Data Analysis of Traffic Accidents Resulting in Injuries and/or Fatalities in Lithuania from 2014 to 2022

Data Analytics Course

Capstone Project

prepared by

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Abstract

Despite making honorable progress, Lithuania is still suffering from relatively high injury and fatality rates of traffic accidents. The goal of this data analysis is to contribute to finding out key reasons for these tragic accidents and to provide recommendations for the future, in order to decrease the number of affected people. The data for the analysis was publicly available and was processed before visualization and insights presentation steps. As traffic accidents are a complex problem and include many variables - many angles of the dataset were explored: most dangerous road sections, children injuries and so on. It turned out that to mitigate the effects of this problem many recommendations and solutions should be applied at the same time. For example, prioritizing road infrastructure modernization in problematic sections and educating different demographic groups about pedestrian behavior and alcohol hazards while driving. Only by addressing these challenges comprehensively, Lithuania can strive for safer roads and fewer tragic outcomes in the future.

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Introduction

Traffic accidents resulting in injuries or even death remain a tragic issue all over the world including Lithuania. Despite making significant progress in lowering traffic accident related fatalities in the last decade, Lithuania was still above the EU average with ~53 fatalities per million inhabitants in 2021 [1]. Traffic accidents are also not only a huge sociological tragedy, but a financial burden as well, which every country should try to mitigate as much as possible. A research project published in 2017 estimated that each car accident fatality would cost around 1 million € and a serious injury about 100K € for Lithuania's economy [2]. This report aims to review an analysis conducted on public data collected from police reports in Lithuania from 2014 to 2022, mainly focusing on traffic accidents involving injuries and/or fatalities.

Methodology

The data for the analysis was taken from Lithuania's government open data website [3]. There were 10 nested JSON files for each year. Relevant data was unnested and combined into one file for accident, participant and vehicle information by using a pandas module in Python. Additionally, geographical coordinate information was converted into compatible format (WGS-84) instead of a Lithuanian one (LKS-94) by a publicly available converter [4]. All visualizations were done in Tableau public; the final dashboard can be accessed here [5]. Geographical point clustering was done by using sklearn's DBSCAN function and visualized with matplotlib module in Python; the clustering was heavily based on a publicly available tutorial [6]. Finally, the findings were presented with Google Slides.

Findings and Discussions

General Traffic Accident Trend

The amount of traffic accidents is trending downwards in Lithuania since 2014. Inspiringly, traffic accidents in which people were fatally injured decreased more than a half in this time period (Fig. 1). This closely mimics the EU fatal traffic accidents yearly trend, but in higher volumes. The amount of fatal accidents in the EU dropped only 17% during 2014-2021 period compared to 46% in Lithuania [1]. This shows an outstanding progress that Lithuania has made in recent years despite still being among the countries with higher accident rates.

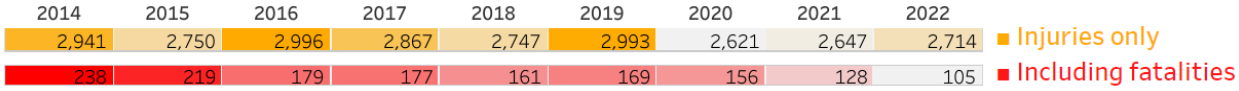

Figure 1. The amount of registered accidents in each year by accident type.

Neringa - an Exemplary Case

Looking at the geographical map of Lithuania showing all traffic accidents which have resulted in fatalities, the thing that stands out is that the Neringa region did not have any for the past 8 years (Fig. 2). This sounds too good to be true, especially when it is

