Using The Cochran's Q Test to Identify Ordinary Drivers' Impact on Road Traffic Accidents

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Abstract. *Today, deaths and injuries from road traffic accidents are considered one of the main problems of modern society. It is well known that there are many factors contributing to road traffic accidents. We have divided them into three main categories: driver, road and vehicle. The article focuses on the study of the influence of the state, experience and driving conditions of the driver, the state of the road surface, as well as the technical condition of the vehicle. In the course of the study, we learned about the effect of age on road traffic accidents, and also looked at all the effects of the independent variables. The use of Cochran's Q-test can be key to assessing the degree of influence of the explanatory variables, and then a model will be created to assess the participants in road traffic accidents, which will provide a theoretical basis for preventing road traffic accidents. For this, an online survey was organized in the Google Forms format, which includes 25 questions.*

Keywords: road safety, traffic accident factors, Cochran's Q test analysis, statistics.

INTRODUCTION

According to the UN World Health Organization Newsletter, about 1.35 million people die from road traffic crashes every year, and between 20 and 50 million people suffer non-fatal injuries, many of which result in disabilities. Road traffic accidents (hereinafter referred to as RTAs) cost most countries 3% of their gross domestic product (GDP). More than half of the world's road deaths are "vulnerable road users" - pedestrians, cyclists and motorcyclists. 93% of road deaths occur in low-income countries, although these countries account for approximately 60% of all vehicles in the world. Road traffic injuries are the leading cause of death for children and young people aged 5-29. [1].

Unfortunately, according to statistics alone, an average of about 9-10 thousand road accidents occur annually on the territory of Uzbekistan, including more than 2 thousand of them - with human casualties. The main reasons for this sad statistics on highways are an increase in the speed limit of vehicles, ignorance, as well as a gross violation of traffic rules by its participants. At the same time, if violation of traffic rules by pedestrians threatens exclusively their health, then similar actions of vehicle drivers are fraught with grave consequences both for the drivers themselves and for other road users - drivers of other vehicles, their passengers and, in fact, for pedestrians [2].

The causes of road traffic accidents can be attributed to several factors such as drivers, vehicles, roads, environment, etc. Therefore, it is important to investigate the causes and factors that influence road traffic accidents. In our study, we used the Cochran Q-test to assess the impact of certain factors on road safety and identified some conclusions from the study.

LITERATURE REVIEW

Currently, there are several methods for predicting accidents. Road accidents were predicted using regression analysis [3, 4]. Social risks were investigated for predicting road traffic accidents by calculating the Smid model [5]. Poisson's regression model is used in studies to predict accidents in road traffic [6]. Also today the forecast of mortality and injuries in road traffic using artificial neural networks is relevant [7, 8, 9].

Researchers have built a microscopic forecasting model using a Bayesian network, with weather, time, traffic flows and speed as independent variables [10]. Other researchers have built a model for predicting traffic accidents using factor analysis and logistic regression, taking into account visibility, humidity, precipitation and other meteorological factors as independent variables [11]. However, the model took into account only meteorological factors and did not take into account the most key drivers of road traffic accidents, such as drivers and road conditions. The environment, road users and the vehicle affect the driver's experience and their important factors that can lead to a road accident. Because in most cases, road accidents happen due to driver errors.

Thus, this article has attempted to clarify the causes of road accidents by paying more attention to the status of vehicle owners, gender and age. This study provides a theoretical basis for predicting and assessing the drivers of road traffic accidents. 23 explanatory variables will be selected according to the effects on drivers, such as vision problems, vehicle defect, poor psychological state, etc.

To calculate the results of the survey of respondents and assess the independent variables, the Cochran Q-test was chosen, since when studying studies on assessing heterogeneity in a meta-analysis, the relevance of this method was revealed [12]. For example, the Cochran Q test has been used to provide multifactorial assessment and targeted interventions to prevent falls and injuries in older adults in communities and emergency settings [13], the prevalence of post-traumatic stress disorder among road traffic crash survivors has been investigated [14], and meta- analysis of alcohol prevalence among fatal motorcyclists [15], analysis of the impact of frontal airbags on driver mortality [16], etc.

STUDY

The study is based on an online survey that helps evaluate hypothetical road traffic accident scenarios. It includes gender: male and female, age group: young, middle-aged and older drivers. For each scenario, the respondents answered the questions (for example, about speeding) in the questionnaire that, in their opinion, could contribute to the occurrence of a road traffic accident. To assess the factors, the Cochran Q-test was used as the most appropriate method for calculating the results of the survey of respondents and identifying the most significant factors affecting road accidents.

The Cochrane Q test is a nonparametric statistical test used to test whether two or more treatments have the same effect on groups. In this case, the group's response can take only 2 possible values (denoted as 0 and 1). The criterion was named after the researcher William Cochran. When using the Q-test, it is assumed that there are only two types of outcomes (eg, success / failure, 1/0) and there are more than 2 groups of the same size. The criterion determines whether the success rate is the same in different groups. It is often used to determine whether different observers of the same phenomenon get a similar result (variability of subjective expert judgment) [17].

To use the Cochran tests, twenty-three road traffic accident factors that can lead to a road traffic accident will be selected as independent variables. These twenty-three independent variables were selected by examining the factors that influence the road. For example, some of the selected factors: vision problems, vehicle malfunction, poor psychological status can affect the fact that a road traffic accident occurs [Brightman, K.A., Kirley, BB, McCart, A.T. , Chaudhary, N.K., 2008]. As well as unethical driving (speeding problems, visibility distances, phone use while driving, drug use and behavior that can cause 59.8% of all accidents [Md Mahabubul Bari Debela Deme Jima 2018]. In addition, the role of gender, traffic volume, alcohol consumption, driving experience have also been used as serious factors in road traffic accidents [Imran Ashraf, Sujung Khur, Muhammad Shafiq, Yong van Park, 2019]. 23 questions, including questions about the selected twenty-three crash factors.

