

CAR ACCIDENTS IN THE CZECH REPUBLIC AND LIGHT AS A CONTRIBUTORY FACTOR

^aTOMÁŠ ŘEZNIČEK, ^bVOJTĚCH SLOUP

^{a,b} *Institute of Technology and Business in České Budějovice, School of Expertness and Valuation, Okružní 517/10, 370 01 České Budějovice, Czech Republic*
email: ^a33241@mail.vstecb.cz ^b28923@mail.vstecb.cz

Abstract: Ensuring road safety and preventing car accidents are vital concerns for public health and safety. Despite advancements in vehicle technology and traffic management, the number of road accidents remains alarmingly high, leading to significant loss of life and injuries. The study aims to assess the relationship between causes and types of car accidents depending on lighting conditions when an accident happens. The quantitative content analysis of the car accidents recorded by the POLICE between October 2022 and October 2023 provided relevant data, processed by cluster analysis and illustrated via a heat map. Road safety and preventing car accidents have always been a public priority. The authors analysed crucial aspects of traffic safety and alarming numbers of casualties, including 440 deaths, 1,466 badly and 18,389 slightly injured people. The most common types of accidents involved head-on collisions with solid obstacles and ongoing non-rail vehicles. Careless drivers were the main provokers of the tragic events over the monitored period. Looking at the time of accidents, we can see interesting parallels in their causes, irrespective of the day or nighttime. Our recommendations included raising drivers' awareness and police imposing preventative measures against the common causes of accidents. The study did not consider other factors behind traffic collisions.

Keywords: Road safety, car accidents, lighting conditions, causes of car accidents, road manners, accident prevention.

1 Introduction

Car accidents cause irreparable harm to public health, affecting social development and public safety [1]. Road collisions take a terrible toll on human lives, the national economy and society, inflicting millions of casualties on the global population every year [2]. Experts predict car accidents to be on par with heart disease as the most common cause of death in the world [3]. Insufficient road safety is a contentious issue, taking millions of lives every year and inflicting severe losses on the global economy and humanity [4].

The population and urban growth lead to a higher demand for transport, giving rise to many traffic habits [5]. Identifying how infrastructure and other risk factors affect car accident rates is vital for pushing the research forward. An increasing number of studies focus on local conditions causing high accident rates over a period [6]. Car crashes were fatal for many people involved in an accident throughout the world, attributed to multiple risk factors [7]. Analysing critical determinants of road collisions to discover the underlying cause of the accident is a burning issue to deal with [8]. Car crashes are a global problem, predominantly among young people, who cause most accidents [9].

To make transport systems sustainable, we must reduce accident rates and impose measures to diminish their adverse impacts on society [10]. In the last decade, most developed countries have seen a sharp cutback in car crashes thanks to improved vehicles and road conditions, advanced medicine, healthcare, education, and driver training [11]. Safety analyses often assess accident rates and the effects of the measures for reducing collisions [12]. When we have successfully identified the places of frequent car accidents and road sections with high accident rates, transport officials may adopt preventative measures and introduce traffic regulations to reduce car accidents, deaths, injuries, and financial losses [13]. Road collisions result from many factors, including people, vehicles, roads, and visibility. Exploring connecting links between the risk determinants will help us identify the primary causes of the accidents [14].

1.1 Goal of the paper

The study aims at assessing the relationship between the causes and types of accidents depending on lighting conditions when an accident occurs.

1.2 Research questions

The analysis involves total car accidents from October 2022 to October 2023. Answering the research questions will inform us about the extent of the issue, allowing us to conduct in-depth road safety analyses.

RQ1: How many car accidents happened in the Czech Republic from October 2022 to October 2023?

We must detect the most common types of accidents over the monitored period. This question will help identify the most serious risks and improve road safety.

RQ2: What are the most common types of car accidents over the monitored period?

The following question concerns the most common causes of car accidents over the monitored period, allowing us to understand the factors contributing to road collisions and impose effective preventative measures.

RQ3: What are the main causes of car accidents over the monitored period?

