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ANALYSIS OF TRAFFIC ACCIDENT RATE INVOLVING VULNERABLE CATEGORIES OF ROAD USERS

АНАЛИЗ ДОРОЖНО-ТРАНСПОРТНОЙ АВАРИЙНОСТИ С УЧАСТИЕМ НЕЗАЩИЩЕННЫХ КАТЕГОРИЙ УЧАСТНИКОВ ДОРОЖНОГО ДВИЖЕНИЯ

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Abstract. *The object of the research is the accident rate among vulnerable categories of road users (pedestrians, cyclists, and animal-drawn transport drivers) on the territory of the Gomel region of the Republic of Belarus. With their participation, a significant number of road accidents occur in Belarus. Given the specifics of such categories of road users, the severity of the consequences of these accidents is usually high. Therefore, the development of measures to improve the safety of vulnerable categories of road users will significantly affect the situation with accidents.*

Keywords: *road safety, pedestrian, cyclist, traffic accident.*

Introduction. The accident reduction problem is urgent and development of measures to reduce road traffic injuries [1, 2].

As compared to developed countries, the road accident rate in the Republic of Belarus is characterized by a high fatality risk in road traffic accidents and vehicles dangerous to humans as well as a high severity of consequences, which is 3 to 15 times higher than similar indicators in countries with developed automobilization [3].

On the territory of the Gomel region there is a set of measures to improve road safety "Good Road". One of the areas of work provided for in this document is the development of measures to improve road safety for vulnerable categories of road users. This article presents the results of a statistical analysis of accidents involving such categories of road users in the Gomel region and, based on it, suggests ways to reduce accidents involving vulnerable categories of road users.

Statement of basic materials. To assess the dynamics of accidents and to identify significant influencing factors, a large amount of information is required. The given objective is very ambitious and requires a large number of observations to draw serious conclusions. As a source of information, we use the database of the State Traffic Inspection of the Department of Internal Affairs of the Gomel Oblast Executive Committee of the Gomel Region on road traffic accident victims over the last twelve years from 2009 to 2020. The number of people dead and injured in road traffic accidents involving vulnerable road users is taken as the accident rate.

The main tool for solving the problem is the statistical analysis of accident data with participation of vulnerable categories of road users. The main indicators that

characterize the dynamics of changes in accidents in the Gomel region with the participation of this category of road users for the period from 2009 to 2020 are shown in Figure 1.

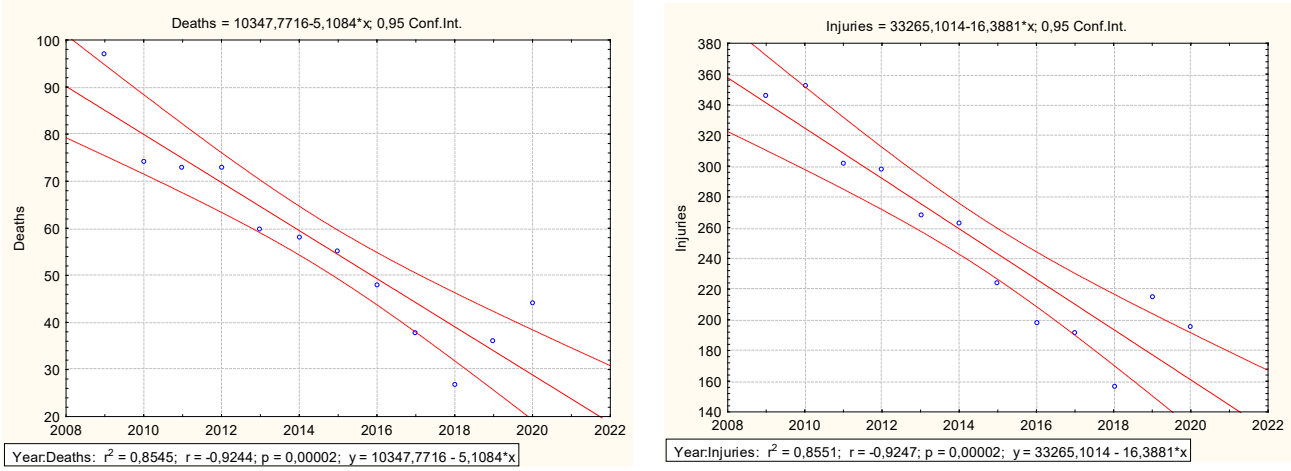


Fig. 1 Changes in the number of road traffic deaths and injuries among vulnerable categories of road users

