: http://www.jstor.org/stable/4416498.
8. Elvik, R. An analysis of official economic valuations of traffic accident fatalities in 20 motorized countries. *Accident Analysis & Prevention*. 1995. Vol. 27. No. 2. P. 237-247. DOI: 10.1016/0001-4575(94)00060-Y.
9. Qirjako, G. & Burazeri, G. & Hysa, B. & Roshi, E. Factors associated with fatal traffic crashes in Tirana, Albania: Cross-sectional Study. *Croatian Medical Journal*. 2008. Vol. 49. No. 6. P. 734-740. DOI: 10.3325/cmj.2008.49.734.
10. Hammad, H. M. & Ashraf, M. & Abbas, F. & Bakhat, H. F. & Qaisrani, S. A. & Mubeen, M., ... & Awais, M. Environmental factors affecting the frequency of road traffic accidents: a case study of sub-urban area of Pakistan. Environmental Science and Pollution Research, 2019. Vol. 26. N. 12. P. 11674-11685. DOI: 10.1007/s11356-019-04752-8
11. Bahadorimonfared, A. & Soori, H. & Delpiseh, A. & Esmali, A. & Salehi, M. & Bakhiyari, M. Trends of fatal road traffic injuries in Iran. *PLoS ONE*. 2011. Vol. 8. No. 5. P. e65198. DOI: 10.1371/journal.pone.0065198.
12. Bayoumi, A. The epidemiology of fatal motor vehicle crashes in Kuwait. *Accident Analysis & Prevention*. 1981. Vol. 13. No. 4. P. 339-348. DOI: 10.1016/0001-4575(81)90058-0.
13. Frieden, T.R. & Jaffe, H.W. & Stephens, J.W. & Cardo, D.M. & Zaza, S. Mobile device use while driving-United States and seven European countries. *Morbidity and Mortality Weekly Report*. 2013. Vol. 62. No. 10. P. 177-182. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4604823.
14. Eid, A.M. Road traffic crashes in Qatar the size of the problem. *Accident Analysis & Prevention*. 1980. Vol. 12. No. 4. P. 287-298. DOI: 10.1016/0001-4575(80)90006-8.

15. Chung, W. Y. & Chong, T. W. & Lee, B. G. Methods to detect and reduce driver stress: a review. *International journal of automotive technology*, 2019. Vol. 20. N. 5. P. 1051-1063. DOI: 10.1007/s12239-019-0099-3
16. Nabi, H. & Consoli, S.M. & Chastang, J.F. & Chiron, M. & Lafont, S. & Lagarde, E. Type A behavior pattern, risky driving behaviors, and serious road traffic crashes: a prospective study of the GAZEL cohort. *American Journal of Epidemiology*. 2005. Vol. 161. No. 9. P. 864-870. DOI: 10.1093/aje/kwi110.
17. Alavi, S.S. & Mohammadi, M.R. & Souri, H. & Mohammadi Kalhori, S. & Jannatifard, F. & Sepahbodi, G. Personality, driving behavior and mental disorders factors as predictors of road traffic crashes based on logistic regression. *Iranian Journal of Medical Sciences*. 2017. Vol. 42. No. 1. P. 24-31.
18. Scott-Parker, B. & Oviedo-Trespalacios, O. Young driver risky behaviour and predictors of crash risk in Australia, New Zealand and Colombia: Same but different? *Accident Analysis & Prevention*. 2017. Vol. 99. P. 30-38. DOI: 10.1016/j.aap.2016.11.001.
19. Oviedo-Trespalacios, O. & Scott-Parker, B. The sex disparity in risky driving: A survey of Colombian young drivers. *Traffic Injury Prevention*. 2017. Vol. 19. No. 1. P. 9-17. DOI: 10.1080/15389588.2017.1333606.
20. Parker, D. & Lajunen, T. & Stradling, S. Attitudinal predictors of interpersonally aggressive violations on the road. *Transportation Research Part F: Traffic Psychology and Behaviour*. 1998. Vol. 1. P. 11-24. DOI: 10.1016/S1369-8478(98)00002-3.
21. Chossegros, L. & Hours, M. & Charnay, P. & Bernard, M. & Fort, E. & Boisson, D. & Sancho, P.O. & Yao, S.N. & Laumon, B. Predictive factors of chronic post-traumatic stress disorder 6 months after a road traffic accident. *Accident Analysis & Prevention*. 2011. Vol. 43. No. 1. P. 471-477. DOI: 10.1016/j.aap.2010.10.004.
22. Useche, S. & Cendales, B. & Gómez, V. Work stress, fatigue and risk behaviors at the wheel: data to assess the association between psychosocial work factors and risky driving on bus rapid transit drivers. *Data Brief*. 2017. Vol. 15C. P. 335-339. DOI: 10.1016/j.dib.2017.09.032.
23. Sharma, B.R. Road traffic injuries: a major global public health crisis. *Public Healt*h. 2008. Vol. 122. No. 12. P. 1399-1406. DOI: 10.1016/j.puhe.2008.06.009.
24. Singh, D. & Singh, S.P. & Kumaran, M. & Goel, S. Epidemiology of road traffic accident deaths in children in Chandigarh zone of North West India. *Egyptian Journal of Forensic Sciences*. 2015. Vol. 6. No. 3. P. 255-260. DOI: 10.1016/j.ejfs.2015.01.008.
25. Yau, K.K.W. Risk factors affecting the severity of single vehicle traffic crashes in Hong Kong. *Accident Analysis & Prevention.* 2004. Vol. 36. No. 3. P. 333-340. DOI: 10.1016/S0001-4575(03)00012-5.
26. Valent, F. & Schiava, F. & Savonitto, C. & Gallo, T. & Brusaferro, S. & Barbone, F. Risk factors for fatal road traffic crashes in Udine, Italy. *Accident Analysis & Prevention*. 2002. Vol. 34. No. 1. P: 71-84. DOI: 10.1016/S0001-4575(00)00104-4.
27. Vorko-Jovic, A. & Kern, J. & Biloglav, Z. Risk factors in urban road traffic crashes. *Journal of Safety Research*. 2006. Vol. 37. No. 1. P. 93-98. DOI: 10.1016/j.jsr.2005.08.009.
28. Lindqvist, K.S. Epidemiology of traffic accident in a Swedish municipality. *Accident Analysis & Prevention*. 1991. Vol. 23. No. 6. P. 509-519. DOI: 10.1016/0001-4575(91)90016-X.
29. Davis, G.A. Accident reduction factors and causal inference in traffic safety studies a review. *Accident Analysis & Prevention.* 2000. Vol. 32. No. 1. P. 95-109. DOI: 10.1016/S0001-4575(99)00050-0.
30. Pearson, J. & Stone, D.H. Pattern of injury mortality by age-group in children aged 0-14 years in Scotland, 2002-2006, and its implications for prevention. *BMC Pediatrics*. 2009. Vol. 9. No. 26. DOI: 10.1186/1471-2431-9-26.
31. Staubach, M. Factors correlated with traffic crashes as a basis for evaluating Advanced Driver Assistance Systems. *Accident Analysis & Prevention*. 2009. Vol. 41. No. 5. P. 1025-1033. DOI: 10.1016/j.aap.2009.06.014.
32. Calafat, A. & Blay, N. & Juan, M. & Adrover, D. & Bellis, M.A. & Hughes, K. & Stocco, P. & Siamou, I. & Mendes, F. & Bohrn, K. Traffic risk behaviours at nightlife: drinking, taking drugs,