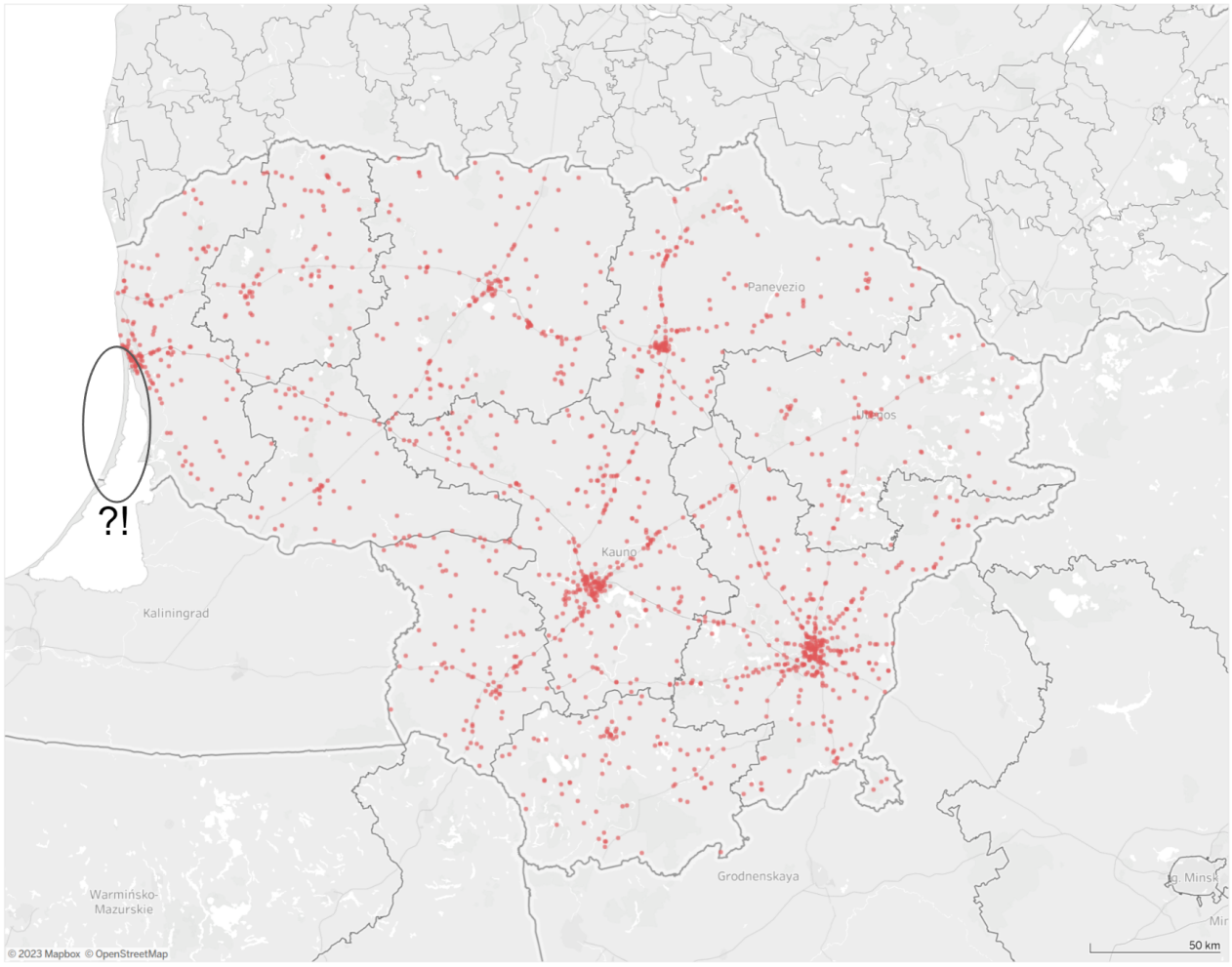

Figure 2. Geographical map of Lithuania showing fatal accidents with the Neringa region indicated.

estimated that about half a million tourists visit this region every year. The reason for this enviable result is most likely a complex one. There is only one road stretching out throughout the whole spit, which connects the most northern town - Smiltynė with the most southern one - Nida. Originally, the road was built in 1970’s and was not properly maintained until 2012. During this time it was quickly named as one of the worst rural roads in Lithuania, which, surprisingly, has been causing many accidents [7]. To fix the problem, a general road repair was started from 2012 to 2013, which contributed to making one of the most dangerous roads in Lithuania to one of the safest. Another signature activity in Neringa is riding bicycles as bicycle roads accompany the main road everywhere. They are the preferred means of transportation in the area with many

rental points. Bicycle roads have also been reconstructed recently [8], which encourages more people to choose bicycles instead of a car - a more dangerous form of transport. Moreover, the main road in Neringa is more regulated than others, because of the intertwined bicycle paths that cross the main road from time to time. Therefore, most of the road has stricter speed limitations outside of towns (70 km/h instead of 90 km/h) and an increasing number of speed cameras [9]. Lastly, as Neringa is a natural park with 2 reserves [10], there is a fee to be paid if you want to get in with a motorized vehicle [11]. But to get into Neringa in the first place you need to use a ferry, which charges more for motorized vehicles. All of this added up makes safer alternatives of transportation like bicycles and buses more attractive than dangerous ones - cars and motorcycles, thus contributing to zero fatal traffic accidents.

