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THE ANALYSIS OF THE ROAD TRAFFIC SAFETY IN THE CITY OF JAWORZNO IN 2018-2019

Summary: The article describes an analysis of road safety in the city of Jaworzno over the years 2018 and 2019. The analysis has been performed with the use of data contained in the "System of Accidents and Collisions Record". The analyzes were based on the QGIS program. The conducted analyzes allowed for the conclusion that the number of traffic incidents in the city increases every year. The number of victims in road accidents in the city is low and has not changed significantly over 2018 and 2019.

Keywords: road accident, road collision, road traffic engineering, road transport, road traffic

ANALIZA STANU BEZPIECZEŃSTWA RUCHU DROGOWEGO W MIEŚCIE JAWORZNO W LATACH 2018-2019

Streszczenie: W artykule została przedstawiona analiza stanu bezpieczeństwa ruchu drogowego w mieście Jaworzno na przestrzeni lat 2018 i 2019. Analizę wykonano z wykorzystaniem danych zawartych w systemie "System Ewidencji Wypadków i Kolidacji". Analizy przeprowadzono w oparciu o program QGIS. Przeprowadzone analizy pozwoliły na stwierdzenie, że z roku na rok liczba zdarzeń drogowych w mieście wzrasta. Liczba ofiar w wypadkach drogowych na terenie miasta jest niska i nie znacznie się zmieniła na przestrzeni 2018 i 2019 roku.

Słowa kluczowe: wypadek drogowy, kolizja drogowa, inżynieria ruchu drogowego, transport drogowy, ruch drogowy

1. Introduction

The most developed type of transport is road transport. Its continuous development is observed both in passenger and freight transport. This development is accompanied by the constant expansion and modernization of road infrastructure and vehicles. The development of road transport, apart from economic and social benefits, also carries many threats and unfavorable occurrences, the most serious of which are

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environmental impact and accident rates. Road accidents are a consequence of an error in the human-vehicle-road system, violation of several or even one of the safe driving conditions at the same time may lead to an accident, human casualties, and material losses [1].

In Poland, the definitions of the types of traffic incidents and the types of road accident victims were given in order No. 31 of the Police Commander in Chief of October 22, 2015, on the methods and forms of statistics on traffic incidents kept by the Police [2]. This ordinance gives the following definitions:

- a road accident is a traffic incident in which a person was killed or injured,
- a road collision is a traffic incident in which only material losses were incurred,
- a fatal victim of an accident is a person who died at the scene of a road accident or within 30 days of the road accident as a result of bodily injuries,
- a heavily injured person is a person who has suffered a health impairment in the form of deprivation of eyesight, hearing, speech, fertility, other serious disability, serious incurable disease or long-term illness that is really life-threatening, permanent mental illness, total and permanent incapacity to work in the profession, or permanent, significant disfigurement or deformation of the body and other injuries causing disturbance of the functions of an organ of the body or health impairment lasting more than 7 days,
- a slightly injured person is a person against whom a doctor or paramedic has stated that victim suffered a health impairment or injury other than that specified for a heavily injured person.

Research in the field of traffic safety in transport networks is an important element of research conducted in traffic engineering. These studies are important because the results of the obtained analyzes allow for improvements in the transport network, which in turn affects the protection of human life and health. Research and analysis in the field of road safety have been the subject of various scientific papers many times. The research concerned a spatio-temporal analysis of the impact of congestion on road traffic safety [7, 8, 9], road traffic safety analysis using the on-board monitoring system [10], Analysis of Fatal Road Traffic Accidents [11], and causes of traffic accidents [12, 13, 14].

To improve traffic safety, a register of data on accidents and collisions is kept, which enables traffic safety analysis. In Poland, the central system for recording road accidents and collisions, kept by the Police Headquarters, has been in operation since 1961 and is called the "Accident and Collision Record System" ("SEWiK" in Polish). On its basis of the data, the analysis of road safety in the Jaworzno in 2018-2019 was performed. The analysis consisted of the preparation of maps concentration of traffic incidents and collision. The locations of the traffic incidents were entered based on geographic coordinates appearing on the sewik.pl portal which is a non-commercial website that allows searching for collisions and road accidents in Poland. The search engine uses the data of the Accident and Collision Records System provided by the Police Headquarters in Warsaw[5].

The maps were made using the QGIS program, which is an open-source Geographic Information System (GIS) licensed under the terms of the GNU General Public License. The types and kinds of traffic incidents were taken into account when preparing the concentration maps of incidents and collisions. For the accident concentration maps, the number of victims in the accident and the degree of injuries suffered by the victims were additionally taken into account.

2. Characteristics of the city of Jaworzno

Jaworzno is a city with district status, located in the eastern part of Silesian Voivodeship, between the Upper Silesia and Lesser Poland regions. The city area covers an area of 152.7 sq. km, which makes it one of the largest cities in Poland. The population in the city is over 90,000 people [6]. Jaworzno developed at the intersection of important road and rail communication routes. Its accessibility is good due to its location at the junction of the A4 motorway and the S1 expressway. The favorable location of Jaworzno, between Silesia and Lesser Poland, and near important transport routes, ensure fast and easy access to the largest sale and supply market in Poland, qualified personnel, business environment institutions, and research and development centers. Travel by car from Jaworzno to Katowice can be reached within 20 minutes, Kraków in 40 minutes, Wrocław in two hours, and just over an hour to the border crossing with the Czech Republic in Cieszyn.

