

ACCIDENT RATE AND VICTIMS OF ROAD TRAFFIC IN A BIG CITY

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ABSTRACT

Based on the statistics of road accidents, an analysis of accident and injury rates on the roads of Irkutsk was carried out. It is shown that, for the most part, the causes of road accidents are violation of traffic rules by drivers and pedestrians, unsatisfactory road conditions. It was revealed that the greatest

number of accidents occurs in the summer-autumn period. Most often, vehicle collisions and pedestrian collisions are recorded. About 40 % of road accidents with victims are committed in the foci of accident rate, the distribution of which directly depends on density of settlement of the territory and the functional specifics of the city's administrative units.

Keywords: motor transport, road traffic accident, accident rate on roads, foci of accident, severity of accident consequences, road safety.

Background. In Russia, the problem of accidents associated with road transport has become particularly acute in recent years. According to the official statistics, annually on the country's roads there are about 200 thousand road accidents (RA). The actual number is much larger, since the current recording rules assume the inclusion in the state statistical reporting of information only about RA in which people were killed or injured [1]. At the same time, «injured» means a person who received bodily injuries, which caused his hospitalization for at least one day, or the need for outpatient treatment [2]. In reality, they are victims with traumas, at least, of moderate severity. Outside of reporting, there are also accidents that have arisen as a result of violation of safety and operation regulations for vehicles, including during car or motorcycle sport events.

Objective. The objective of the author is to consider problems associated with the accident rate on the roads of a big city, using the example of Irkutsk.

Methods. The author uses general scientific methods, comparative analysis, statistical data, evaluation approach.

Results.

1.

Irkutsk is a large industrial city with an area of 277 sq. km and a population of more than 620 thousand people. Of 16 446 km of public roads of local importance registered in Irkutsk region, Irkutsk accounts for only 5 %, or 796,5 km [3]. Nevertheless, about a third of road accidents (RA) with the victims takes place in the regional center.

According to the data of the Department of the State Traffic Safety Inspectorate of the Municipal Authorities of the Ministry of the Internal Affairs of Russia «Irkutskoe», every year a considerable number of RA are registered in the city, where about 1500 people are injured to various degrees of severity (Table 1).

Despite a significant proportion of RA in Irkutsk (34–37 %), the share of deceased from the total

number in the region did not exceed 10–14 %. The individual risk of death, determined by the ratio of the number of deceased in RA to the number of residents, for Irkutskians in 2014–2015 was on average significantly lower than the region-wide values and corresponded to the value of the acceptable (permissible) risk in international practice of 10^{-6} fatal injuries/(persons/year) – for residents of the region as a whole, in recent years it was $2,0\text{--}2,2 \cdot 10^{-4}$ fatal injuries/(persons/year). Relative indicators (the number of deaths in 100 RA and per 100 thousand residents) were also significantly (2–3 times) less. Apparently, the availability and speed of first aid is of decisive importance here. It is known that untimely arrival of first aid is one of the main causes of death in a road accident [4].

Most of the accidents that occurred in Irkutsk, was associated with the collision with on the pedestrian and the collision of cars (Pic. 1). In this statistics on the city practically did not differ from the regional data [5]. The share of other types of accidents accounted for about 19 % of the total. The distribution of the days of the week varied in certain years, the decrease in the number of accidents on Sunday remained unchanged, which is quite understandable – on weekends, when there are fewer cars on the streets, accidents are less likely. The greatest number of accidents occurred in the summer-autumn period (Pic. 2), in these months on the roads, the intensity of the movement of private cars sharply increases.

The share of RA that occurred through the fault of drunk drivers is small and amounted to about 2 %. Although, most likely, the figure is understated, as some drivers refuse to undergo the survey. In 2015, this happened, for example, in 75 RA. Most of the accidents involving drunken drivers occurred on weekends. The daily dynamics of such accidents did not have a clear dependence, although there was a tendency to increase them in the evening.