Looking for Most Dangerous Roads in Lithuania

On the other hand, to find the most dangerous road sections in Lithuania, which would be prioritized for investigation and modernization, a geographical clustering of fatal traffic accidents was performed. 18 clusters were found after using DBSCAN. Clustering parameters: minimum samples in a cluster - 5, maximum distance between two points in a cluster - 1km. 15 clusters were located in densely populated cities and therefore were discarded as accidents in those clusters were dispersed on different roads, which were usually separated by traffic regulations (traffic lights, intersections etc.), which change the traffic flow. What was left were 3 clusters, which had accidents on the same road, without changes of the traffic flow and indicated the most dangerous road sections in Lithuania. All of these sections had common characteristics - were highways going through or near more densely populated areas - towns: Radviliškis, Pasvalys and Jonava (Fig. 3). These identified road sections are also correlated with the so called,

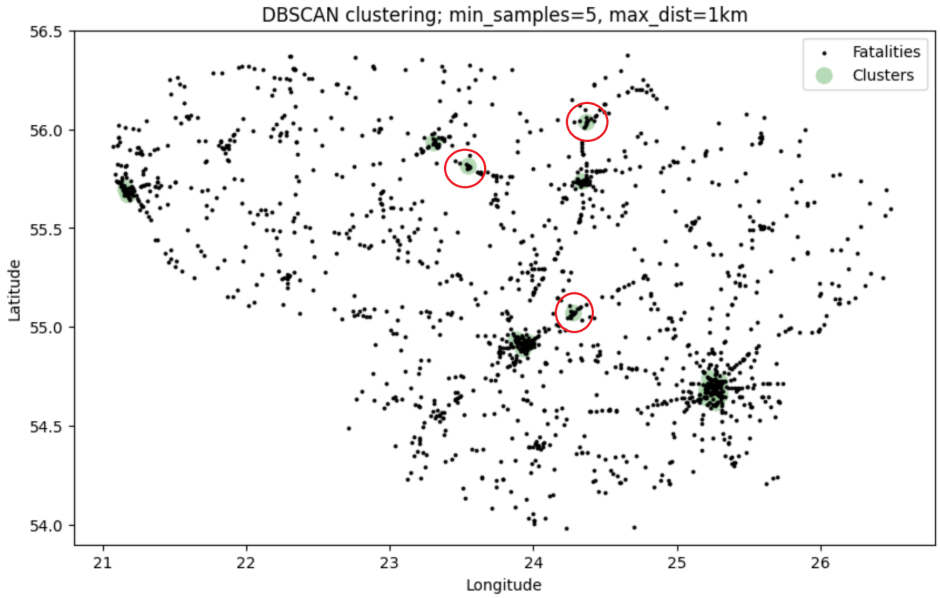

Figure 3. Clustering results. 3 red circles indicate the most dangerous road sections in Lithuania.

“black spot” statistics in 2020, where “black spots” were identified in road sections and are described as an area where during a 4 year period more than 4 traffic accidents were registered, which included injuries or fatalities [12]. However, as the parameters for DBSCAN identified areas are more strict (identified using only fatalities), the attention should be given to these 3 areas before black spots when road safety engineering works will be done in Lithuania.

Children Injuries

As injured adults are the biggest victim group in traffic accidents, it is also closely following the traffic accident trend downwards. However, the injured children group is opposedly slightly trending upwards (Fig. 4).