This question focuses on possible differences between the combinations of the types of car accidents and their causes relative to daylight. Analysing their combinations will inform us whether accidents are contingent on lighting conditions and if daylight affects some types.

RQ4: Is there any difference between the combinations of car accident types and causes depending on daylight?

2 Literary research

Car accidents directly reflect road safety levels. Predictions must be reliable for the Department of Transport to suggest rational decisions within the traffic management system [15]. The accurate prognosis of the traffic flow may increase effectiveness and road safety [16]. Nowadays, in times of various public transport systems, driver fatigue has become an underlying cause of car accidents [17]. Given diverse and volatile driving conditions, feelings of weariness and aggravating causative factors [18], we must develop a sophisticated safety system for detecting the drivers' lack of attention and preventing fatigue [19]. The increased skin temperature and heat dissipation marks the onset of sleep.

Risky behaviour significantly reduces drivers' ability to react, assess and act, increasing the risk of accidents [20]. Using a mobile phone when driving involves a high danger of a collision, seriously distracting the driver [21]. Given the technological advancement of social networks, recent years have seen a tremendous increase in the use of smartphones during driving, imposing a grave threat to road safety [22]. Safety systems of checking the following distance currently available on the market can largely contribute to accident prevention or, at least, make them less severe [23]. A bad condition of a vehicle imposes another danger on road safety, dramatically increasing accident rates, as the transport industry lacks relevant tools for detecting the poor state of the car [24].

[25] devised a negative binomial model for statistical factor identification that significantly affects the duration of road closures using a non-negative integer. The results showed a strong correlation between the road closure duration and the collision type, seriousness, roadway type, driving under the influence of alcohol, involvement of heavy trucks and the number of vehicles involved, leaving lighting and road conditions, speed and surface insignificant. [26] applied the Apriori algorithm to find connections between risk factors, probing deeper into the causes of accidents on urban road

networks to detect links between risk factors of driving. [27] analysed data using approximate and standard mortality rates and potential and average premature deaths, revealing car crashes as the principal contributor.

[28] devised a regression model for predicting the lethality or injuriousness of accidents according to data observed from testing road sections using flexible neural networks. The experiments showed that analytical methods are highly efficient in assessing the conditions which may cause death or injury. [29] used correlation and cluster analysis to explore the relationship between holding a driving licence, intoxication, speeding, excessive load, vehicle performance, weather etc. Specific conditions like evening or nighttime, exiting the road, crashing into a solid object, passing through a tunnel, sharp bends, rainfall, fog, poor lighting, and a road narrower than seven metres contribute to higher accident rates among young drivers [30]. [31] investigated the relationship between the price of a vehicle and its safety using correlation coefficients, and found that these two factors are not so highly correlated.

[32] used a questionnaire survey to determine the factors endangering drivers, revealing reckless driving and speeding as crucial contributing factors in Cyprus over the monitored period. [33] applied content analysis for secondary data collection. [34] conducted interviews to explore factors and impediments hampering the cooperation between paramedic medical services and emergency hospital admission during car accidents, analysing the data using qualitative content analysis. [35] examined mobile applications on road safety and health using qualitative content analysis.

We apply content analysis to answer the first, second and third research questions. The cluster method will tackle the fourth, allowing the identification of patterns and interrelationships between factors and variables illustrated in heat maps.

3 Data and methods

We use quantitative content analysis of the official websites of the Police of the Czech Republic [36] to answer the first three research questions, informing about all car accidents the Police dealt with. The quantitative method deep probes and statistically analyses the data, allowing a better understanding of the dynamics of car collisions in the Czech Republic and contributing to introducing measures for extra road safety. We systematically record the data on traffic accidents, including the date, deaths, critically and slightly wounded people, damage caused and the type and cause of the accident.

This data collection system is imperative for a comprehensive overview of the nature of car accidents in the Czech Republic over the monitored period. These observations will suggest the most frequent types of accidents (e.g., crashes into another car, single-vehicle collisions, etc.) and their causes.