In recent years, a large investment has been made, which was the change of the road system in the city. Besides, modern buses with free internet access have also appeared on the streets of Jaworzno, and interactive screens were installed at bus stops to provide passengers with information on the real-time bus departures. Traditional tickets were long ago replaced in the city by electronic smart chip cards [3]. The following roads run through the city:

- A4 highway (part of the European route E40) connecting the state borders (east-west) Jędrzychowice - Korczowa,
- S1 expressway (part of the European route E75) Gdańsk - Cieszyn,
- national road no. 79 Warsaw - Bytom,
- provincial road No. 903 Jaworzno 79 - Jaworzno A4.

To improve safety, the road manager in the city of Jaworzno decided to change the road system. The roads were narrowed from 9.0 m to 6.0 m wide, sidewalks and bicycle paths were widened, and new safe intersections and roundabouts were planned. Such road infrastructure, contrary to the negative opinion of users, did not paralyze the city but led to an improvement in road capacity. The city center was freed from car traffic and replaced with good public transport organization. It also contributed to a significant improvement in road safety in the city of Jaworzno [4].

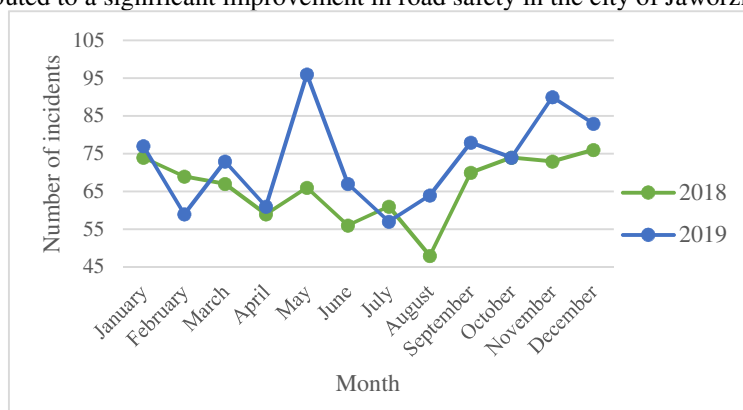


Figure 1. A total number of incidents and collisions in the city of Jaworzno in 2018 and 2019

Figure 1 presents the number of incidents in the individual months of 2018 and 2019 in the city of Jaworzno.

Based on Figure 1, it can be concluded that the number of incidents is increasing both in 2018 and 2019. This fact is probably related to the continuous increase in traffic on the city's transport network. Most incidents can be observed in the autumn and winter season, which may be affected by unfavorable weather and lighting conditions. On the other hand, Figure 2 shows the number of road accidents in 2018 and 2019 in the city of Jaworzno.

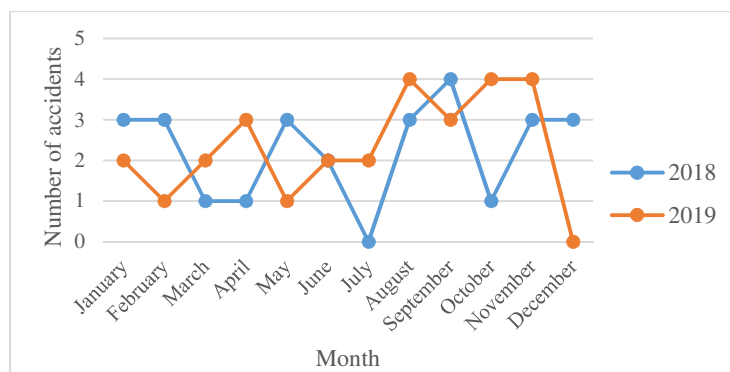


Figure 2. A total number of road accidents in the city of Jaworzno in 2018 and 2019

Figure 2 shows that the number of accidents in 2018 and 2019 is similar. In 2018, the number of road accidents during the year was 27, and in 2019 there were 28 accidents. Most road accidents occurred in August and September

3. Materials and methods

The study aimed to analyze the road safety condition in the city of Jaworzno in 2018-2019. For the study, the data was obtained from the SEWIK database. These data included the following features for each of the years of the analysis:

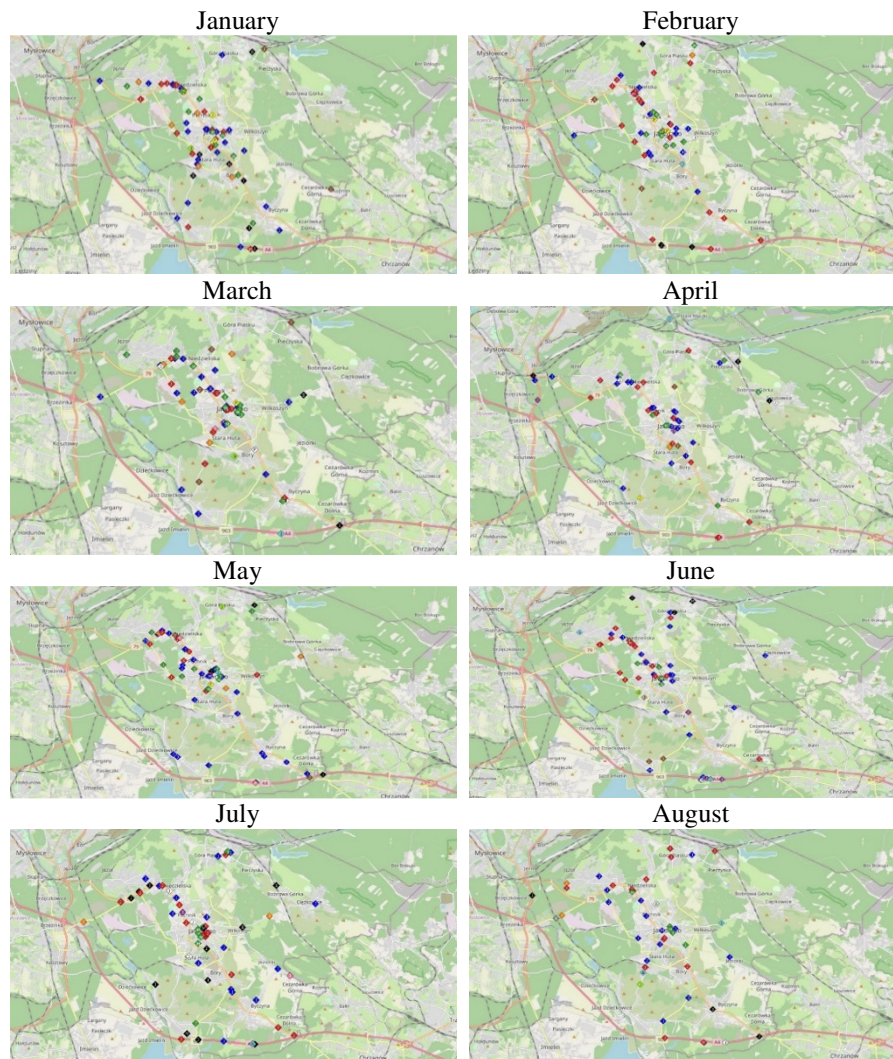
- number of incidents (total and apportionment into accidents and collisions),
- number of victims (total and apportionment into fatal victims, heavily injured victims, and slightly injured victims),
- incident location coordinates,
- location of the incident (shoulder, verge; road; sidewalk, pedestrian road; pedestrian crossing; median strip; escarpment, ditch; railroad crossing with barriers; parking place; entry, exit from the property, fields; road works, temporary marking; public transport stop; bridge, viaduct, tunnel; road, lane for bicycles),
- type of incident (rear-end vehicle collision; side-impact vehicle collision; head-on vehicle collision; driving over a pole, sign; driving over an animal; driving over an immobilized vehicle; driving into a hole, bump, hump; driving into a railway barrier; driving over a pedestrian; driving into a protective barrier; driving over a tree; vehicle rollover; accident with a passenger and other).

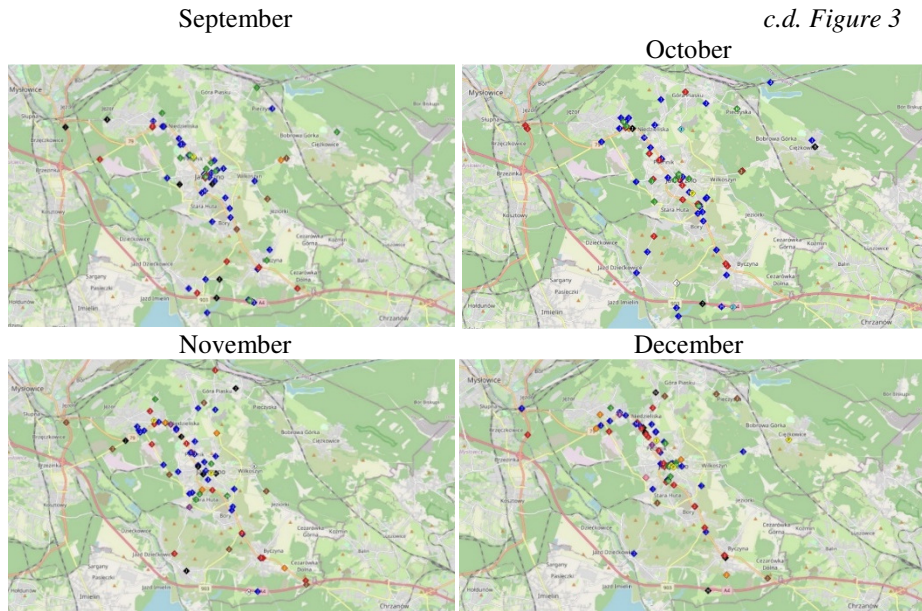
Classical statistical methods were used in the analyzes.

4. Analysis of the road traffic safety in Jaworzno city in 2018

4.1. Traffic incidents

Figure 3 shows the map of accidents and collisions in the city of Jaworzno in 2018 in the individual months.