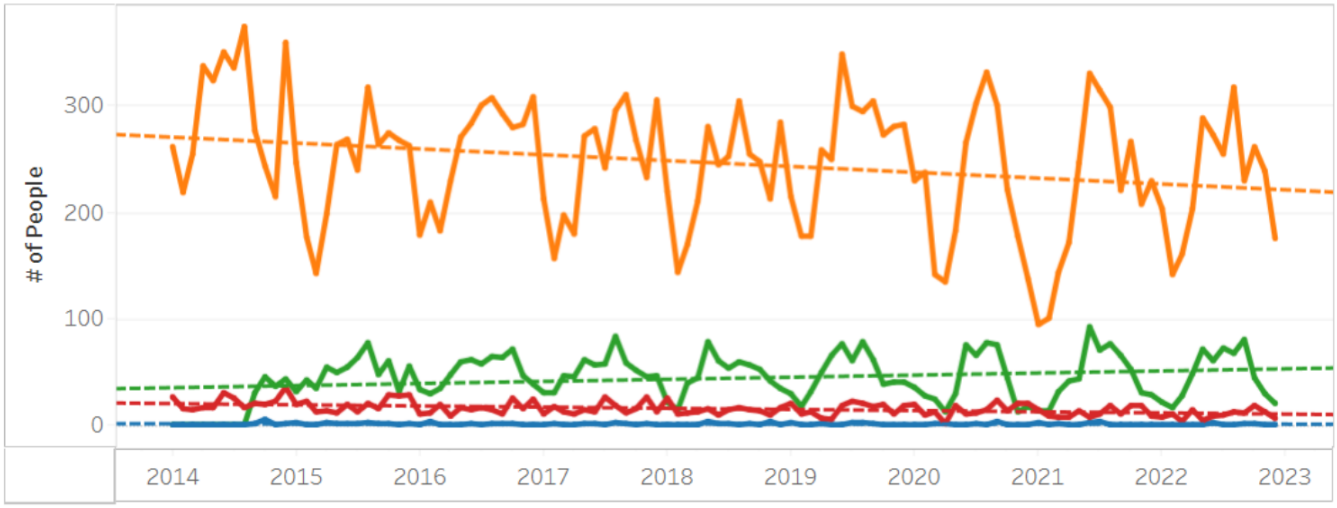

Figure 4. Amount of victims in traffic accidents by victim type. Orange - injured adults; green - injured children; red - adults killed; blue - children killed.

Top 5 accident categories were searched where children got injured in order to find out the reason for this upward trend (Fig. 5).

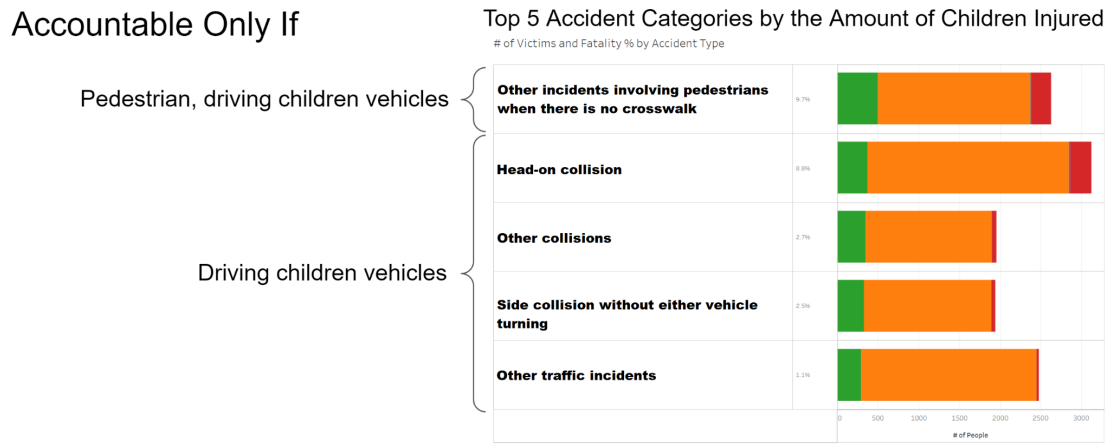

Figure 5. Top 5 accident categories where children got injured. Orange - injured adults; green - injured children; red - adults killed; blue - children killed.

In all of those categories a child would be held accountable only if he was a pedestrian in “Other incidents involving pedestrians when theres is no crosswalk” category or he would be driving children vehicles (vehicles you can legally drive under 18 in Lithuania - bicycles, mopeds, e-scooters, light quad bikes). Distributing pedestrian participants by age revealed that children group (under 18) are more likely to get in an accident which results in an injury or fatality and are more likely to cause that type of accident, especially the 7-10 years old subgroup (Fig. 6). This only shows how important road