First, the collected data on the type and cause of accidents are subject to cluster analysis which enables answering RQ4 and analyse the factors of causes and types of accidents in a proxy context. This way, it is possible to determine the relationship between these variables. The analysis also allows the identification and clustering of similar patterns and characteristics of traffic accidents, thus making it possible to systematically group the data and providing a comprehensive insight into the differences and similarities between individual types of accidents. Cluster analysis is a machine learning and statistical method that enables grouping data into clusters (or groups) based on the similarities between individual observations.

A dataset is created (see below):

$$X = x_1, x_2, \dots, x_n \quad (1)$$

Where:

X_i represents a factor of various attributes or characteristics

k = cluster, or group

Types of accidents, such as vehicle collisions, collisions with pedestrians, etc. are indicated by numbers 1 – 10, while the causes of accidents are divided into individual categories and assigned values 11 – 96. The structure of the evaluation provides a basis for the data analysis and clustering of the most frequently occurring situations. For example, clusters such as the combination of the accident type identified as 2 and the cause with the assigned number 74 can represent a basis for the identification of specific scenarios recurring most frequently in the dataset.

The goal is to minimize the internal variation within individual clusters and maximize the variation between them.

Next, a heat map is created on the basis of the cluster analysis, which provides a visual tool to visualize the relationship between individual clusters or groups of data. A distance matrix is created that contains the distance values between the clusters.

The distance matrix is then visualized using a colour scheme where the values in the matrix are represented by various shades of colours, where shorter distances (lower values of distances), which indicate greater similarity between clusters, are usually represented by lighter colours, while for greater distances between clusters, darker colours are used.

Mathematically, the heat map can be expressed as follows:

$$\text{Heat map } (i, j) = f(d_{ij}) \quad (2)$$

Where:

f = function mapping the values of distances using a corresponding colour scale or intensity of colour for the visualization of the heat map.

f represents the distance between the i -th and j -th cluster. The values in this matrix are then transformed into values for coloured visualization using a specific colour spectrum or colour gradient.

This visualization enables easier identification of clusters showing similar characteristics or behaviour and provides a comprehensive overview of the data structure and relationships between the clusters within the data analysis.

Heat maps are divided according to the season and part of the day concerning daylight or darkness at the moment of accident occurrence. This classification enables the analysis of the relationships between the clusters in the context of the time of the day and visibility.

The division of the heat maps according to individual seasons is also because of the variability of traffic accidents' causes, as various seasons bring specific conditions on the roads, thus affecting the behaviour of drivers and types of accidents.

In the heat map, the x-axis shows different types of accidents, while the y-axis presents individual causes of these accidents.

4 Results

Based on the content analysis performed, it was found that during the monitored period, a total of 93,784 road accidents were recorded in the Czech Republic, which represents an extensive dataset for performing cluster analysis and examination of factors affecting this set of accidents.

Tab 1. Number of road accidents in the Czech Republic between 1 October 2022 and 30 September 2023

| Type | Number of accidents | Number of persons |
|------------------|---------------------|-------------------|
| Deaths | 440 | 474 |
| Serious injuries | 1,466 | 1,691 |
| Minor injuries | 18,389 | 23,358 |

| | | |
|-------------|--------|--|
| No injuries | 73,489 | |
| In total | 93,784 | |

(Source: Author based on Nehody.cdv.cz, 2023)

Table 1 provides a clear overview of the consequences of road accidents in the Czech Republic in the monitored period. Death as the saddest part of this statistics was a consequence of 440 accidents resulting in the death of 474 people. There were 1,466 accidents with serious injuries, affecting 1,691 people; minor injuries were recorded in 18,389 accidents affecting 23,358 people.