Map legend:

- location of the incident:
 - B** – shoulder, verge
 - Ch** – sidewalk, pedestrian way
 - D** – median strip
 - J** – road
 - K** – railroad crossing with barriers
 - M** – parking place
 - P** – pedestrian crossing
 - R** – escarpment, ditch
 - S** – road, lane for bicycles
 - W** – entry, exit from the property, fields
 - X** – road works, temporary marking
 - Y** – public transport stop
 - Z** – bridge, viaduct, tunnel
- type of incident:
 - - rear-end vehicle collision
 - - side-impact vehicle collision
 - driving over a pole, sign
 - - driving over an animal
 - - head-on vehicle collision
 - - driving over a immobilized vehicle
 - - driving into a hole, bump, hump
 - - other
 - - driving into a railway barrier
 - - driving over a pedestrian
 - - driving into a protective barrier
 - - vehicle rollover
 - - driving over a tree
 - - accident with a passenger

Figure 3. Map of incidents and collisions in 2018 in the city of Jaworzno

Based on Figure 3, it can be concluded that the least incidents occurred in the summer months during the holiday season. This is due to a decrease in road traffic on the transport network, as many residents then leave the city for holidays, and students do not have as much transport needs as during the school and academic year. In total, all incidents and collisions in 2018 are shown in Figure 4.

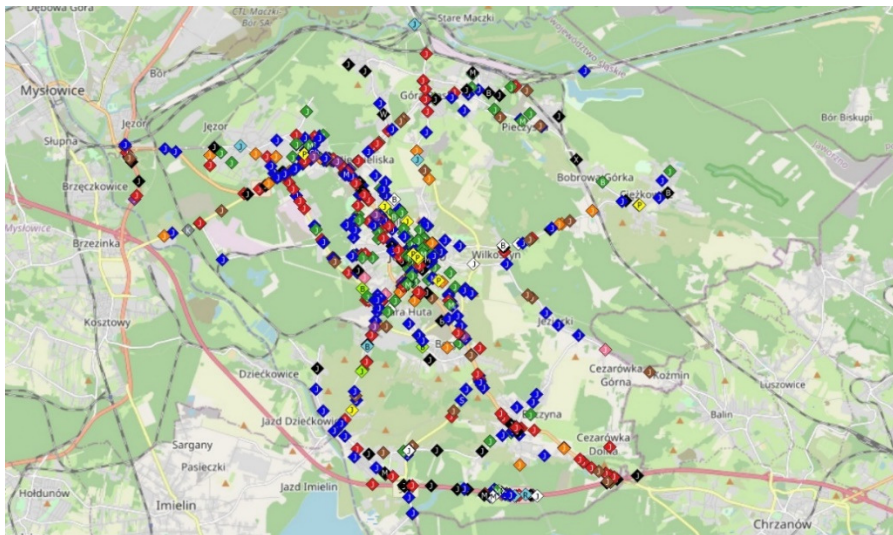


Figure 4. Maps of incidents and collisions in 2018 in total

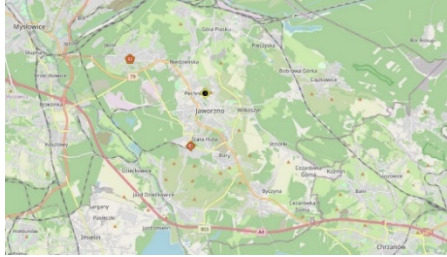
Based on Figure 4, it can be concluded that the most incidents are side-impact vehicle collisions and rear-end vehicle collisions. The least frequent incidents are driving over a tree, rollover a vehicle, driving into a railway barrier and driving into a protective barrier. Most of the incidents took place on the road. Incidents are most frequent in the vicinity of the city center and on access roads to the city center along the main communication routes.

4.2. Victims

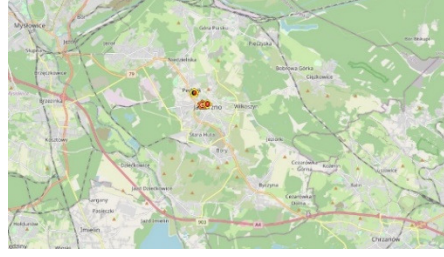
On the Figure 5 presents the maps of accident in the city of Jaworzno in 2018 in the individual months.

Based on Figure 5, it can be concluded that the number of accidents increases in the autumn period, when road weather conditions deteriorate and drivers do not careful. Additionally, it can be seen that accidents with a large number of casualties were side-impact vehicle collisions and occurred on the road of an expressway or a national road. In total, all road accidents in 2018 are presented in Figure 6.