The lion's share of the road accidents in which the minors were injured was related to the collision with

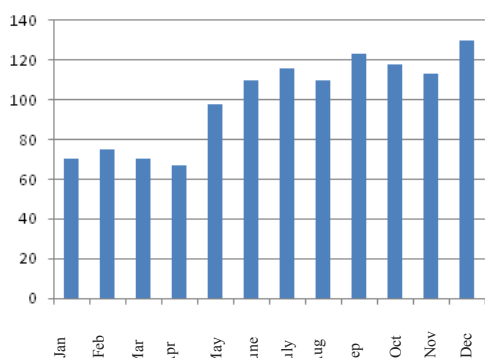
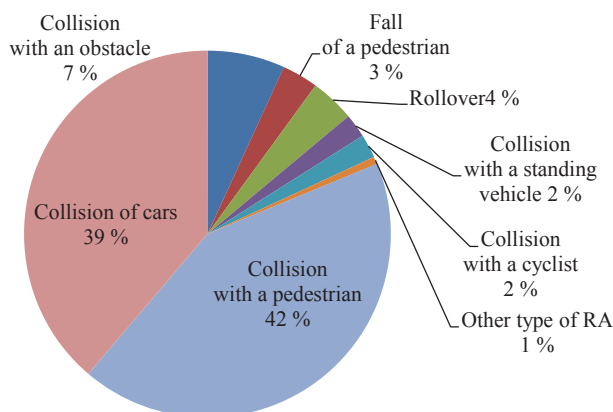
Table 1

Summary of road accidents in Irkutsk

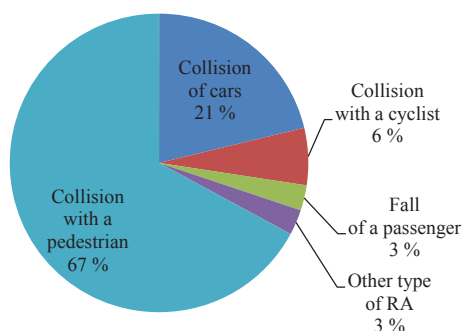
Indicators	2014	2015
Total RA	26160	17786
Number of RA with victims	1157	1240
Fatal injuries, persons	71	48
Injuries, persons	1454	1478
Number of RA with children under 16 y.o.	116	146
Children, fatal injuries, persons	3	3
Children, injuries, persons	122	148
Damaged vehicles	1756	1869



Pic. 1. Structure of RA in Irkutsk.



Pic. 2. Graph of accident rate in Irkutsk.



Pic. 3. Structure of RA involving children under 16 y. o. in 2015.

a pedestrian (Pic. 3). Of the total number of accidents involving children under the age of 16 due to their fault in 2015, 43 RA occurred, i.e. about 30 %. Of these, four were caused by children driving a bicycle, 39 by the fault of children on the roadway in violation of traffic rules. These accidents could have been avoided, because often they occur because of negligence and oversight of adults. In fairness, it should be noted that

in Irkutsk, the training of children in traffic rules is conducted in many educational organizations, an annual contest-festival of young traffic inspectors of «Safe Wheel» is held. Its priority task is to prevent children's road traffic injuries, to involve minors in promoting safe behavior rules at streets and roads.

One of the main causes of RA every year is the low discipline of drivers and pedestrians, manifested in non-compliance with traffic rules. The unsatisfactory road conditions also have a significant impact on the accident rate, in particular, half of RA with the victims in 2014–2015 occurred precisely for this reason.

2.