Tab 1. Accidents by types

| Type of accident | Number |
|---|---------------|
| Collision with a fixed object | 21,028 |
| Collision with wild animals | 9,656 |
| Other types of accident | 2,867 |
| Domestic animal collision | 264 |
| Collision with a moving vehicle (not on rail) | 26,777 |
| Accident | 5,562 |
| Collision with a parked vehicle | 22,572 |
| Collision with a tram | 455 |
| Collision with a train | 130 |
| Collision with a pedestrian | 2,417 |
| In total | 93,784 |

(Source: Author based on Nehody.cdv.cz, 2023)

Table 2 provides information on various types of road accidents in the Czech Republic during the monitored period. The most common type of accidents was a collision with a parked vehicle, a collision with a moving vehicle not on rail, and a collision with a fixed object.

Tab 2. Traffic accidents by causes in the CR between 1 October 2022 and 30 September 2023 including their causes

| Main cause | Number of accidents | Deaths | Serious injuries | Minor injuries |
|---|---------------------|--------|------------------|----------------|
| The driver not fully focused on vehicle driving | 18,334 | 58 | 197 | 3,063 |
| Not caused by the driver | 13,491 | 17 | 120 | 1,124 |
| Improper turning or reversing | 9,066 | 5 | 33 | 405 |
| Loss of control of the vehicle | 6,119 | 24 | 100 | 1,621 |
| Dodging without sufficient side clearance | 5,733 | 3 | 10 | 242 |
| Not adjusting the speed to the conditions of the road | 5,159 | 32 | 88 | 1,875 |
| Failure to keep a safe distance behind the vehicle | 4,755 | 3 | 40 | 1,78 |
| Not adjusting the speed to road conditions (curve, descent, gradient, road width) | 3,803 | 62 | 179 | 2,082 |
| Failure to respect the traffic sign GIVE WAY | 3,438 | 28 | 130 | 2,188 |
| Other type of improper driving | 2,948 | 11 | 18 | 337 |
| Driving on the wrong side of the road, contraflow driving | 2,898 | 72 | 139 | 1,324 |
| Reckless, aggressive, inconsiderate driving | 2,333 | 4 | 31 | 356 |

| | | | | |
|---|-------|----|----|-------|
| Not adjusting the speed to vehicle and load characteristics | 1,694 | 30 | 79 | 765 |
| During turning left | 1,511 | 8 | 90 | 1,052 |

(Source: Author based on Nehody.cdv.cz, 2023)

Table 3 enables answering the third research question by means of listing the main causes of traffic accidents in the Czech Republic and their consequences. The highest number of accidents recorded occurred due to the failure of the driver to fully focus on driving, which resulted in 18,334 accidents and 58 deaths, 197 seriously injured persons, and 3,063 persons with minor injuries.

Tab 3. Classification of accidents by season and light conditions

| Season | Time | Light conditions | Number of accidents | Period |
|--------|--------------|------------------|---------------------|---|
| Spring | 6:00 - 21:00 | Light | 14,979 | 1 March 2023 – 31 May 2023 |
| Spring | 21:00 - 6:00 | Dark | 7,958 | 1 March 2023 – 31 May 2023 |
| Summer | 6:00 - 22:00 | Light | 21,037 | 1 June 2023 – 31 August 2023 |
| Summer | 22:00 - 6:00 | Dark | 2,996 | 1 June 2023 – 31 August 2023 |
| Autumn | 7:00 - 20:00 | Light | 16,056 | 1 October 2022 – 30 November 2022 ,1 September 2023 – 30 September 2023 |
| Autumn | 20:00 - 7:00 | Dark | 10,132 | 1 October 2022 – 30 November 2022 ,1 September 2023 – 30 September 2023 |
| Winter | 7:00 - 17:00 | Light | 11,29 | 1 December 2022 – 31 December 2022, 1 January 2023 – 28 February 2023 |
| Winter | 17:00 - 7:00 | Dark | 9,395 | 1 December 2022 – 31 December 2022, 1.1.2023 – 28 February 2023 |

(Source: Author)

Individual periods were divided into seasons (summer, spring, autumn, and winter) and times of the day with good and low light conditions. It follows from Table 4 that the highest number of traffic accidents was recorded in the summer and good light conditions (21,037 in total).