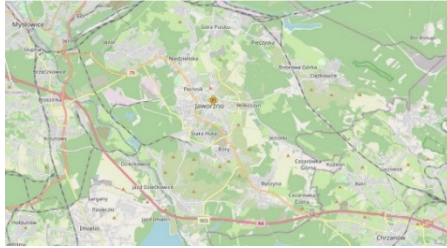
January



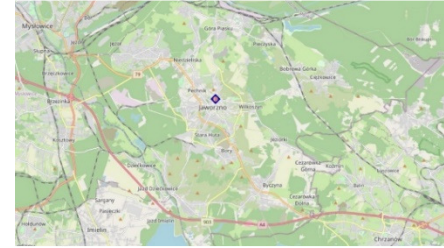
February



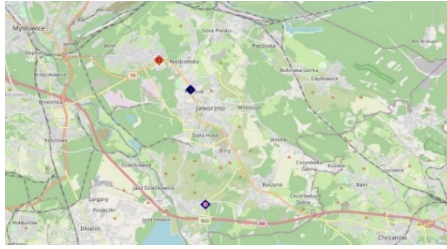
March



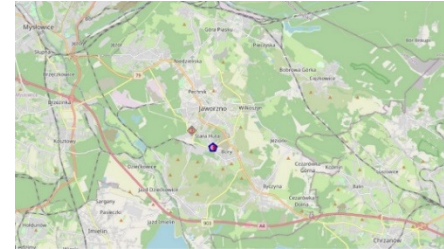
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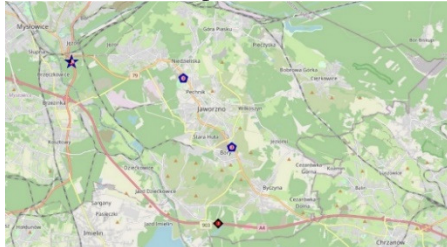
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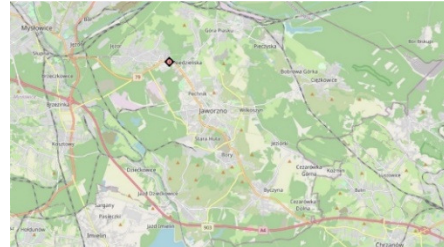
August



September



October



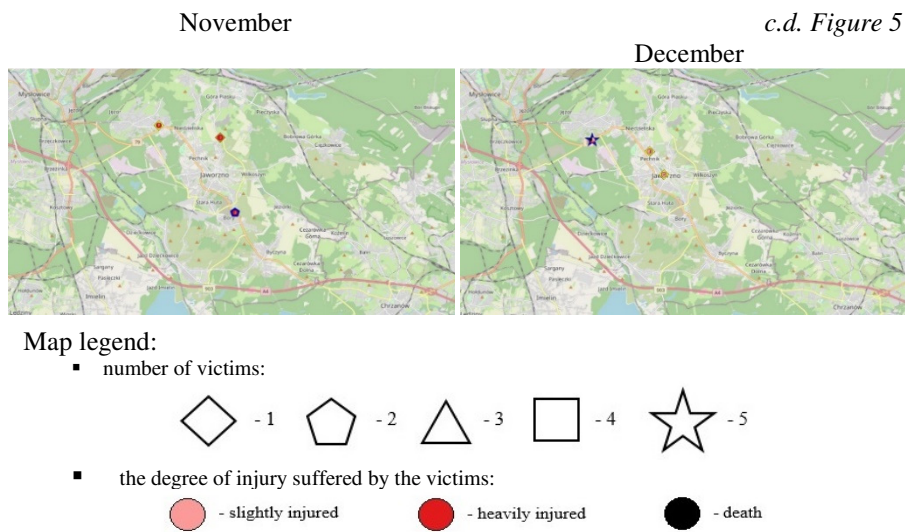


Figure 5. Maps of accidents in 2018 in the city of Jaworzno.

