

Analysis of car accidents involving children

Introduction

Road transport is the most unsafe of all human beings. According to all data, it is the accident that is put in the first place by the number of dead and injured. By these parameters, cars significantly overtake the rail, air and water transport.

Traffic accidents are the main cause of death. They occur for many reasons, among which are both technological and human factors. An accident can happen because of a tired driver, due to icing of the road surface or a malfunction of the brake system. However, the risk of getting into an accident is often influenced by external factors such as the day of the week, weather conditions and the quality of the asphalt pavement.

Identification of factors significantly influencing the risk of a traffic accident when solving the problem of improving road safety should be considered as a priority task. This will make decisions that really can eliminate the third-party causes of accidents. The given example is devoted to the analysis and revealing of the similar reasons.

The results and conclusions made here can be useful for improving road safety or for insurance companies planning to introduce driver and passenger life and health insurance programs.

A large amount of information is required to conduct an analysis in order to identify factors that significantly influence the size of an accident. In fact, the task at hand is very dimensional and requires a large number of observations to build serious conclusions. The open data of the Committee on Legal Statistics and Special Accounting of the General Prosecutor's Office of the Republic of Kazakhstan was used as a source of information [1].

According to paragraph 13 of Article 12 of the Law of the Republic of Kazakhstan “On State Legal Statistics and Special Accounts”, since 2011, the Committee on Legal Statistics and Special Accounts of the General Prosecutor’s Office of the Republic of Kazakhstan has become the authorized body for maintaining a unified statistical record of road accidents causing death or injury to people . Accounting allows you to analyze the statistics of this category of incidents in the context of regions, district centers and other cities of Astana, Almaty, etc. since 2011. This project does not cover information where there is no death or injury of the participants of road accidents. Data for viewing is available from 2011.

Formulation of the problem

After importing the data into the system and pre-cleaning the data file, about 15 parameters were taken as available for interpretation of the factors. They can be divided into “random” factors and “external” factors. Their detailed description will be given in the part Descriptive analysis.

The aim of the research is to identify factors that significantly affect the number of victims of accidents and the construction of a model that allows predicting the number of victims in an accident. This is necessary for making decisions that will reduce human losses.

It should be noted that DataMining tools are often used to analyze data of this size, which allow analyzing and finding patterns that are inaccessible to ordinary statistical criteria. These methods will be partially used for exploratory analysis and prognostic analysis along with classical ones.

Descriptive analysis

As a measure of the size of the accident was selected the number of victims. The damage data was not available. In this regard, as a variable, illustrating the result of an accident we will use the number of victims.

Of interest is not only the search for dependence between the circumstances of a traffic accident but also their statistics. The number of accidents will be used as a dependent factor for such an analysis. Data was collected from different sources as governmental open data and other information sources [2-6].

The inputs are a summary table that contains information about accidents that occurred in different regions of the country on different roads under different circumstances. An exemplary view of the data source is given below [2].

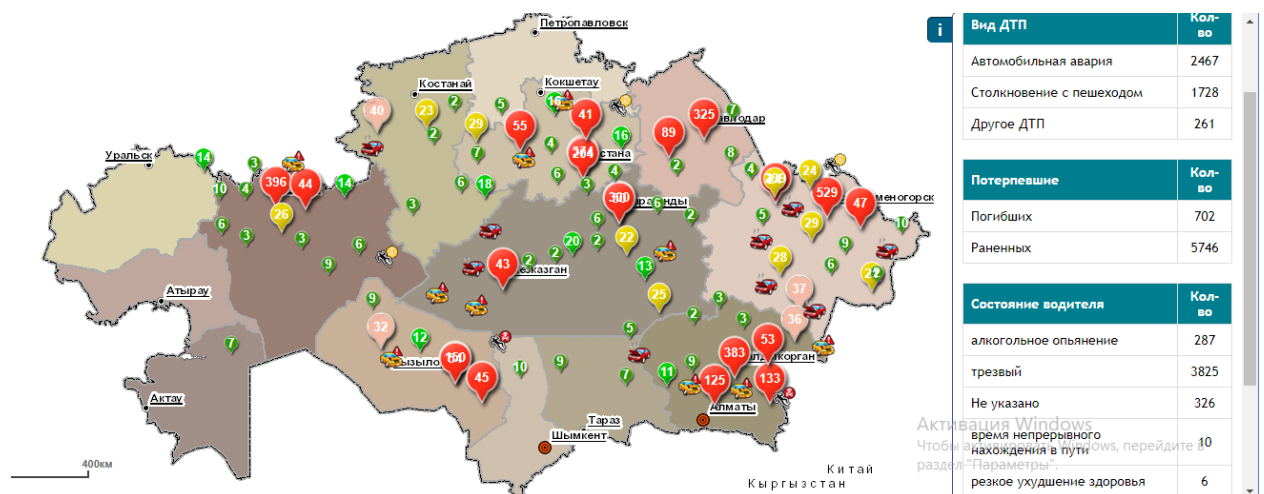


Figure 1. Example of data source

The first step is to conduct descriptive studies to determine the effect of various factors on the number of accidents. The description of the main variables is given right there.

Variable Day of the week

This is a categorical factor responsible for the day of the week when the accident occurred. The distribution of the number of accidents by day of the week will obviously be non-uniform - on weekends, when there are fewer cars on the streets, accidents are less likely. This distribution can be empirically obtained by studying the frequency table and the pie chart. The results are shown below.