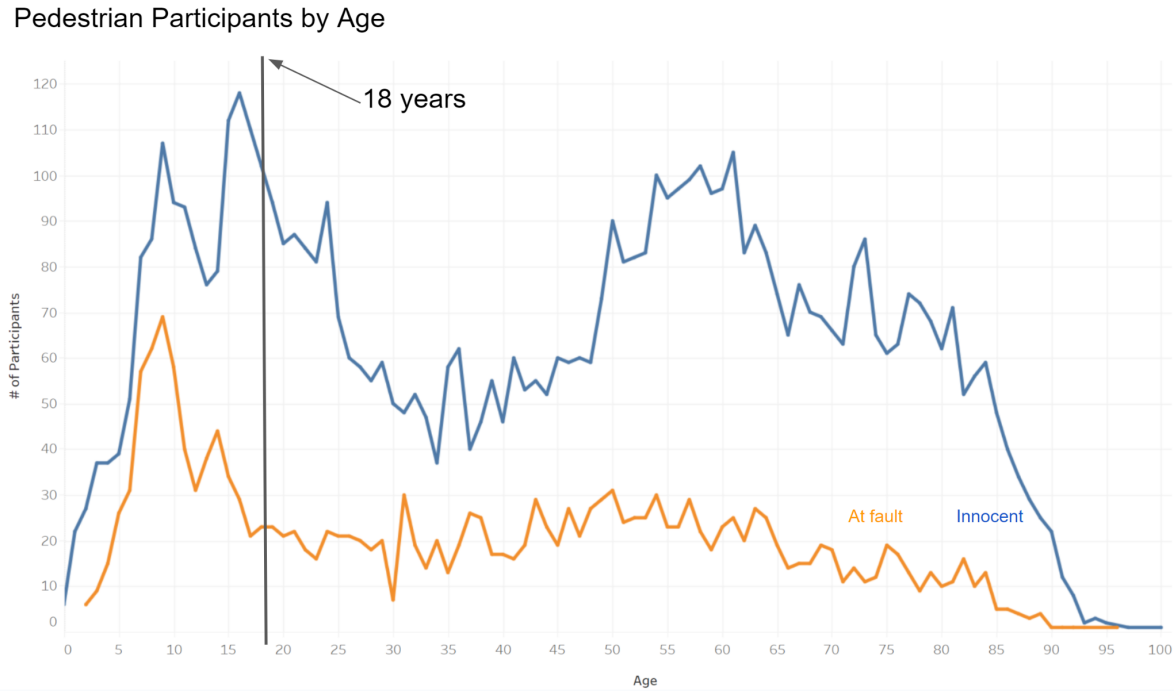

Figure 6. Pedestrian participants by age. Orange - At fault; Blue - Innocent.

safety education for primary school children is. For most children in this age group, these are their first times when they engage in traffic on their own as pedestrians, traveling back and forth to school and so on. This graph shows that mandatory road safety lessons should be introduced in primary school and by parents, in order to mitigate the number of injured children.

Moreover, plotting children vehicle drivers by age group showed even more drastic results. Teenagers are much more inclined to both cause and be involved in life threatening traffic accidents with these kinds of vehicles (Fig. 7). This corresponds with studies showing that teenagers are more likely to take risks [13]. Sadly, this applies when driving vehicles as well. The solution to this problem is likely the same as with pedestrians. More education not only about the theory and practice of driving, but also psychological education on hardships of traffic accidents.