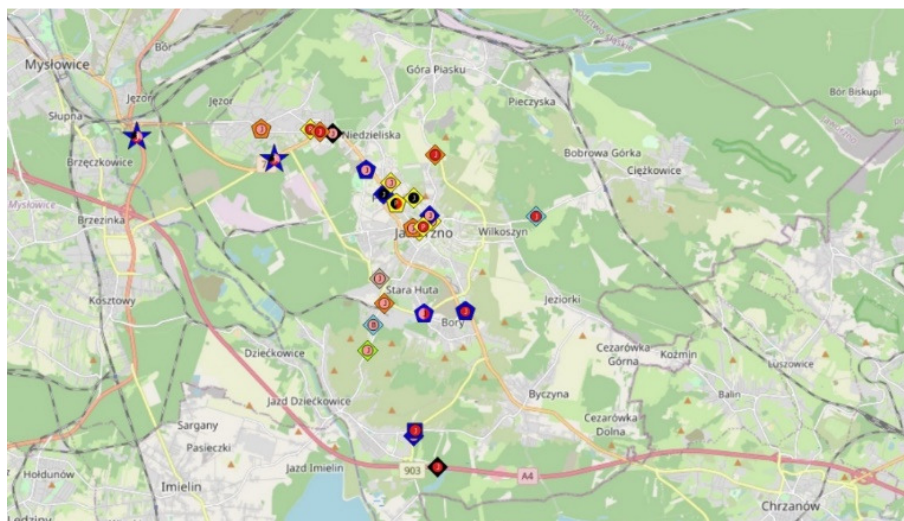


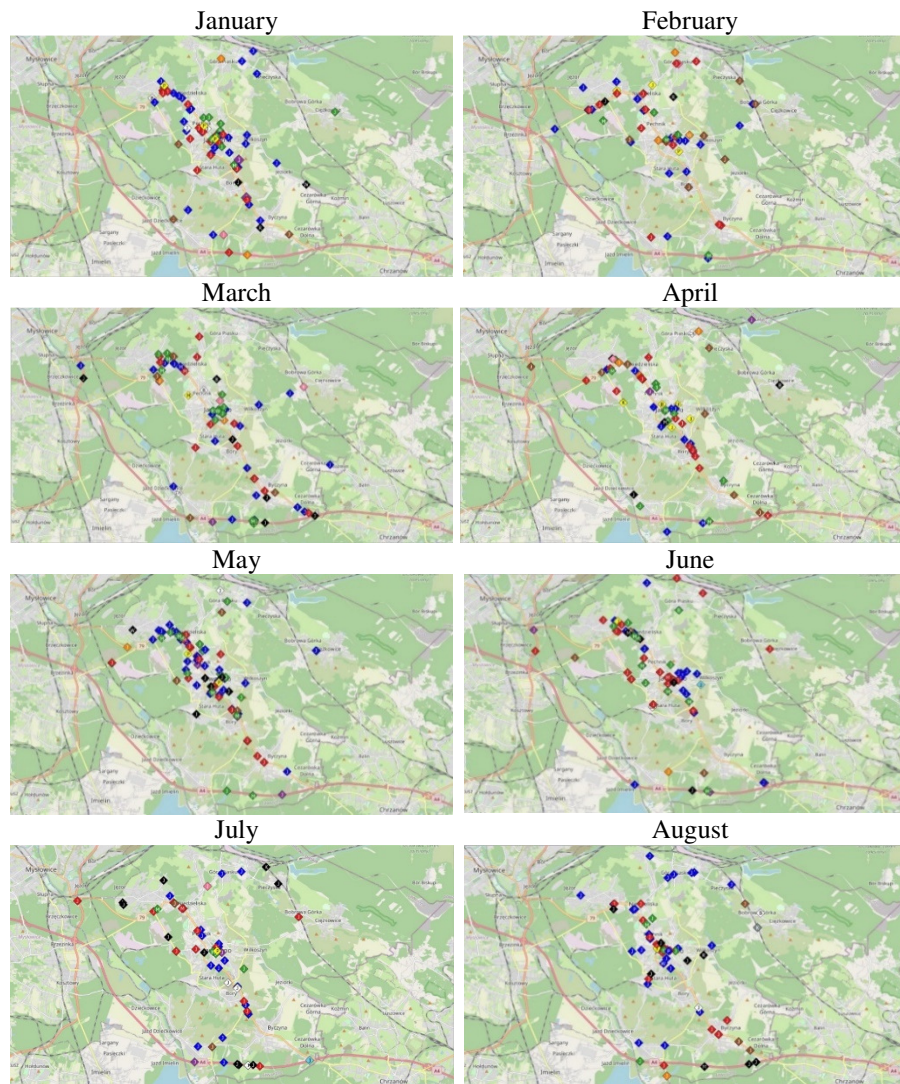
Figure 6. Map of accidents in 2018 in total

From Figure 6 it can be concluded that most of the accidents are concentrated on the border of the city center and on the main roads. The most common types of accidents were side-impact vehicle collisions, head-on vehicle collisions, and driving over a pedestrian. Most of the accidents occurred on the road.

5. Analysis of the road traffic safety in Jaworzno city in 2019

5.1. Traffic incidents

Figure 7 shows the map of accidents and collisions in the city of Jaworzno in 2019 in the individual months.



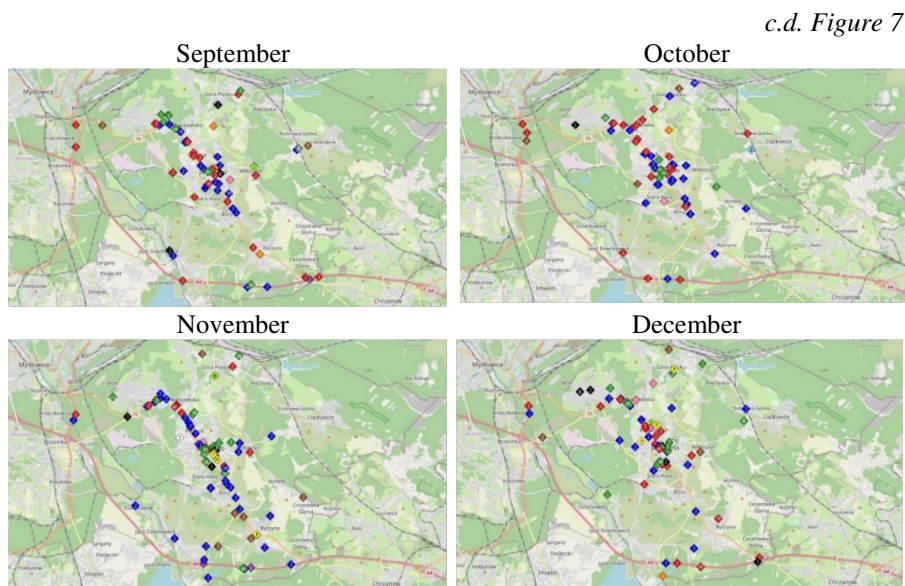


Figure 7. Map of accidents and collisions in 2019 in Jaworzno city

Based on Figure 7, it can be concluded that the most incidents occurred in November, and especially the side-impact collisions of vehicles on the national road 79. The least incidents occurred in July, which could have been due to good weather conditions. Each month, most of the incidents happened on the road. All accidents and collisions in 2019 are shown in Figure 8.