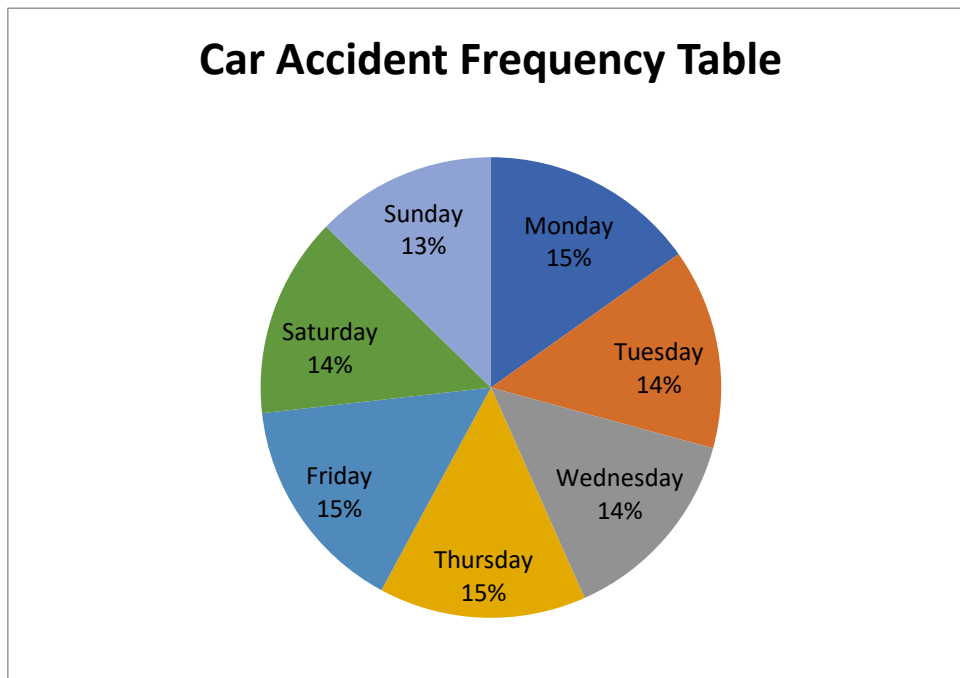


Figure 2. Pie chart and frequency table for variable Day of week

As can be seen from the frequency table, the most emergency days are Friday (15%), Monday (15%) and Thursday (15%). The smallest number of traffic accidents occurred on Sunday (13%), a day that is far behind the number of accidents (14% is the next day for accident rate). Consequently, the end and the beginning of the working week is marked by a large number of accidents, the beginning is small, the weekends are the least dangerous.

Variable Month

For each accident, the day was recorded when it occurred. The distribution of accidents by month is interesting in terms of finding the most emergency seasons. We give a pie chart.

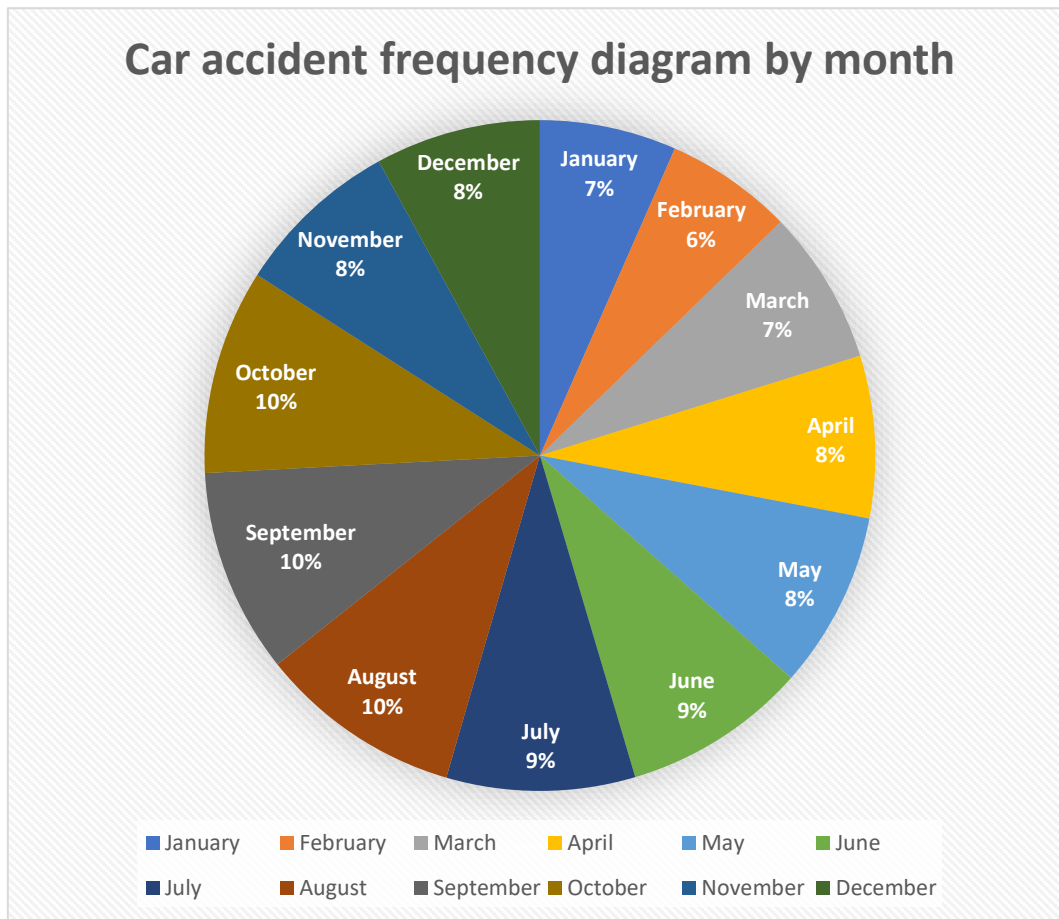


Figure 3. Pie chart of accidents by month

The greatest number of accidents is from June to October, while the winter and spring time can be considered the least emergency. The increase in the number of accidents in the summer can be explained by poor weather conditions, the emotional state of the driver due to hot weather.

Variable total hurt

For each accident, the number of victims was recorded. The task of reducing the number of victims and wounded in road accidents is a priority for road and law enforcement agencies; for this task, we can consider this variable dependent. The following sections will discuss ways to reduce the value of this variable for specific accidents.