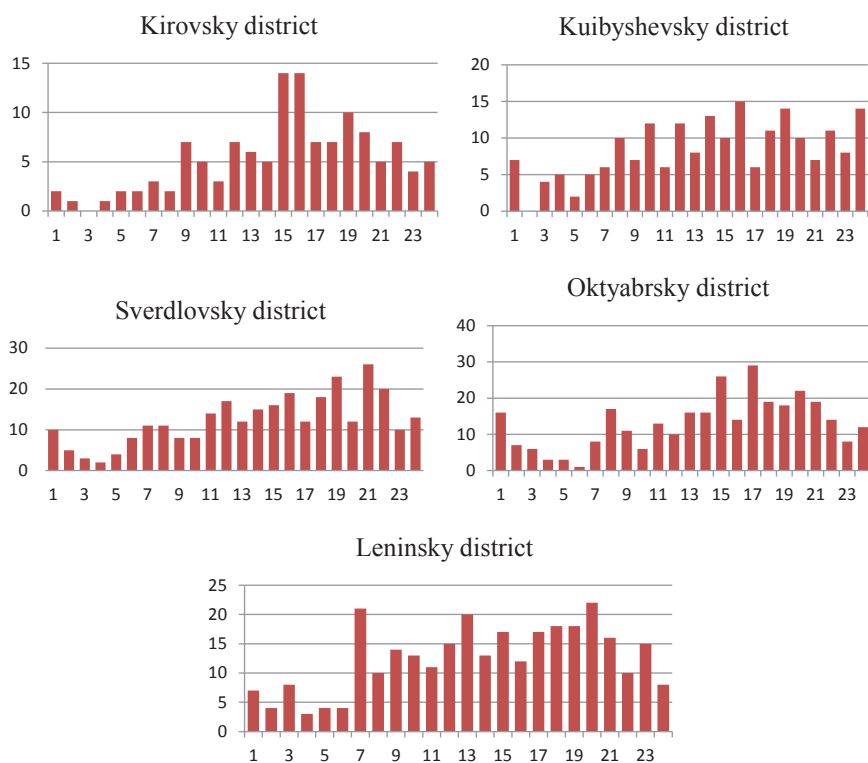
Territorially Irkutsk is divided into five districts: Kirovsky, Kuibyshevsky, Oktyabrsky, Sverdlovsky and Leninsky, although the administrative division assumes the presence of four districts with the unification of Kirovsky and Kuibyshevsky districts into Pravoberezhny district (Pic. 4). Roughly the same and the largest in terms of area are Leninsky and Pravoberezhny districts, which occupy 75 % of the city's territory, the most densely populated are Sverdlovsky and Oktyabrsky districts.

Despite the difference in area and population, the number of RA with the victims is distributed around the districts approximately evenly. Recalculation of the accident rate per unit area leads to the first place Oktyabrsky district – in relative units the number of RA here is 1,8 times higher than in Sverdlovsky and 3,5–3,7 times higher than in Pravoberezhny and Leninsky districts.

The distribution of the number of RA with injured depending on the time of the day in the districts of the



Pic. 4. Administrative-territorial division of Irkutsk: districts – Pravoberezhny (1), Oktyabrsky (2), Sverdlovsky (3), Leninsky (4).



Pic. 5. Day dynamics of RA by the districts of Irkutsk in 2015.



Pic. 6. Dynamics of indicators of RA in foci of accident rate in Irkutsk.

city is not uniform. If you do not take into account the decrease in the number of RA during the night, there are noticeable differences between the districts that make up Pravoberezhny district. In this connection, the analysis of the accident rate in this case is expedient to be carried out by districts. For example, let's consider the data for 2015 (Pic. 5).

The histograms for Kirovsky district have a clear peak from 14 to 16 hours. The most emergency time of the day – from 14 to 20 hours: for a six-hour interval 47 % of all RA occurred. In Kuibyshevsky district, except for the night period, the occurrence of accidents was almost independent of the time of day, and periodic ups and downs can be explained by errors in the registration of RA. Sverdlovsky district was characterized by an increase in accident rate

throughout the day, a decline which was observed only after 22 hours. A close to this type of distribution with the obvious mode, which falls on the evening hours, was observed for Oktyabrsky district. The distinctive morning peak of the accident rate was noted only for Leninsky district – the most remote from the city center and combining the features of a sleeping and industrial area.

3.

About 40 % of RA with victims in Irkutsk occur in so-called foci of accidents – sections of the city's roads up to 200 meters in length or in crossroads, during which three or more RA of one type occurred, or five or more different types (Pic. 6).