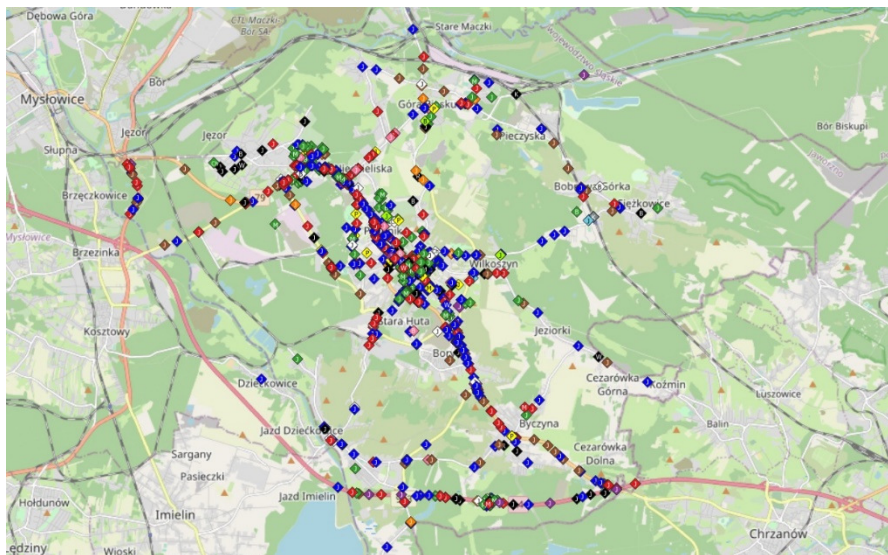
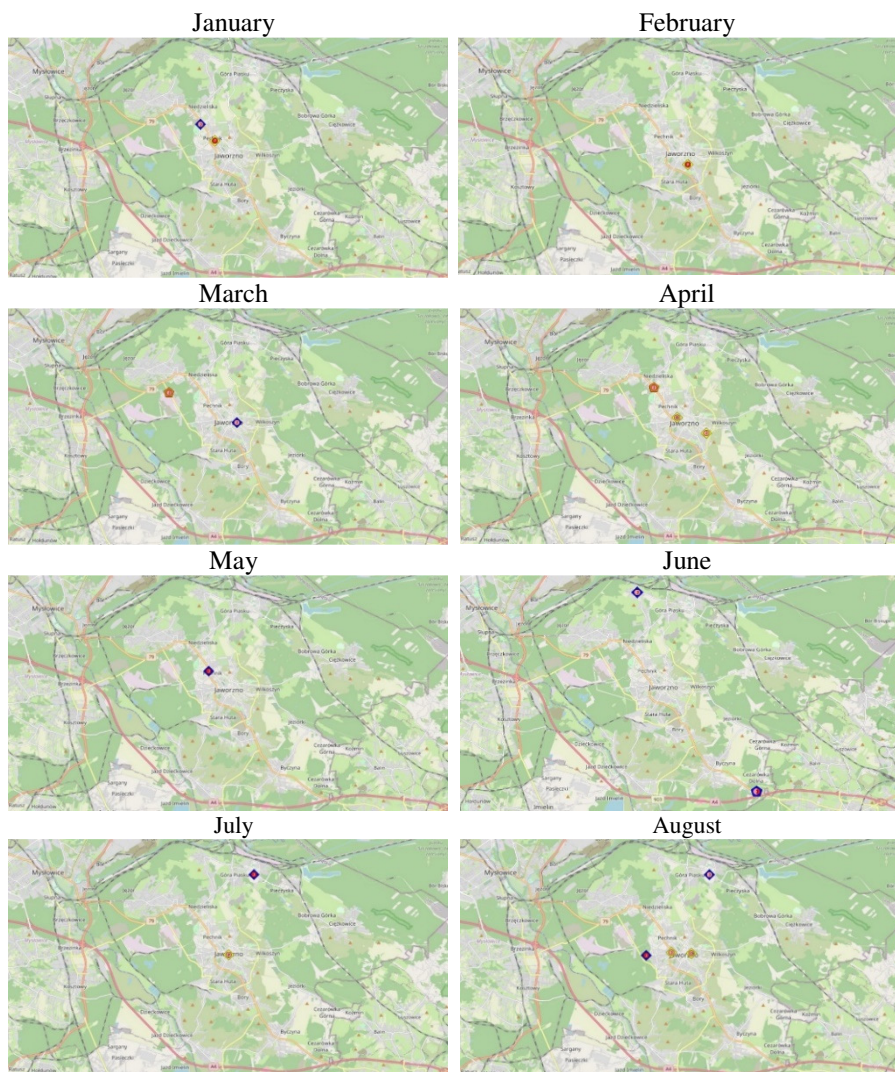


Figure 8. Map of incidents and collisions in 2019 in total.

Based on Figure 8, it can be concluded that most of the incidents occurred in the city center and on roads with the highest technical classes and, at the same time, the highest traffic intensity, such as the A4 highway, the S1 expressway, and the national road 79. Also, it can be stated that the most incidents took place on roads serving as access roads to the center of Jaworzno, i.e. on Ciężkowicka, Kasztanowa, Admiral Andrzej Karweta, Księża Jan Suliński, Martyniaków, and Szczakowska streets.