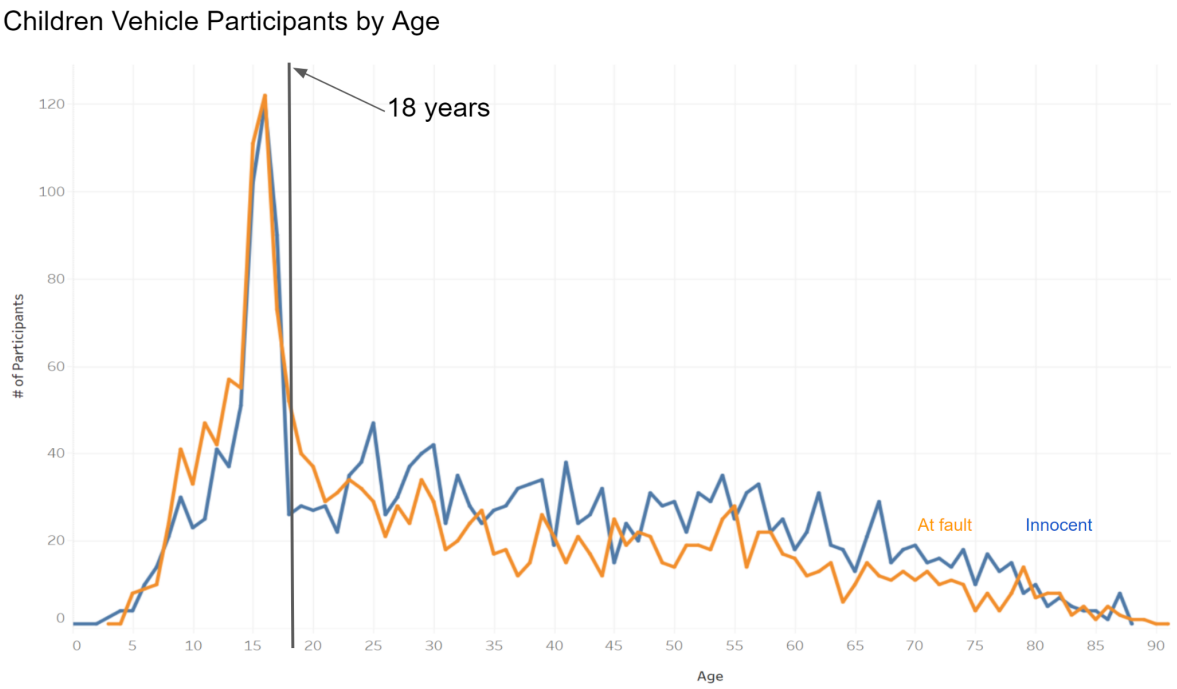

Figure 7. Children vehicle participants by age. Orange - At fault; Blue - Innocent.

Victims of the Night

~23% of all traffic accidents happen in the night time. If we filter general victim information by accidents that only occur in the night we can see that there is a visible decrease in adult injuries since 2020 (Fig. 8).

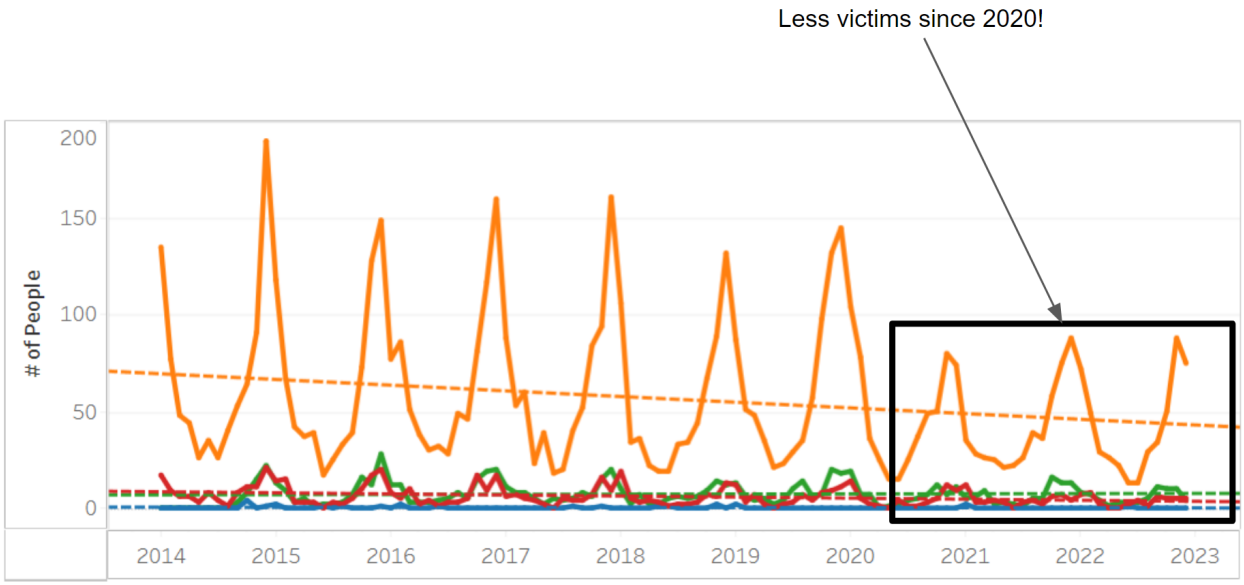

Figure 8. Amount of victims in traffic accidents in the night by victim type. Orange - injured adults; green - injured children; red - adults killed; blue - children killed.