Tab 4. Brief specification of the x- and y-axis for heat maps

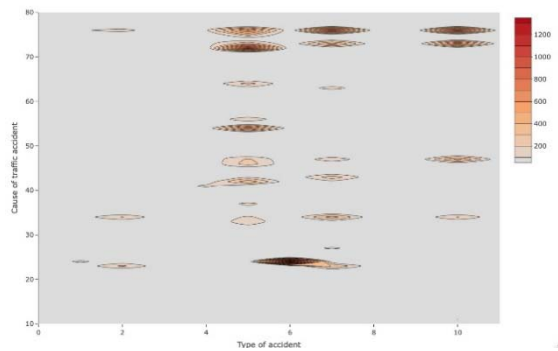
| y | Type | x | Cause |
|---|---|----|---|
| 1 | Other type of accident | 11 | Reckless, aggressive, inconsiderate driving |
| 2 | Accident | 12 | Other type of improper driving |
| 3 | Domestic animal collision | 15 | overtaking with limited visibility (in or near an obscure bend, before the top of a gradient, etc.) |
| 4 | Collision with a pedestrian | 16 | During turning or reversing |
| 5 | Collision with a moving vehicle not on rail | 23 | Failure to adjust speed to crosswinds and gusts (even when passing or overtaking vehicles) |
| 6 | Collision with wild | 23 | Failure to adjust speed to |

| | | | |
|----|---------------------------------|----|---|
| | animals | | crosswinds and gusts (even when passing or overtaking vehicles) |
| 7 | Collision with a fixed object | 33 | Not adjusting the speed to road conditions (curve, descent, gradient, road width) |
| 8 | Collision with a tram | 34 | Not caused by the driver |
| 9 | Collision with a train | 35 | Overtaking a vehicle turning left |
| 10 | Collision with a parked vehicle | 37 | Driving on an unpaved road |
| | | 44 | Loss of control of the vehicle |
| | | 45 | During turning right |
| | | 47 | Dodging without sufficient side clearance |
| | | 53 | Not adjusting the speed to the conditions of the road (ice, potholes, mud, wet surface of the road, etc.) |
| | | 73 | Improper turning or reversing |
| | | 76 | Driver not fully focused on driving |

(Source: Author)

As seen in Figure 1, during the spring period and in the daylight, the most common type of accident was a collision with wild animals not caused by the driver (1,364 accidents in total). The second most common type was a collision with another vehicle, where the cause was usually the lack of attention the driver paid to driving (1,039 accidents).

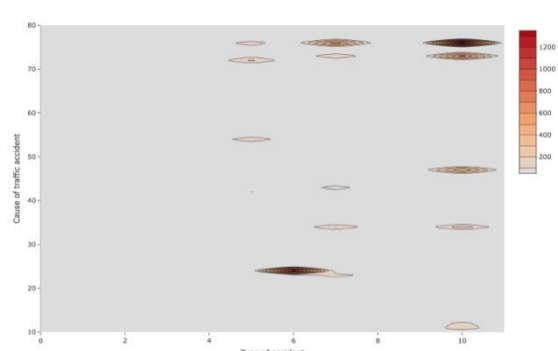
Figure 1. Heat map – types of traffic accidents and their causes – spring, in the daylight



(Source: Author)

Figure 2 shows that in the spring and in the darkness, the most common type of traffic accident is a collision with a parked or stopped vehicle (1,331), with the lack of attention paid to driving as a cause. There is a considerable difference when comparing with accidents occurring in the same season but in the daylight, as the number of accidents caused by not giving way to other vehicles decreased by 343.