5.2. Victims

Figure 9 presents the maps of the accident in the city of Jaworzno in 2019 in the individual months.



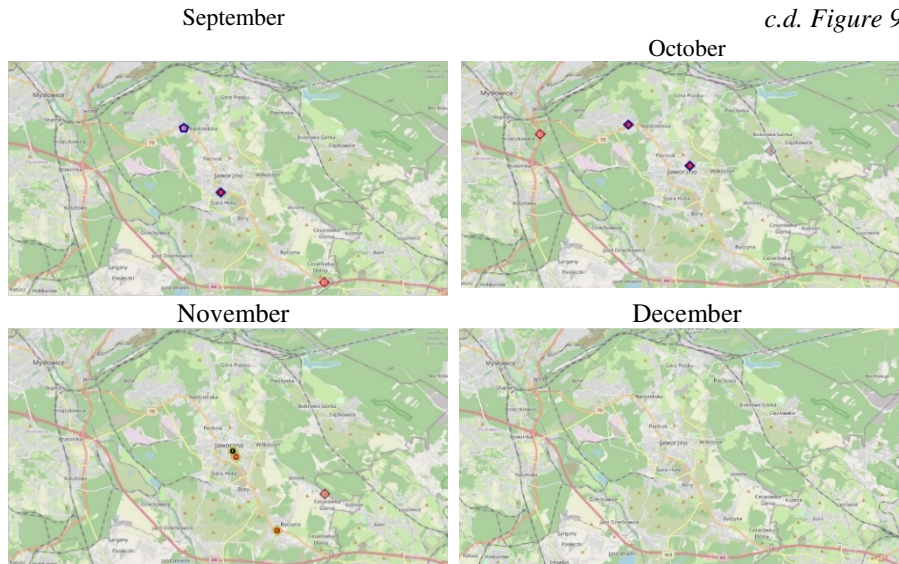


Figure 9. Maps of accidents in 2019 in the city of Jaworzno

Based on Figure 9, an increase in the number of accidents in the autumn period can be stated. This is probably due to the deterioration of weather conditions as well as an increase in traffic intensity resulting from the beginning of the school and academic year. However, all road accidents in 2019 in total are presented in Figure 10.

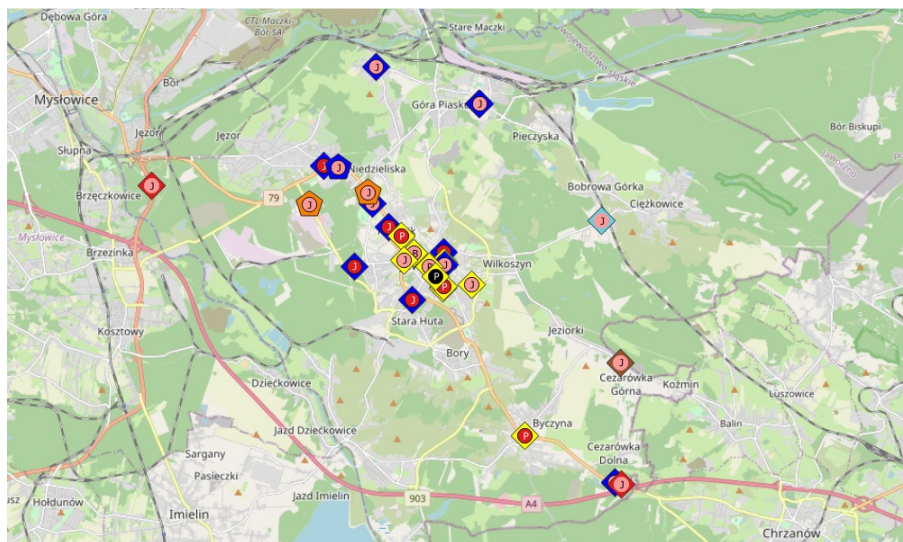


Figure 10. Map of accidents in 2019 in total.

Based on Figure 10, it can be concluded that most accidents are side-impact collisions of vehicles and accidents resulting from driving over a pedestrian. Most of the accidents took place on the road and near the pedestrian crossing.

6. Summary and conclusions

Based on the analyzes presented in the article, the following conclusions were formulated:

- most incidents can be observed on the main roads running through the city of Jaworzno, i.e. on the A4 highway, national road 79, Martyniaków Street, Wojska Polskiego Street, Sulińskiego Street, Szczakowska Street, and Ciężkowicka Street;
- most incidents are concentrated in the city center area, with a low number of incidents in the suburbs of the city;
- in the fall, can be noticed an increase in the number of incidents, which is probably due to the deterioration of weather and lighting conditions and an increase in traffic;
- incidents caused by driving over an immobilized vehicle usually occurred in parking places;
- the number of injured victims in the city of Jaworzno is much lower than in the neighboring cities;
- most accidents occurred with victims who were slightly injured;
- road accidents most often occurred on the road and at pedestrian crossings.

Safety is an important consideration in many human activities, it has a particularly prominent role in transportation. Every type of transportation system involves some risk of harm. The number of accidents is a serious problem in society because they result in too many injured persons and fatalities. These injuries create a lot of negative consequences both for those injured and for others and put demands on resources from society.

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