The distribution of the number of victims has a complex appearance and depends on many factors, ranging from the condition of the coating to the illumination. We give an unconditional histogram - it is able to give an idea of the number of victims in all available accidents. Construct a frequency table for this variable.

Category	Frequency	Cumulative frequency	Percent	Cumulative percent
1	9416	9851	84,23654	84,23
2	1075	10399	9,3254	95,36
3	361	10268	2,1546	97,68
4	98	10645	0,9562	98,96
5	35	10365	0,1254	99,48
6	6	10245	0,0321	99,52
7	4	10236	0,0125	99,61
8	3	10899	0,0241	99,95
9	2	10569	0,00015	99,78
10	2	10587	0,00214	99,84
11	2	10258	0,001587	99,91
12	1	10248	0,001554	99,96

Figure 4. Frequency table by the number of victims

As can be seen from this table, in most accidents only one person suffered. This can be considered a consequence of a large number of such incidents, such as hitting a pedestrian, when invariably one person is injured. The number of accidents in which 2 people suffered was less by an order of magnitude; the proportion of accidents with a higher number of victims is negligible.

The study of the distribution of this variable allows us to conclude that the number of accidents with a large number of victims is small. The most frequent are accidents with one or two victims, which can occur in a collision or a pedestrian.

Mortality from injuries is one of the most crucial problems in developing countries. Mostly victims of accidents are children under 18 years old, teenagers from 18 years old to 21 years old and adults up to 44 years old. According to a study of the World Bank, in our country every year more than 34 thousand people die or become disabled due to accidents. These indicators are high not only in Kazakhstan but also in general in Central Asia. At the same time, it is indicated that all over the world injuries sustained in road accidents are the main cause of death for people aged 14 to 30 years.

We divided children into 4 categories.

- I.** I. Newborn children up to 6 years old (from 0 to 6)
- II.** II. Children aged 7 and up to 13 years.
- III.** III. Adolescents aged 14 and up to 17 years.
- IV.** IV. Adolescents aged 18 and up to 20 years.

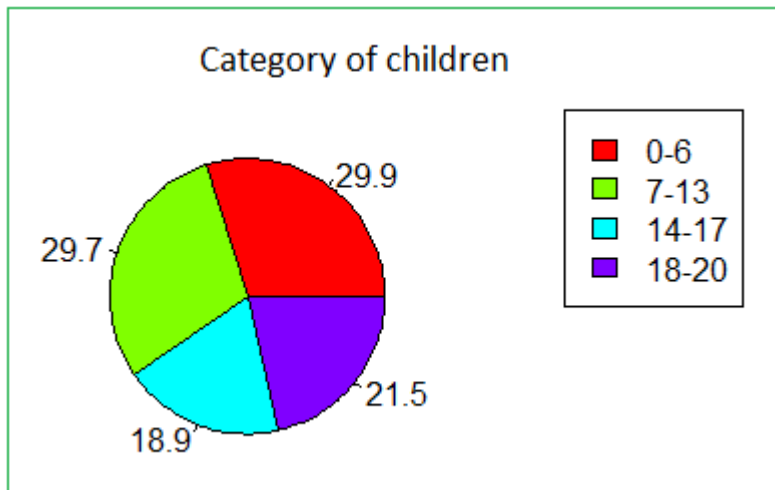


Figure 5. Categories of Children

Based on data from the World Bank, we did not look for mortality and injuries after an accident in developed countries, since mortality in Central Asia is on average 10 times higher.

This is influenced by several risk factors and characteristics in Central Asia, for example:

- Overspeed.
- Driving under the influence of alcohol and other psychoactive substances.
- Lack of motorcycle helmets, seat belts and child restraints.
- Distracted driving.
- Infrastructure with a high risk of accidents.
- Vehicles that did not pass the technical inspection.
- Inadequate assistance after an accident.
- Inadequate enforcement of traffic regulations.

2. Analysis

According to the statistics committee, the number of victims in 2017 amounted to 24 thousand people, of which about 22 thousand were injured or disabled, and 2 thousand people died. From these data it can be seen that almost every 10 accident on the roads leads to death, and this death rate does not bypass children.