Figure 2. Heat map – types of traffic accidents and their causes during the spring season – in the darkness

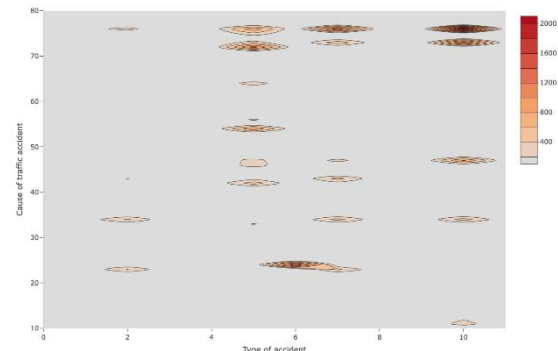


(Source: Author)

In the summer months, in the daylight, the most common type of accidents is caused by the lack of attention the driver paid to

driving, which leads to various types of traffic accidents. There were 747 cases of failing to respect the GIVE WAY sign, and 1,364 cases of collision with wild animals not caused by the driver (see Figure 3).

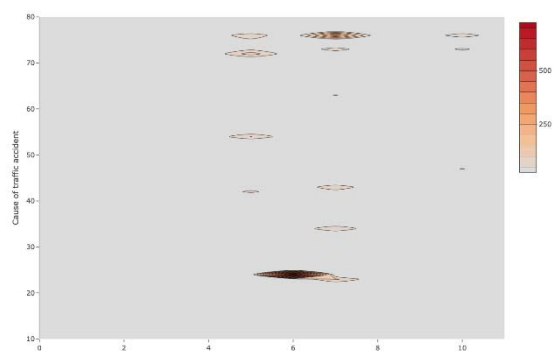
Figure 3. Heat map – types of accidents and their causes in the summer, in the daylight



(Source: Author)

In the same period, but in the darkness, a change was recorded in the form of a decrease in the number of traffic accidents caused by the lack of attention of the drivers. On the other hand, the number of traffic accidents not caused by the driver grew, as seen in Figure 4.

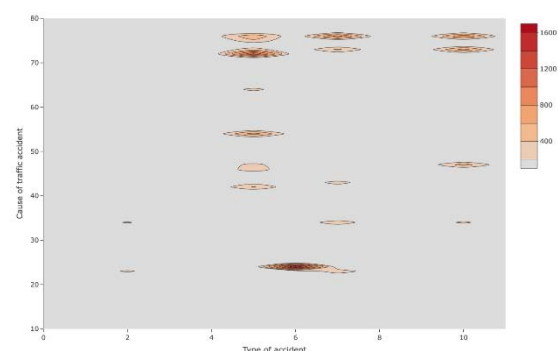
Figure 4. Heat map – types of traffic accidents and their causes in the summer, in the darkness



(Source: Author)

It follows from Figure 5 that in the autumn, the number of traffic accidents caused by failing to keep a safe distance between vehicles grew significantly (1,305 cases in total), which is a difference compared to previous periods. However, in other aspects, the characteristic of the map is very similar to the previous ones.

Figure 5. Heat map – types of traffic accidents and their causes in autumn, in the daylight

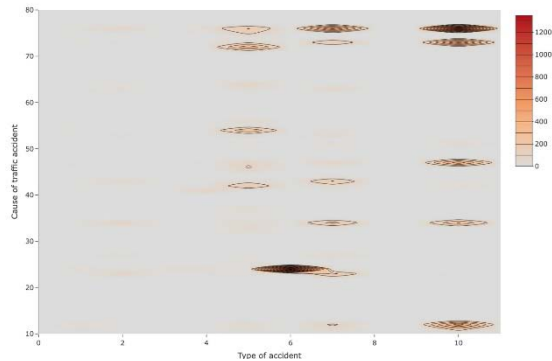


(Source: Author)

Figure 6 shows that compared to the number of traffic accidents that happened in the autumn in the daylight, there was a growth

in the number of accidents with the drivers not paying full attention to driving. This situation, which could not be seen in the summer and spring months, indicates a higher risk of insufficient attention paid to driving in the autumn night hours. Compared to previous periods, there is again a greater number of traffic accidents caused by improper driving.