driving, and use of public transport by young people. *Traffic Injury Prevention*. 2009. Vol. 10. No. 2. P. 162-169. DOI:10.1080/15389580802597054.
33. Hatfield, J. & Boufous, S. & Eveston, T. An evaluation of the effects of an innovative school-based cycling education program on safety and participation. *Accident Analysis & Prevention*, 2019. Vol. 127. P. 52-60. DOI: 10.1016/j.aap.2019.02.021
34. Primanto, A., & Undang, G. Impact evaluation of the road infrastructure development policy in improving the quality of education services in Indonesia. *Jurnal Mantik*, 2022. Vol. 5, N. 4. P. 2332-2339.
35. Clarke, S. Injuries and crashes: psychosocial aspects. *International Encyclopedia of the Social & Behavioral Sciences*. 2015. Vol. 12. P. 130-134. DOI: 10.1016/B978-0-08-097086-8.14108-X.
36. Xie, G. & Zhang, X. & Gao, H. & Qian, L. & Wang, J. & Ozguner, U. Situational assessments based on uncertainty-risk awareness in complex traffic scenarios. *Sustainability*. 2017. Vol. 9. N. 9. P. 1582. DOI: 10.3390/su9091582.
37. Zhang, G. & Yau, K.K.W. & Chen, G. Risk factors associated with traffic violations and accident severity in China. *Accident Analysis & Prevention*. 2013. Vol. 5. P. 18-25. DOI: 10.1016/j.aap.2013.05.004.
38. Useche, S.A. & Montoro, L. & Alonso, F. & Pastor, J.C. Psychosocial work factors, job stress and strain at the wheel: validation of the Copenhagen psychosocial questionnaire (COPSOQ) in professional drivers. *Frontiers in Psychology*. 2019. Vol. 10. P. 1531. DOI: 10.3389/fpsyg.2019.01531.
39. Useche, S.A. & Alonso, F. & Montoro, L. Validation of the walking behavior questionnaire (WBQ): a tool for measuring risky and safe walking under a behavioral perspective. *Journal of Transport & Health.* 2020. Vol. 18. No. 100899. DOI: 10.1016/j.jth.2020.100899.
40. Slavinskienė, J. Predicting future traffic offenders by pre-drivers' attitudes towards risky driving. *3rd International Conference on Health and Health Psychology*. 2017. DOI: 10.15405/epsbs.2016.07.02.3.

Received 15.01.2021; accepted in revised form 24.05.2022