Figure 1 shows that there was an increase in the number of deaths in 2019 and 2020. The increase in the number of injured was observed only in 2019. The dynamics of changes in the number of dead and injured is well described by linear regression. At the same time, the average annual number of dead is 5.1 people, and the number of injured is 16.39 people. Despite the increase in the number of dead and injured in recent years, in general, during the period under review, there is a tendency to reduce their number. In addition, this allows us to talk about the presence of a trend both in absolute values of indicators and in relative ones.

A negative point that requires attention is the trend of increasing the proportion of dead and injured cyclists, which, against the background of the trend of reducing their absolute values, indicates that the decline in the number of dead and injured cyclists is less rapid than other categories of vulnerable road users.

To assess the significance of the impact of various factors on the number of deaths and injuries in road accidents with vulnerable categories of road users, Data Mining technology was used [4]. The results of the analysis are shown in Figures 2-3.

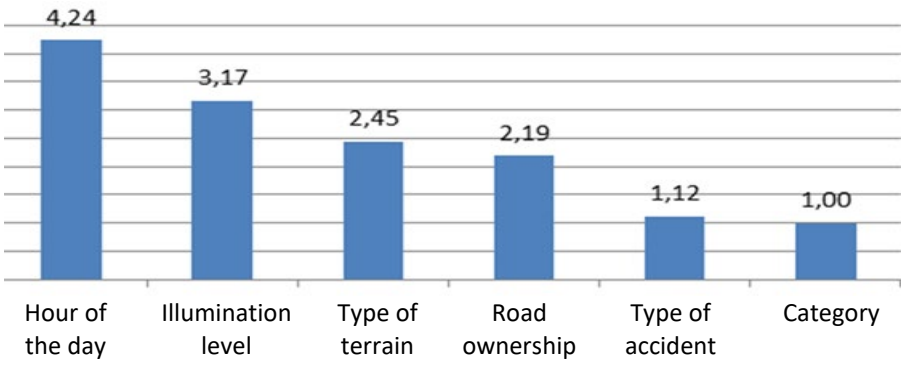


Fig. 2 Factors affecting the number of deaths in road accidents involving vulnerable categories of road users and their significance

Figure 2 shows that the number of dead is significantly influenced by five factors, and the number of injured is six factors (Figure 3). The most significant factors, both for the number of dead and the number of injured, are the hour of day, illumination level, type of terrain, and road ownership.

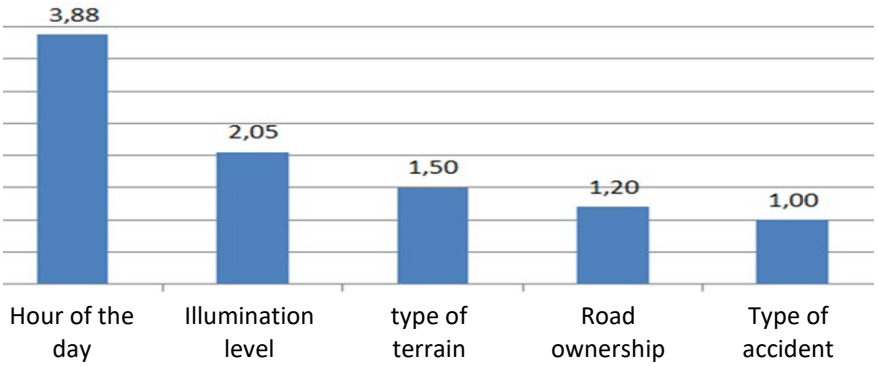


Fig. 3 Factors affecting the number of injuries in road accidents involving vulnerable categories of road users and their significance

For the factors that significantly affect the accident rate (see Figures 2-3), a variance analysis was performed. Figure 4 shows box-and-whiskers diagrams of the number of people dead and injured in road accidents by illumination level, type of terrain, and road ownership.