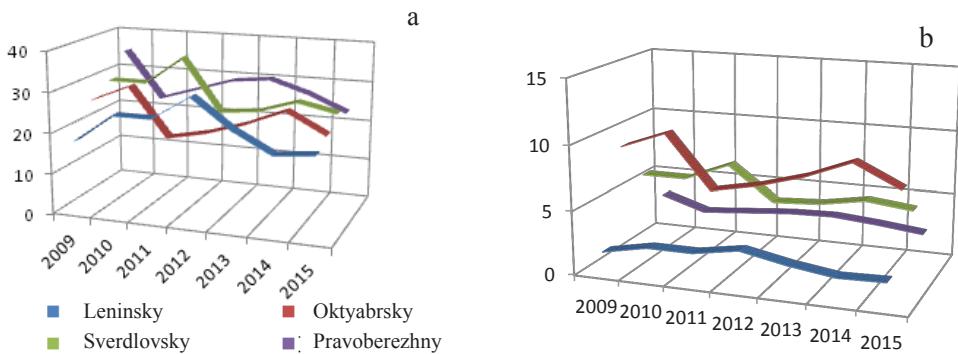
Foci of accidents are, as a rule, slightly more than a hundred sites a year. The maximum number of foci



Table 2

Indicators of road accidents in foci of accident rate

Years	2008	2009	2010	2011	2012	2013	2014	2015
Pravoberezhny district								
RA	232	141	109	142	111	115	112	118
Died	12	4	5	8	6	8	10	3
Injured	290	186	122	162	151	148	136	134
Sverdlovsky district								
RA	272	159	132	186	109	94	136	124
Died	15	7	5	6	11	10	12	9
Injured	337	205	172	244	150	110	161	138
Oktyabrsky district								
RA	257	176	156	118	91	104	144	127
Died	8	7	10	8	4	9	8	8
Injured	318	235	221	151	135	131	189	161
Leninsky district								
RA	233	93	132	124	121	101	89	101
Died	18	2	15	6	14	4	11	2
Injured	274	121	152	162	161	145	105	111



Pic. 7. Distribution of foci of accident rate by the districts of Irkutsk: a – absolute values, b – per 10 sq. km.

occurred in 2006–2008 (150–160 sections), during the same period, the maximum number of RA and victims was recorded (Pic. 6). In the future, there was a tendency to decrease the accident rate for all indicators, although it is not so obvious with respect to fatalities. The smallest number of foci of accident rate (90) was recorded in 2015.

In terms of absolute values, the foci of accident rate are distributed more or less evenly in the districts of the city (Pic. 7a). If we include their number per unit area (10 sq. km), we get a completely different picture (Pic. 7b): most of the centers are in Oktyabrsky and Sverdlovsky districts. Their formation is associated with a high population density.

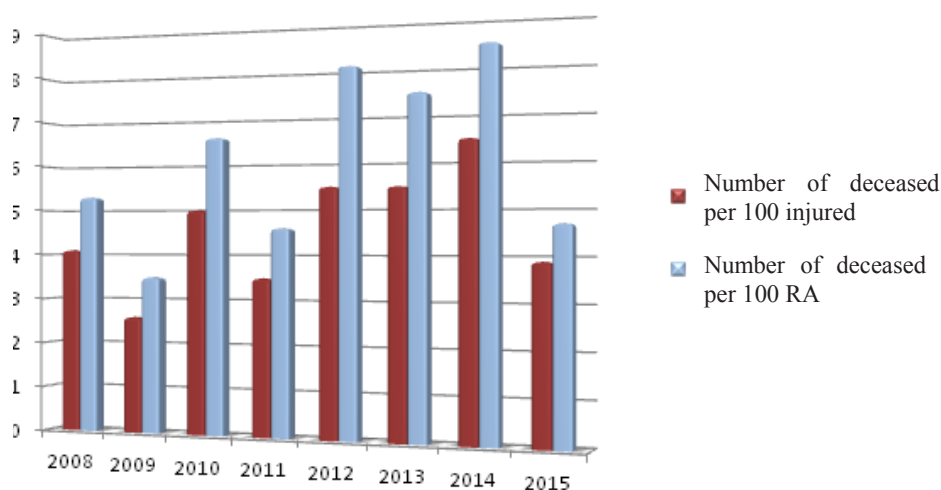
Oktyabrsky district is the smallest in area (by comparison, 3,5 times smaller than Leninsky). In the formation of foci of accidents in this case, apparently, the decisive role is played by population density – in addition to the high density of residents, the district is distinguished by its prestige in office terms. In 2015, for example, five foci of accidents from Oktyabrsky district were included in the top ten most accident sites in Irkutsk (according to the number of accidents and the number of injured).