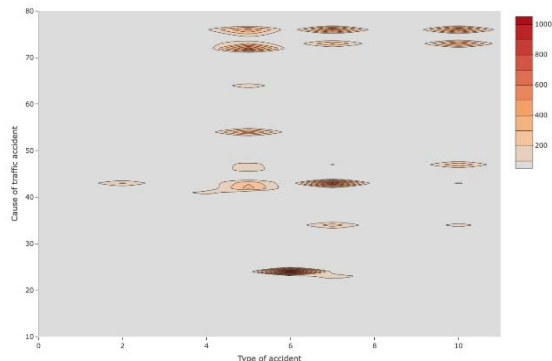
Figure 6. Heat map – types of traffic accidents combined with their causes during autumn - darkness



(Source: Author)

The heat map in Figure 7 indicates that in the winter season, there is a significant change compared to previous seasons, as factors typical of winter conditions can be noticed, such as an increased incidence of accidents caused by failure to adjust speed to road conditions. Moreover, there is also evident the cause of accidents related to failure to control the vehicle.

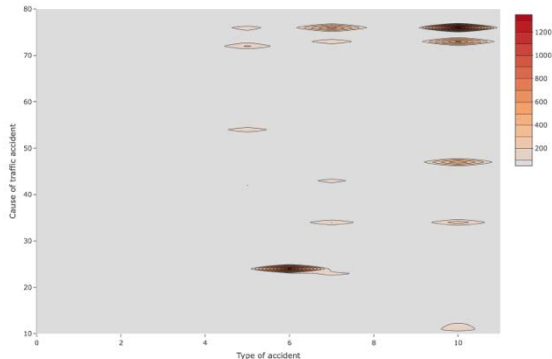
Figure 7. Heat map – types of traffic accidents and their causes in winter season in the daylight



(Source: Author)

The winter season is exceptional by showing the greatest similarities between individual heat maps, without any significant differences concerning the types and causes of traffic accidents that happened in the daylight or in the darkness.

Figure 8. Heat map – types of traffic accidents and their causes during winter, in the darkness



(Source: Author)

5 Discussion of results

RQ1: How many car accidents happened in the Czech Republic from October 2022 to October 2023?

Table 1 shows a significant effect of traffic accidents on road users during the monitored period. The most alarming statistics concern the number of dead people (440 deaths on roads), which is a tragic and unacceptable number. The consequences of traffic accidents also included 1,466 seriously injured people and 18,389 people with minor injuries, which indicates the serious impact of accidents on people's health. At the same time, the majority of accidents (73,489) were without any injury, which shows the importance of maintaining road safety and prevention of accidents. The figures are alarming and point to the need for implementing further measures to improve road safety. This is also confirmed by [37], who argue that more efforts should be put into this issue.

RQ2: What are the most common types of car accidents over the monitored period?

The results in Table 2 provide an overview of various types of traffic accidents that happened within the monitored period. It can be seen that collisions with fixed objects and with moving vehicles not on rails represent the most common type of accidents (21,028 and 26,777 respectively), which may indicate a high number of traffic accidents outside municipalities. Another major category is collisions with parked vehicles, amounting to 22,572 cases. This reflects an important issue of parking and the attention of drivers. According to [38], the lack of attention paid to driving is one of the main factors increasing the number of traffic accidents. A high number of accidents was recorded in the category of collisions with pedestrians (2,417 cases), which emphasizes the need for increasing pedestrian safety on the roads, as they represent a high-risk group in traffic that is at increased risk of injury and death in collisions with motor vehicles.

RQ3: What are the main causes of car accidents over the monitored period?

Two of the most common factors leading to traffic accidents are excessive speed and insufficient attention of drivers. Excessive speed can be due to various factors, including the failure to adjust the speed to the road condition and traffic intensity, which increases the probability of accidents. Insufficient attention of drivers paid to driving includes distractions such as the use of mobile phones while driving, which is also mentioned by [39] and other forms of improper behaviour. Here, emphasis should be put on drivers' education and training to make them more responsible and concentrated on driving.

Of the total number of 93,784 accidents recorded, 2,828 accidents were caused by drivers driving under the influence of alcohol, with blood alcohol of 1.5 ‰ and higher. Another 1,122 accidents involved drivers with blood alcohol ranging from 0.24 ‰ to 1.5 ‰. This means that more than 4,000 accidents involved drivers under the influence of alcohol. This is in line with [40], who state that there are still accidents caused by alcohol intoxication of drivers.