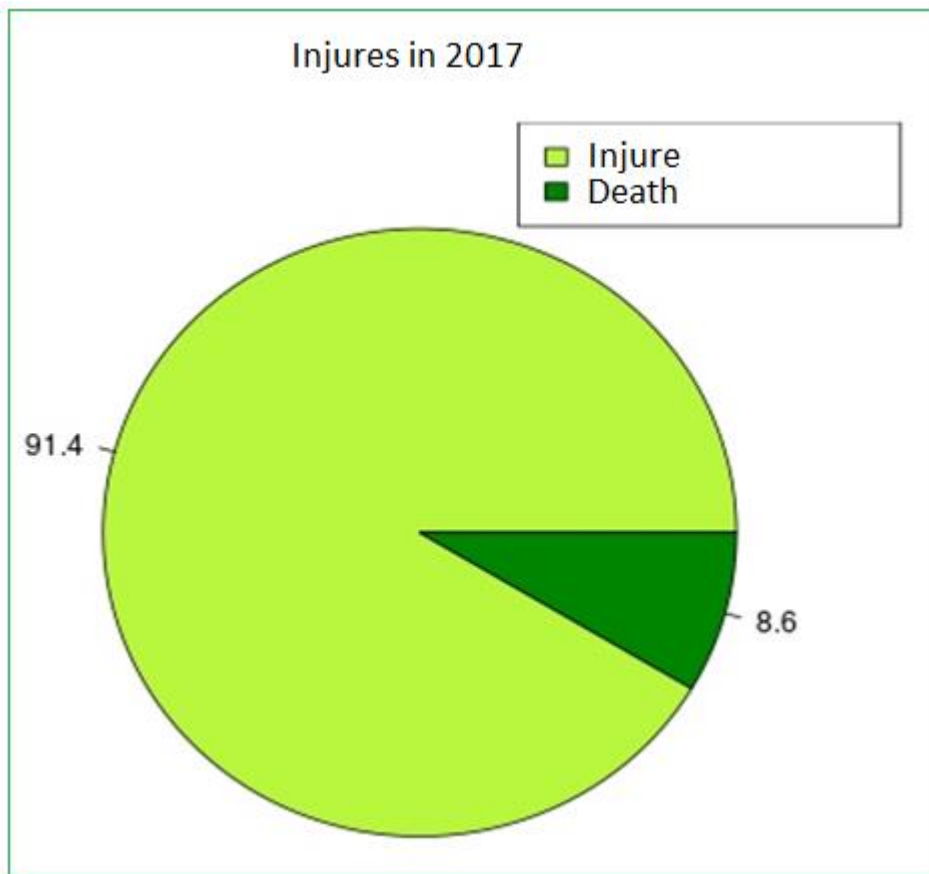


Figure 6. Number of Injured people

I.Newborn children up to 6 years old (from 0 to 6)

Over 90 percent of accidents in Kazakhstan were caused by drivers. More than a third of the injured children were in vehicles as passengers. In 2017, 1891 traffic accidents involving children under 6 years old were registered, in which 80 died and 1811 were injured. In most cases, the affected children were transported in cars in violation of the rules for transporting children by their parents.