In Pravoberezhny district, the proportion of its two constituent parts accounts for an approximately equal

number of foci of accidents. However, Kirovsky district – the historical and administrative center of the city – is only a small part of the district, so there is less chance of getting into an accident in Kuibyshevsky district. This is understandable, given its architectural features. Irkutsk jail, with the construction of which in 1661 the city originates, was founded mainly within the boundaries of the present Kuibyshevsky district, and to this day a large part of it is made up of the private sector, and most of the buildings are low-rise. Foci of accidents at the same time are formed only on a few busy streets, connecting the city's districts, as well as emerging on intercity routes.

Taking as an indicator the ratio of the number of RA to the length of roads, it can be noted that the most unfavorable (with both total and fatal RA) is again Oktyabrsky district. Taking into account the total number of accidents, Leninsky district was relatively prosperous, but the territorial picture of RA is characterized not so much by the general rate of accident rate as by the death rate. So, a small share of RA with a fatal outcome is allocated to Pravoberezhny district.

A considerable part of the injured (total number of dead and wounded) on the roads is connected with the foci of accident rate (Table 2). The severity



Pic. 8. Degree of severity of RA in foci of accident rate.

of the consequences of RA, which is determined by the number of deceased in 100 RA and the number of deceased per 100 injured, did not have a clear trend in the period under study. Only the rise in the quantitative values of these indicators for the city in 2012–2014 (Pic. 8) was clear, although as for the number of RA this was a very prosperous period (Pic. 6).

The severity of the consequences of RA in Oktyabrsky district was, as a rule, lower or close to the average urban values. The Sverdlovsky district is the largest in terms of the population in this respect almost every year in the risk zone (the number of deceased in 100 RA and the number of deceased per 100 injured are above the average for the city). The most favorable situation in the city on the consequences of RA – in Pravoberezhny district, in the borders of it – in Kirovsky district. Possible reasons for this are the features of urban development. Kirovsky district as a historical center of Irkutsk is characterized by narrow streets, often without the possibility of expansion. The low throughput of streets in recent years has led to the formation of traffic jams in the evening hours. According to the Yandex.Probki web service, eight-point jams (on a ten-point scale) have already been registered on the central streets of the city with a speed of transportation of no more than five kilometers per hour. Low speed and high density of cars in the flow lead to an increase in the total number of RA, but road traffic injuries and, especially, the mortality of outcomes are small.

Conclusions. There are reasons to believe that the situation with ensuring road safety in Irkutsk is quite complicated. First of all, the causes of RA are non-observance of traffic rules by drivers and pedestrians, unsatisfactory road conditions. The most frequent recorded accidents are collisions of cars and collisions with pedestrians with 1–2 injured. The occurrence of accidents has a strong time dependence. The number of accidents is greater in

the summer-autumn period, less in the winter months. The peak of accidents every day falls on the evening hours, when people return from work.

About 40 % of RA with victims in the city are committed in the foci of accident rate – small sections of roads or crossings, on which three or more RA of one type or five or more different types occurred during the year. The distribution of foci of accidents directly depends on the density of living of the population and the functional specificity of the administrative units of the city. Comprehensive analysis of data on accidents in the foci of accident rate can be the basis for developing solutions in the field of road safety.

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