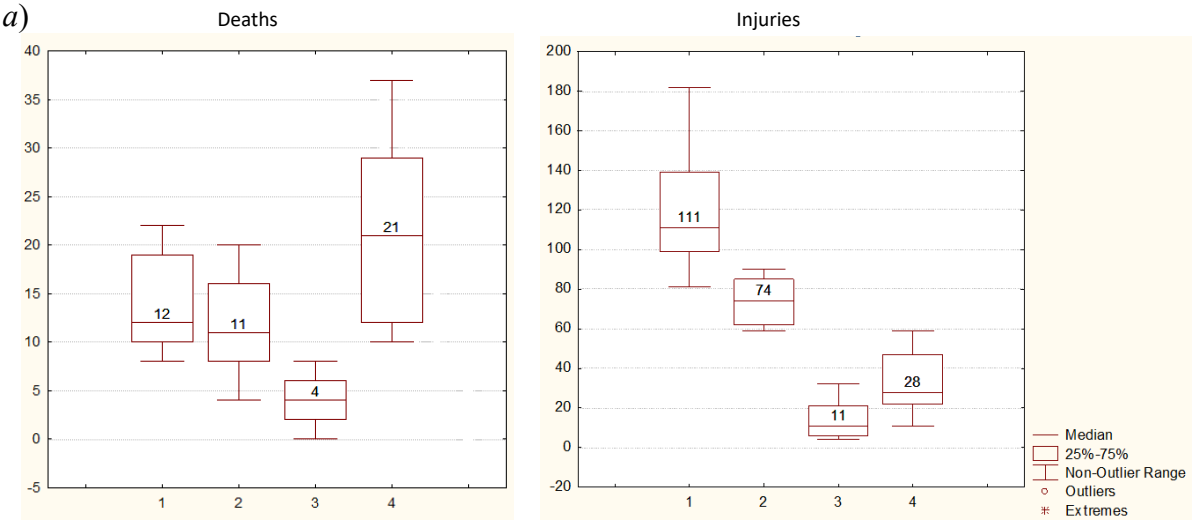
The analysis of Figure 4 shows:

1. The greatest number of deaths (approximately 21 people annually) occurs at night on road sections where there is no artificial lighting. The highest number of injuries (approximately 111 people annually) occurs during daylight hours (Figure 4, a).

2. The highest number of deaths (approximately 27 people annually) occurs in districts. The largest number of injuries (approximately 120 people annually) falls on the city of Gomel (Figure 4, b).

3. The greatest number of deaths (approximately 21 people annually) falls on the roads maintained by the Gomelobldorstroy enterprise. The highest number of injuries (approximately 98 people annually) occur on roads maintained by the GCRCRT enterprise (Figure 4, c).

a)



(1 – daylight hours; 2 – night time, outdoor lighting is on;
3 – night time, outdoor lighting is not turned on or faulty; 4 – night time, there is no outdoor lighting)