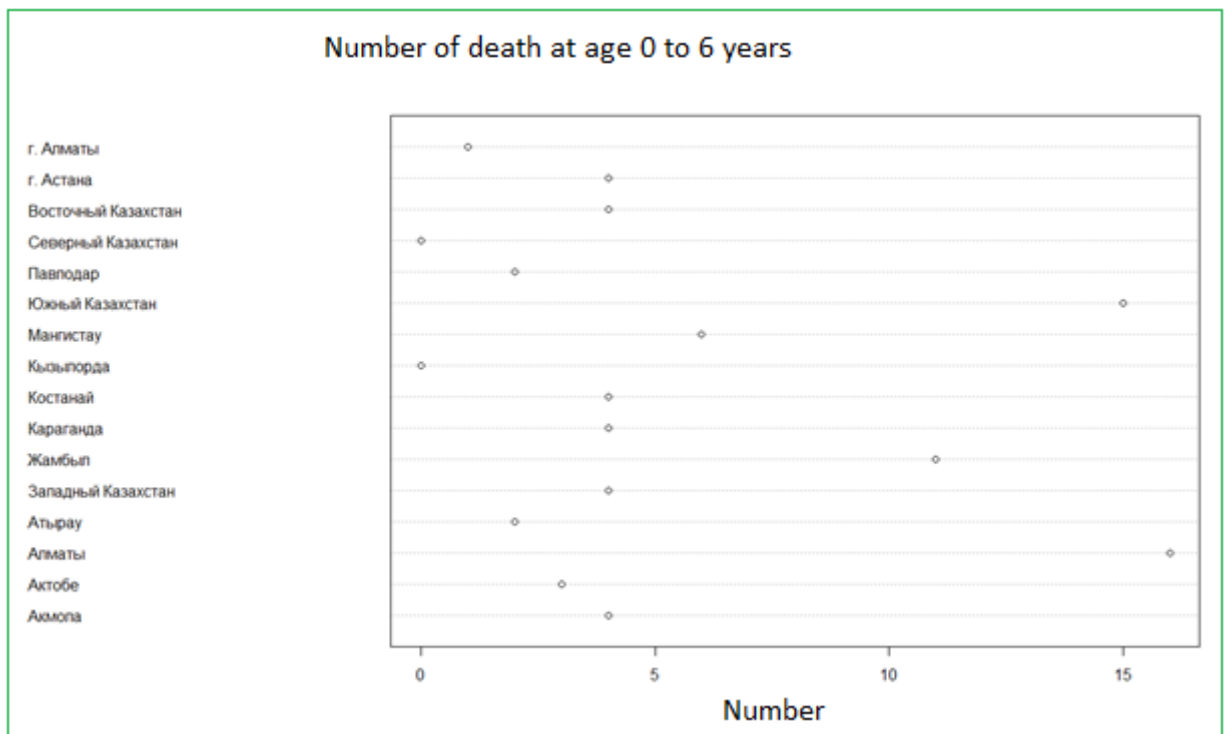


Figure 7. Number of deaths at the age of 0-6 years

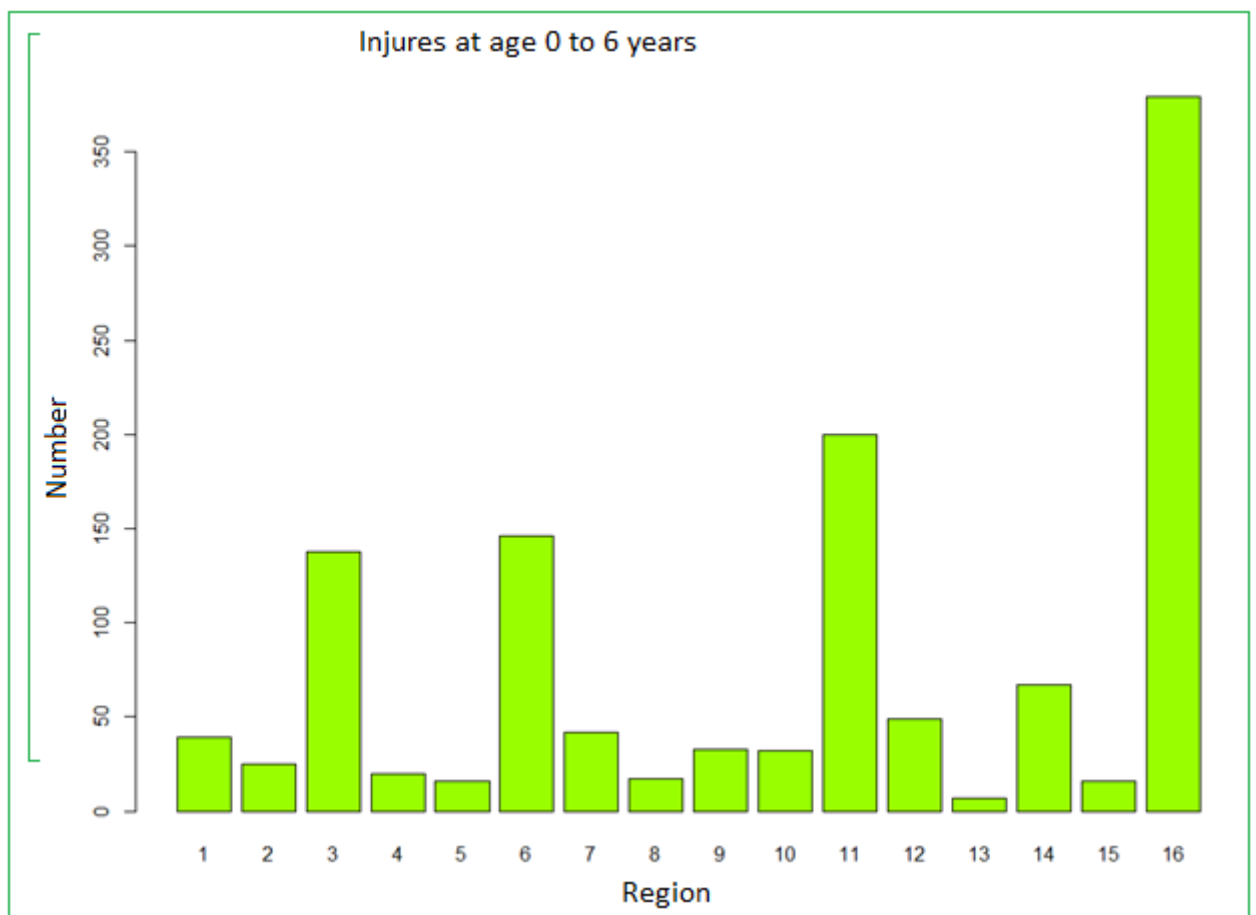


Figure 8. Number of injures at the age of 0-6 years

The leader in pedestrian injuries is the city of Almaty region, and the leader in mortality is Almaty.

II. Children from 7 to 13 years old

In 2017, 1881 accidents involving children under the age of 13 were registered, in which 74 were killed and 1807 were injured. Of the total number of incidents, the guilt of the affected children was established in half of the cases when the child was both the cause and the victim of the accident at the same time. Accidents involving children and adolescents occur when passing through a carriageway in an unspecified location, unexpectedly leaving the roadway due to moving or standing cars. The main share of the victims is children pedestrians. The most common causes of "childish" accidents are:

- ignorance of the Rules of the road and inability to predict the traffic situation,
- lack of skills to perform actions on traffic safety and unconscious imitation of adults violating traffic rules, most often parents;
- loss of vigilance and indiscipline. This is explained by the age characteristics of children and the inadequacy of explanatory work conducted with them in the family and school.

Children are killed and injured through the fault of adults who did not ensure their safety. It would not be superfluous to remind you that it is prohibited to transport a child under the age of 12 in the front passenger seat of a car! The place near the driver is the most vulnerable in an accident. In the backseat, the child must be fastened with seat belts. In the interests of safety, the child must be in a special holding car seat until the age of 12. And in the front passenger seat, child seat must be fixed against the movement of the car.

Statistics show that the number of deaths and severe injuries is greatest for children who were not fastened on the rear seats. For reference: in collisions in urban traffic at a speed of 50 km / h, a child weighing 25 kg experiences a load of 1565 kg. When a collision on a highway at a speed of 70 km / h, the load reaches 2057 kg, the impact force corresponds to a fall from a height of 10 m onto a concrete pavement.