RQ4: Is there any difference between the combinations of car accident types and causes depending on daylight?

The analysis of individual heat maps for different seasons and light conditions provides interesting findings. During the spring season in the daylight, there were often recorded accidents involving a collision with wild animals not caused by the driver and collision with another vehicle caused by insufficient attention paid to driving. In the summer period, there is also a high number of accidents with drivers not paying attention to driving, probably due to the higher intensity of traffic.

In the spring in the darkness, collisions with other vehicles caused by insufficient attention paid to driving were recorded. In the summer period under the same light conditions, the number of this type of accident decreased, but the number of accidents due to causes other than drivers grew. In the night hours, there can be an increase in the number of accidents when the driver is not fully concentrating on driving due to tiredness or worse light conditions. The same conclusion was made by [31]. In the autumn, the increased incidence of accidents caused by failing to maintain a safe distance between vehicles can be related to changes in driving conditions. The winter season can then be associated with more accidents caused by failure to adjust speed to road conditions, e.g., slippery roads or generally worse road conditions.

The results indicate that there is an increased incidence of certain types of traffic accidents in specific seasons and under different light conditions. Insufficient attention of the driver is a constant factor that can be seen as one of the most common causes of accidents across all seasons and light conditions. Other common causes include improper turning or reversing and accidents not caused by the driver.

The incidence of these types of accidents and causes suggests certain consistency in risk situations throughout the year. Although individual seasons of the year show specific characteristics and features, there are recurring patterns in the occurrence of certain types of accidents and their causes. This can point to the need to focus on recurring road safety problems, to pay constant attention to them, and to adopt preventive measures. The police should thus focus on these major factors in order to ensure safer road traffic, which is also confirmed by [41].

6 Conclusion

The goal of the paper was to determine the relationship between various types of traffic accidents and their causes depending on various light conditions at the time of the accident. The data collection was carried out using quantitative content analysis of traffic accidents in the Czech Republic. The data were then processed using the cluster analysis and elaboration of heat maps, which enabled the achievement of the set goal.

An analysis of traffic accidents in the Czech Republic in the period between October 2022 and October 2023 identified several key aspects regarding road safety. An overview was prepared showing alarming figures, such as 440 people killed, 1,466 seriously injured people, and 18,389 people with minor injuries. These statistics undeniably point to the gravity of the situation and the need for adopting other preventive measures.

The analysis of the most common types of traffic accidents revealed a considerable frequency of collisions with fixed objects and moving vehicles not on rail. This trend suggests that accidents often occur outside communities. Moreover, other major categories of accidents were identified, especially collisions with parked vehicles, which may reflect the insufficient attention of drivers paid to parking and normal traffic.

Insufficient attention of drivers and failure to adjust their speed turned out to be two major factors increasing the number of traffic accidents. Insufficient attention can be caused by various factors, including the use of mobile phones while driving, various distractions, or other forms of inconsistent behaviour. Similarly, excessive speed can result from the failure to adjust the speed to road conditions or traffic volume, which increases the risk of crashes.

When looking at light conditions and different seasons, it can be seen that certain causes of accidents are recurring. Insufficient attention of drivers is one of the most common factors across various seasons. Although each season has its specificities, there are still some recurring patterns. This emphasizes the need for a

sustainable and systematic approach to accident prevention and improvement of road safety.

Proposals for improvement should be aimed at drivers' education and safety, increasing the awareness of the causes of traffic accidents. Measures adopted by the police should reflect the main factors leading to accidents and try to improve road safety systematically. The current findings bring important information that could lead to adopting measures to reduce the number of traffic accidents and increase road safety in the Czech Republic and all over the world.

The limitation of the research could be not considering other factors that may have an impact on the occurrence of traffic accidents, such as the road conditions, weather, or psychological aspects of drivers' behaviour.

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