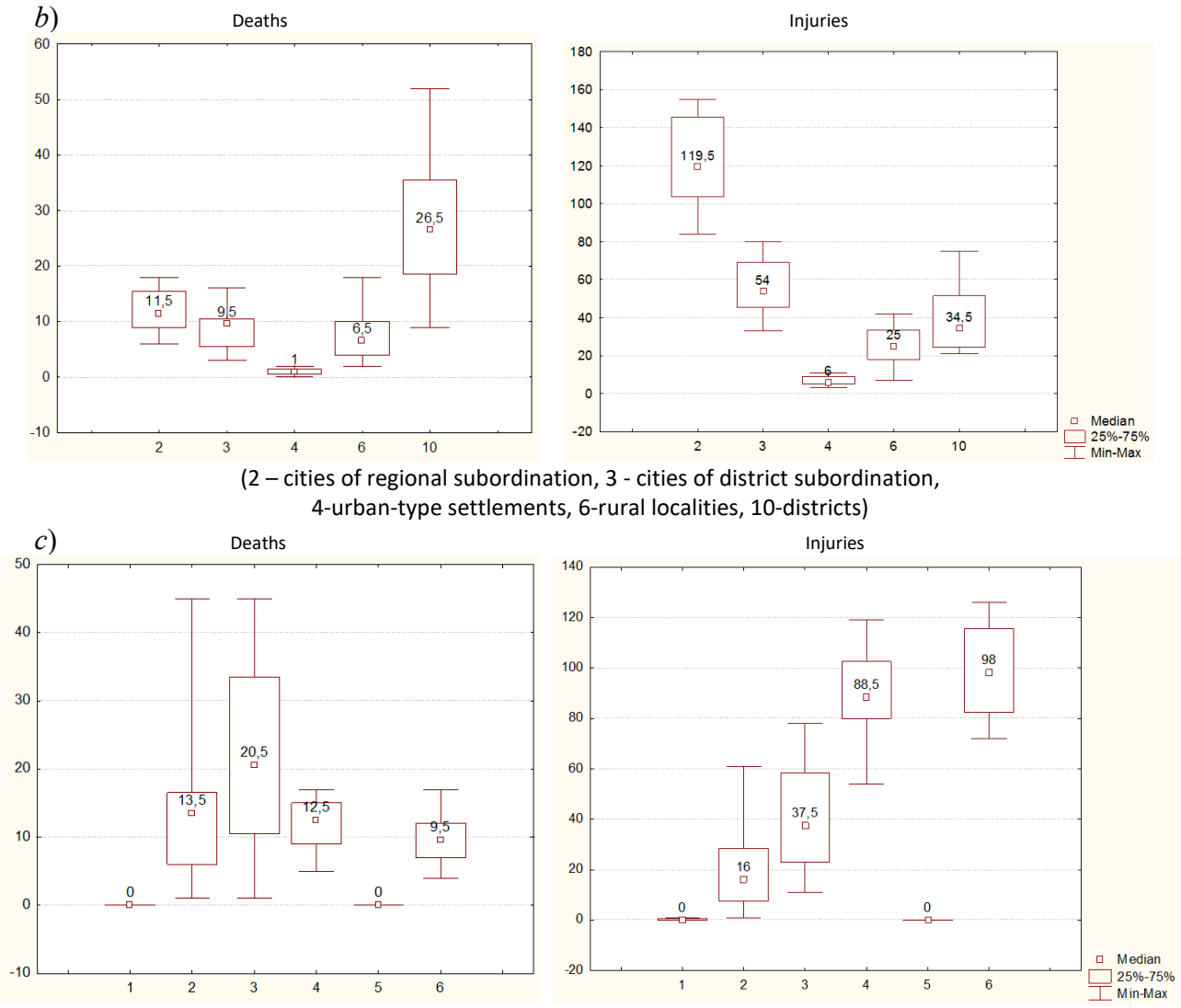


Fig. 4 Box-and-whiskers diagrams of the number of dead and injured in road accidents: a) illumination; b) type of terrain; c) road ownership

According to the criteria "Kruskal-Wallis test" and "F test, p (ANOVA)", it was found that the differences in the number of dead and injured in the considered groups of each factor are significant.

Conclusions.

The influence of various factors on accident rates with the participation of vulnerable categories of road users is analyzed using the methods of Data mining and variance analysis. Based on the results of the study, the following conclusions can be formulated:

1. There is a growing trend in the proportion of dead and injured cyclists in the total number of dead and injured vulnerable road users.

3. The number of people dead and injured in road accidents is significantly affected by the following factors: hour of day, illumination, type of terrain, road ownership, category and type of road accident. This makes it necessary to:

– develop measures to reduce the use of private vehicles;

– carrying out a topographical analysis of the Gomel region with the development of measures, including the arrangement of artificial lighting and traffic light regulation at pedestrian crossings.

4 It is necessary to conduct a survey of a sufficient number of pedestrian crossings, followed by an analysis of the impact of various factors on the accident rate.

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Аннотация. *В статье приведены результаты статистического анализа аварийности с участием незащищенных категорий участников дорожного движения (пешеходов, велосипедистов и возчиков гужевого транспорта) на территории Гомельской области республики Беларусь. С их участием в Беларуси происходит значительное количество дорожно-транспортных происшествий. Учитывая специфику таких категорий участников дорожного движения тяжесть последствий этих аварий, как правило, высока.*

Используя методы Data mining и дисперсионного анализа, проанализировано влияние различных факторов на показатели аварийности с участием незащищенных категорий участников дорожного движения.

Предложены мероприятия по повышению безопасности движения незащищенных категорий участников дорожного движения, внедрение которых позволит значительным образом повлиять на ситуацию с аварийностью и уменьшить последствия дорожно-транспортного травматизма.

Keywords: *безопасность дорожного движения, пешеход, велосипедист, дорожно-транспортное происшествие.*

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