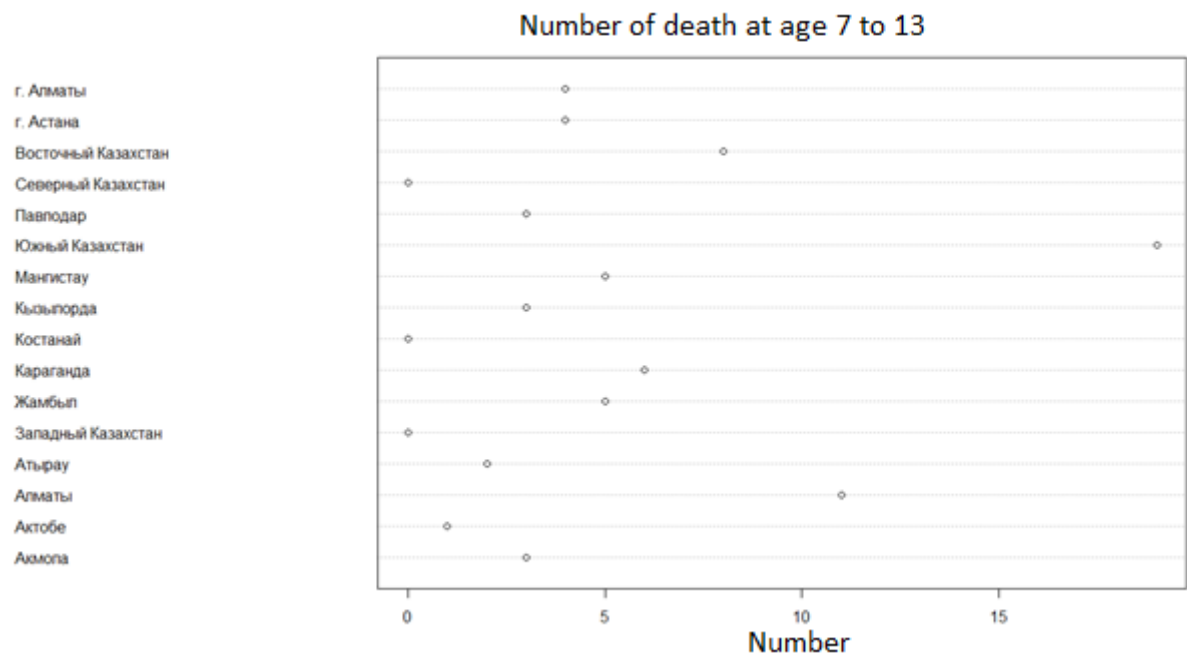


Figure 9. Number of deaths at the age of 0-6 years

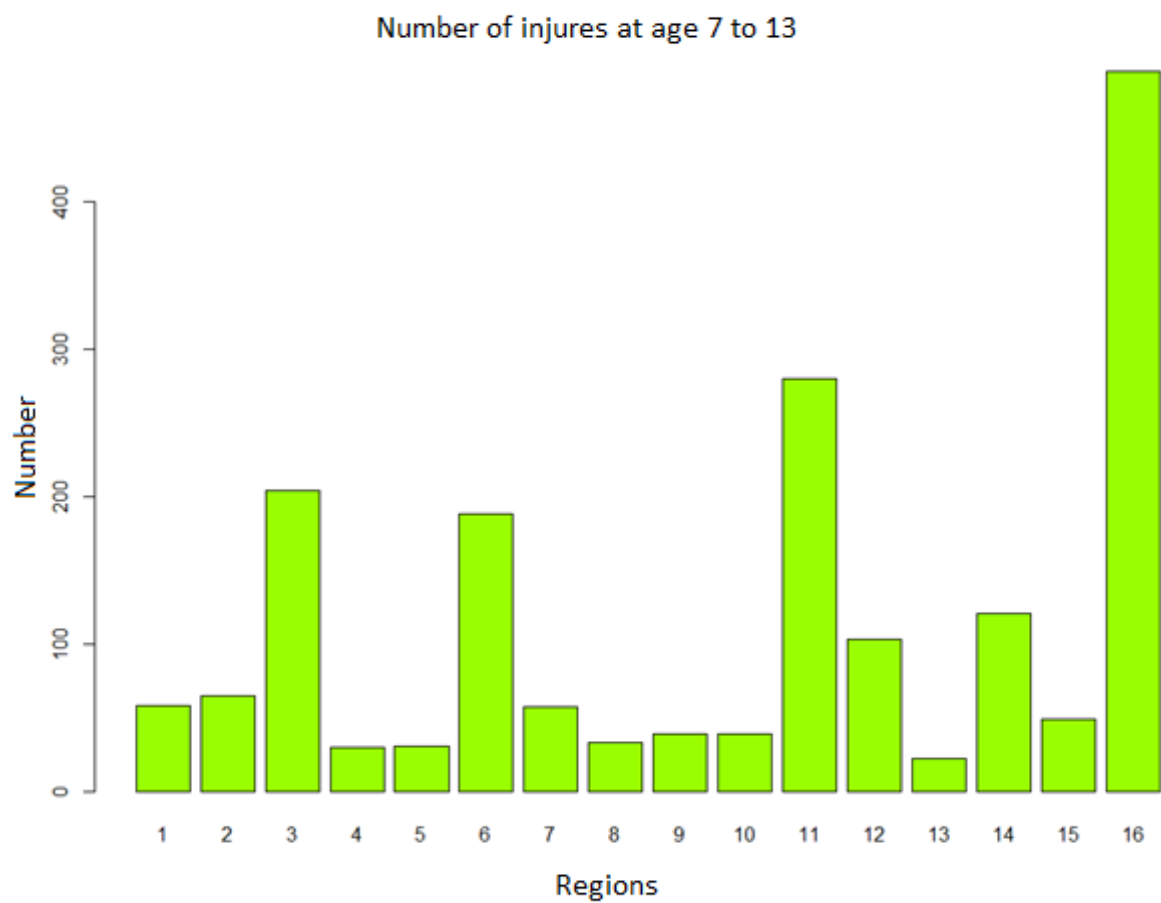


Figure 10. Number of injuries at the age of 0-6 years

The leader in pedestrian injuries is Almaty oblast, and the leader in mortality is the city of South Kazakhstan Region.

III. Teens aged 14 and 17 years.

Children of this age are less at risk than others. Their age is not suitable for driving and they are well aware of the dangers on the roads. In this study, we analyzed in detail the data of the Committee on Statistics and visualized data for 16 regions of Kazakhstan.