This is a most probable consequence of new road lighting systems. From 2020 the modernization of road lighting of national importance was implemented in two stages

during which the old type lamps were replaced with new LED type lamps, which can be operated in real time [14]. The LED lamps and the real time aspect are very important and possibly the most contributing factors as most night traffic accidents happen in the winter time when the visibility becomes poor and more unpredictable. Also, if we look at the top 5 accident categories by the number of total victims, which happened during the night, it is clear that better lighting systems could have prevented some of them (Fig. 9). The “Other incidents involving pedestrians when there is no crosswalk” is a priority category as it has a relatively high fatality percentage - 24%. Possible mitigating solution to this accident category include building crosswalks with new lighting systems where pedestrians tend to cross illegally and educating them about reflector usage. All other categories in the top 5 generally happen on the road and can be mitigated by introducing modern road lighting solutions and better road infrastructure, like sound making traffic lines when entering an opposite lane to prevent head-on collisions or light generating road marks to reduce run-offs.

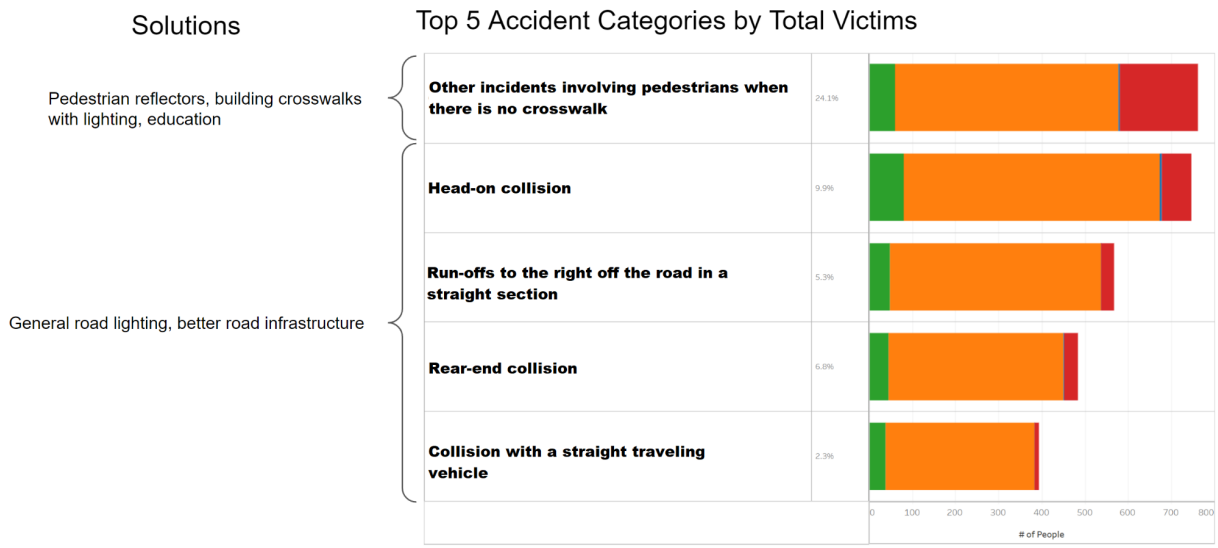

Figure 9. Top 5 accident categories by number of victims. Orange - injured adults; green - injured children; red - adults killed; blue - children killed.

Guardrails and Safety Belts

Paradoxically, the presence of guardrails in a traffic accident turned out to be quite a fatality indicator, despite its name. Fatality rate (9.02%) with guardrails in the accident scene was 85.35% higher than without guardrails (4.86%). However, the increase was observed probably because of the high speeds that accompany roads with guardrails and not the actual guardrails, as guardrails are most popular in highways. But poorly constructed guardrails can still pose threats. If the guardrail is made out of cheap materials it can break in high speed impacts and impale the vehicle, thus doing more harm than good. Also, if guardrails are built not necessarily in a position when it would

be safer to run-off the road (open field without a ditch), they furtherly endanger not only the driver by bouncing it off back into the highway, but other vehicles as well that are driving on the same highway. However, if installed correctly, guardrail reduces fatalities and serious-injuries caused by roadway departure crashes by 16 to 47 percent [15].