The study is based on an online survey to assess hypothetical road traffic accidents. It includes gender: male and female, age group: young (23-38 years old, middle age (39-54), old drivers (over 55)). In this study, respondents were presented with hypothetical questions describing an encounter involving a young man or woman. , middle age or senior driver. For each factor, respondents answered twenty-three questions in the questionnaire that, in their opinion, could contribute to road accidents. After receiving the results of the online questionnaire, they were used as binary data using a Q-test.

More than 500 respondents (98% men, 2% women) took part in this study. The number of female drivers is small, so we did not add their responses to this study.

All questions were asked using a Google questionnaire and its web address was sent to a group of respondents on social media. But the older drivers (over 55) didn't come as often because most of them didn't use social media. As a result, we had to make a paper questionnaire for old drivers.

METHOD

To test the statistically significant effects of driver age and gender on driver-generated factors, we tested the relationship between age and gender in terms of the likelihood that factors were generated for at least one of the scenarios for each driver's age and gender. For this study, Cochran's Q-test was used, as this test is suitable for related samples of binary data. To test for statistically significant differences in public-generated factors, a chi-square ($\chi2$) test was performed, which is suitable for independent examples with binary data.

The basic formula of the Cochran Q-test is used to calculate the probabilistic factors of road traffic accidents. It looks like this (1):

$$Q = k \times (k-1) \times \frac{\sum_{j=1}^{k}\left(C_j - \frac{N}{k}\right)^2}{\sum_{i=1}^{n_f} R_i \times (k - R_i)}$$

(1)

k *is the number of treatments,*

Xj is the column total for the ji treatment,

b is the number of blocks,

Xi • is the row total for the ith block,

N is the grand total..

After the survey, the Cochran Q-test was calculated in the following order:

1. The number of variables (k) is determined, the total number of cases (blocks) (nf) is determined;
2. 2. The total number of positive responses (success) for each variable and the total number of all responses (2, 3) were determined;

$$C_j = \sum_{i=1}^{n_f} x_{ij} \quad (2) \qquad \left(C_j - \frac{N}{k}\right)^2 \quad (3)$$

3. 3. Determined the total number of positive answers (success) for each case (4);

$$R_i = \sum_{j=1}^{k} x_{ij} \quad (4)$$

4. Multiply each result of step 3 by the number of failures in the appropriate case;

$$R_i \times (k - R_i) \quad (5)$$

5. Determined the degree of freedom of argumentation (6);

$$df = k - 1 \quad (6)$$

RESULT

All 23 factors can be used in the Cochran Q-test, which were selected and are categorical variables. They will be summarized and abstracted to be 23 dichotomous variables in the next analysis.

The names of independent variables and the percentage of the likelihood of the influence of factors on road traffic accidents are shown in Table 1.

Table 1.

Selected independent variables

№	Independent variables	Male drivers' age		
		Younger (23-38)	Middle age (39-54)	Older (older than 55)
1	over the 5 years driving experience	52.72	88	95
2	an active driver in over the last 5 years	61,81	78,21	45,36
3	occuring dangerous manoure	36,36	34,6	11,2
4	losing the route	10,9	10,9	7,3
5	alcohol consumption	12,72	45,6	1,3

6	failed to concentration during the driving the car	16,36	25,6	87,6
7	self-confidence	21,81	65,4	76
8	distruction (phone, signals, high level voice)	63,63	58,34	87,6
9	being disturbed by road conition	72,72	92,4	85,6
10	hastening to the destination	57,27	45,6	32,5
11	how often being in the traffic congestion	67,27	58,3	87,3
12	eyesight problem	18,18	48,4	88,4
13	being in the traffic congestion (rarely, often)	62,27	45,32	66,5
14	health problem(affect on driving)	1,81	35,3	65,3
15	slow driver reaction	41,84	38,4	56,3
16	weather	65,45	56,3	87,5
17	vehicle defect	1,81	35,6	51,2
18	occurance road accidents	34,54	48,3	75
19	attendance in road accident in last 5 years	18,81	45,6	13,3
20	driving high speed	45,45	65,8	14,2
21	listening music in the car during the driving	40	55,6	17,6
22	using the mobile phone during the driving	67,27	57,27	5,4
23	giving the chance to illegal road crossers	21,81	41,36	65,4

The result of the variables in the Cochran Q test equation was identified and recorded in Table 2.

Table 2.
Variables in the Q-Test Equation

Total number of independent variables	Q-critic	p-value	Alpha	df	Sig
23	5.99	1.4	0.05	2	yes

Where:

Q- estimating the parameters of the Q-criterion equation;

The **P**-value is a Cochran Q-test that estimates the likelihood of each factor;

df - the degree of freedom of argumentation;

Sig - significance level.

CONCLUSION

This study used 23 factors that are highly associated with a road traffic accident, and were developed taking into account many aspects such as driver experience, reaction, confidence, alcohol consumption, etc. Using the Cochran Q-test, the main factors of the likelihood of road traffic accidents were determined. The results of this study can be used to determine which group of drivers are likely to experience road traffic accidents and provide suggestions for safe driving.

From a survey of respondents, we learned about the effects of age on road traffic accidents, and looked at all the effects of the explanatory variables. The use of Cochran's Q-test can be key to assessing the degree of influence of the explanatory variables, and then a model will be created to assess the participants in road traffic accidents, which will provide a theoretical basis for preventing road traffic accidents.

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