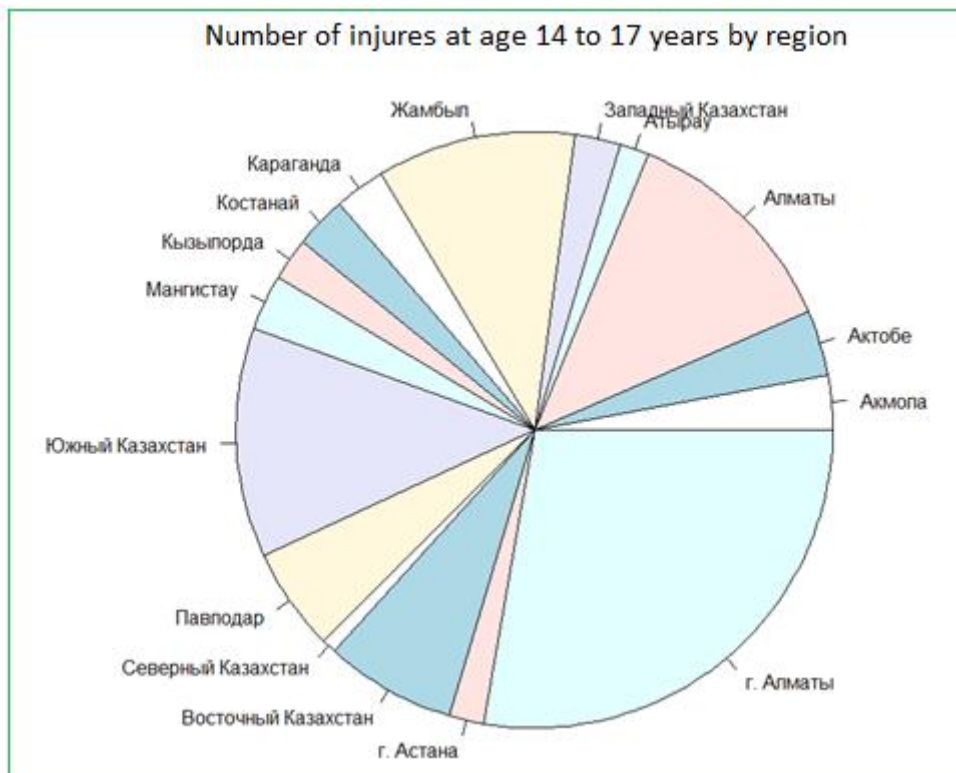


Figure 11. Proportion of injures among children by regions

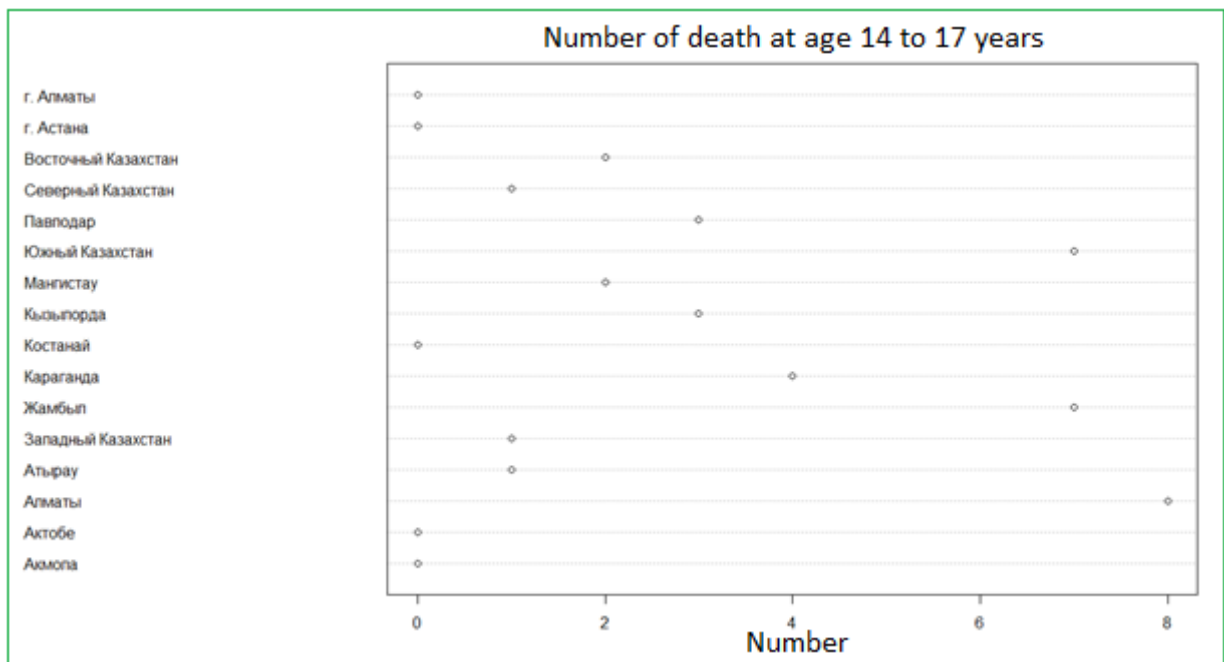


Figure 12. The proportion of death among children at the age of 14-17 years

The leader in pedestrian injuries is Almaty because the pedestrian infrastructure is developed at a low level with heavy traffic, and the death rate leader is Almaty region with 5 international routes where the average speed is about 90 kilometers per hour, which greatly increases the risk of traffic accidents.

IV. Adolescents aged 18 and up to 20 years.

This category is a transitional category because most of the incidents occur through the fault of the subjects themselves. Most are already at an age that is suitable for driving a vehicle, but are not psychologically ready for responsibility for the lives of other road users. Below is the statistics of victims from this category.

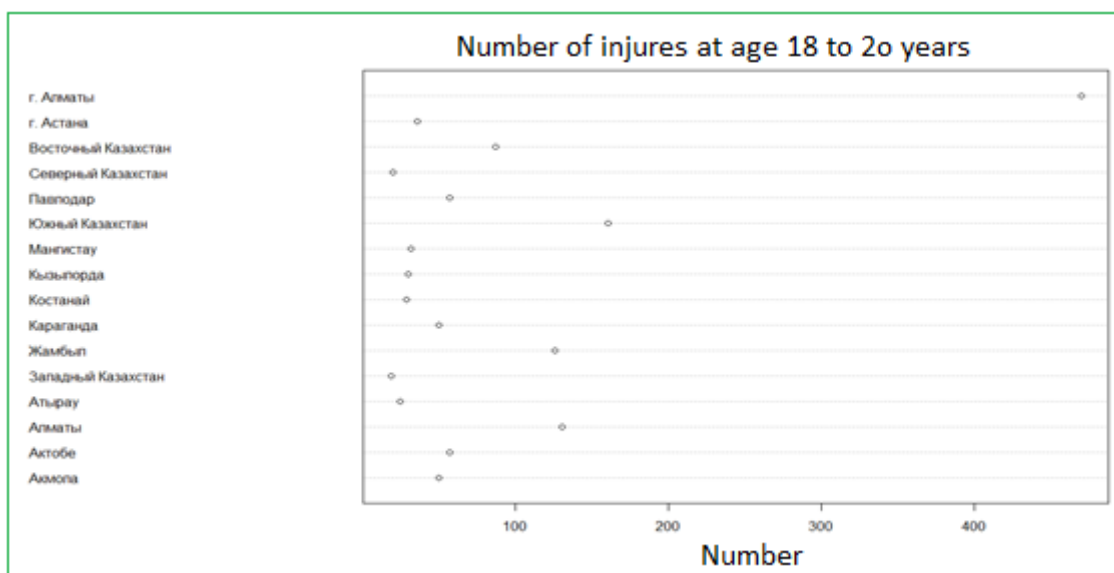


Figure 12. Proportion of injures among children at the age of 18-20 years

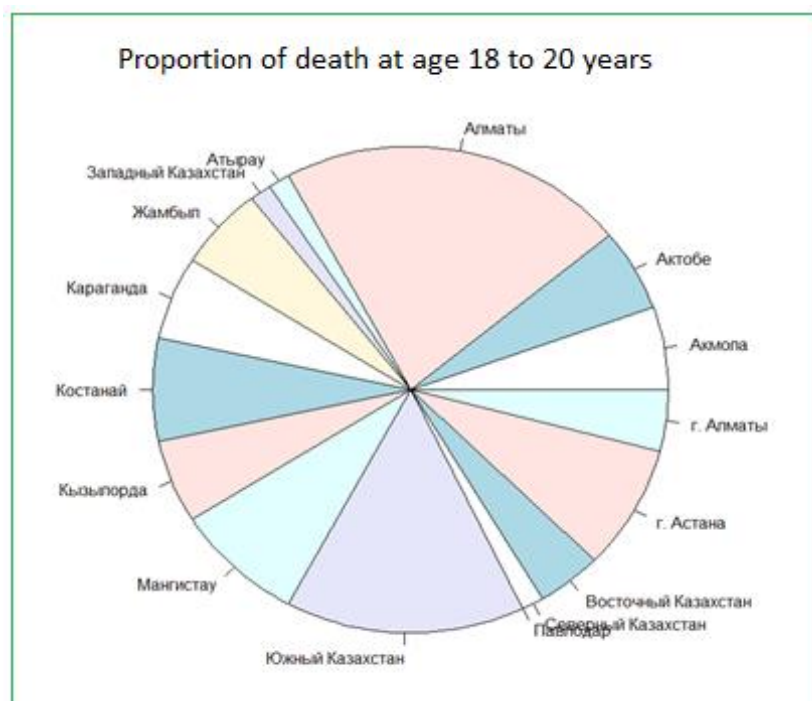


Figure 12. The proportion of death among children at the age of 18-20 years

In Almaty, more than 400 adolescents were injured or disabled as a result of an accident, this is a very high figure compared to other regions because there are a lot of students in Almaty during school hours, due to which the probability of road traffic accidents is very high. And the leader in mortality is the Almaty region.

Conclusion

The studies were relatively superficial and allowed us to identify a number of factors affecting the total number of accidents and the number of victims. Both time (day, hour) and systematic factors (road condition) were analyzed. Of these, the ones actually influencing the result were selected and estimates of the means in various groups were given.

For the total number of accidents, the following conclusions can be drawn:

- For the number of accidents per unit of time, there is a clear and strong time dependence. The number of accidents is more in April-May, less in the winter months. The peak of accidents every day falls on the evening hours when people return from work. The greatest number of accidents occurs at the end of the working week, the smallest - at the weekend.
- Accidents are strongly influenced by systematic factors, such as weather conditions, the presence of structures, and the condition of coverage. Illumination (work of light devices) also influences, and the switched on headlights reduce breakdown rate and in twilight / light time.
- Pedestrian visits and minor collisions with 1-2 victims are most frequently recorded. Clashes mainly occur at intersections, and assaults - at pedestrian crossings.
- Accidents on major highways occur less frequently than on medium-sized roads but are characterized by a large number of victims.

Regarding the number of casualties in accidents, here we can draw the following conclusions:

- There are clear and strong temporary factors depending on the number of victims on the characteristics of the accident, and the periods characterized by a decrease in the accident rate have a high average number of victims.
- Accidents with a large number of participants (people) are characterized by the largest number of victims. But a small number of cars.
- The number of casualties is almost not subject to systematic factors, such as road or weather conditions.
- When building a model of dependence of the number of victims on the accident parameters, the most significant factors are allocated to the type of incident and time parameters.
- Accidents on small roads are characterized by a small number of victims, while on large highways, the number of victims is increasing.

Recommendations

The data should be publicly available and with a well-tuned search. This will provide an opportunity to digitize government agencies, and allow the use of machine learning. In turn, machine learning and artificial intelligence will determine and predict the places where accidents often occur. The formulas that will be customized for the driver, that is, the average speed of the driver, whether the driver observes the rules of the road, whether there are settlements, whether children play on the road, which subsequently reduces the death rate of children as a result of traffic accidents. This will give a good reason for the introduction of the digital era for Kazakhstan.

The conducted studies are mostly superficial and do not give a definitive answer to the question about the model that determines the number of victims. Unfortunately, for conducting detailed studies, there is a lack of information of a systematic nature, such as the circumstances of the collision, the condition of the driver, the speed of movement, etc. These parameters, obviously, directly affect the outcome of an accident. It may also be useful to study random factors on the number of victims. This can provide valuable information for automakers about weaknesses in the design of the car.

Rererences

- [1] <https://qamqor.gov.kz/portal/page/portal/POPageGroup/MainMenu>
- [2] <http://infopublic.pravstat.kz/dtp/>
- [2] <http://stat.gov.kz/>
- [3] <http://www.worldbank.org/>
- [4] <http://www.who.int/>
- [5] <https://www.nhtsa.gov/s>