Safety belts, on the other hand, statistically proved that they save lives. Fatality rate with seatbelts on (5.13%) was 57.54% lower than without (12.08%). Sadly, but 7% of victims still did not wear seatbelts during the accidents, especially victims in their early 20's. Thus, showing that more enforcement and education is needed. A quite drastic enforcement example, which could help to lower this metric nowadays, would be safety belt interlock, which prevented the car from being started unless all front-seat occupants buckled their safety belts first, which was first introduced in 1974 in the USA [16].

Women, Men and Alcohol

Looking at the participant distribution at the accident scene by age, gender and soberness, it was observed that most people, who are involved in the accidents, are in their 20's despite their gender (Fig. 10). However, women tend to be significantly less at fault than men in their 20's and in their retirement age when sober. Also, more men tend to drive under the influence of alcohol than women. Despite that, alcohol consumption makes both men and women more likely to cause a serious or fatal traffic accident. For example, if a man is drunk and gets into an accident while driving a car, there is a 92.2% chance that he is at fault. If he would be sober that chance would be only 51.6%. Similar change is observed in the women group as well with the huge increase from 52.9% to 89.2%.

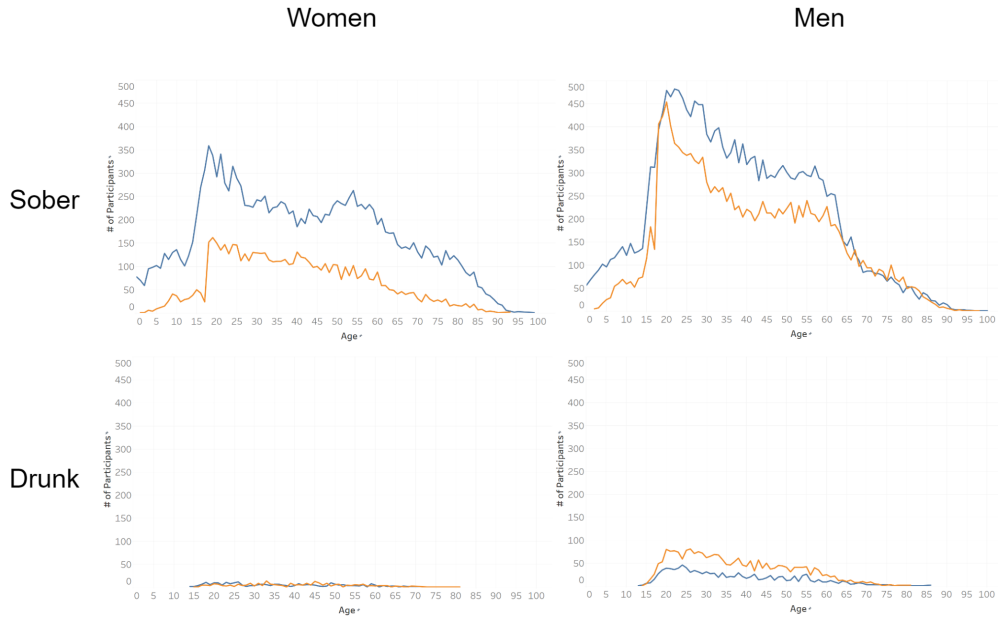

Figure 10. Women and Men by Soberness and Age. Orange - At fault; Blue - Innocent.

Drunk driving and alcohol in general is a serious issue in Lithuania, which it has been fighting against since regaining independence. This problem has many causes, including socioeconomic habits, lack of education and peer influence, especially among young men. In recent years, Lithuania has been targeting alcohol directly by lowering the purchase hours in grocery stores, banning alcohol commercials and alcohol sales in gas stations, which had some positive effects. However, a more educational approach should also be implemented targeting people in the risk group of drinking and driving to prevent it from happening. Also, raising awareness of the public towards reporting drunk drivers should be more encouraged and not stigmatized.

Most Dangerous Car Makes

To find the approximation of most dangerous car makes, a popularity index of car makes in Lithuania in 2022 was used [17] as a representation of car make population in the country. Then the number of vehicles of each car registered in traffic accidents were divided by the popularity index and the resulting metric was used to estimate the results. It was estimated that the most dangerous car makes to drive in Lithuania were Renault, Honda and Mazda and the safest one turned out to be Kia (Fig. 11).

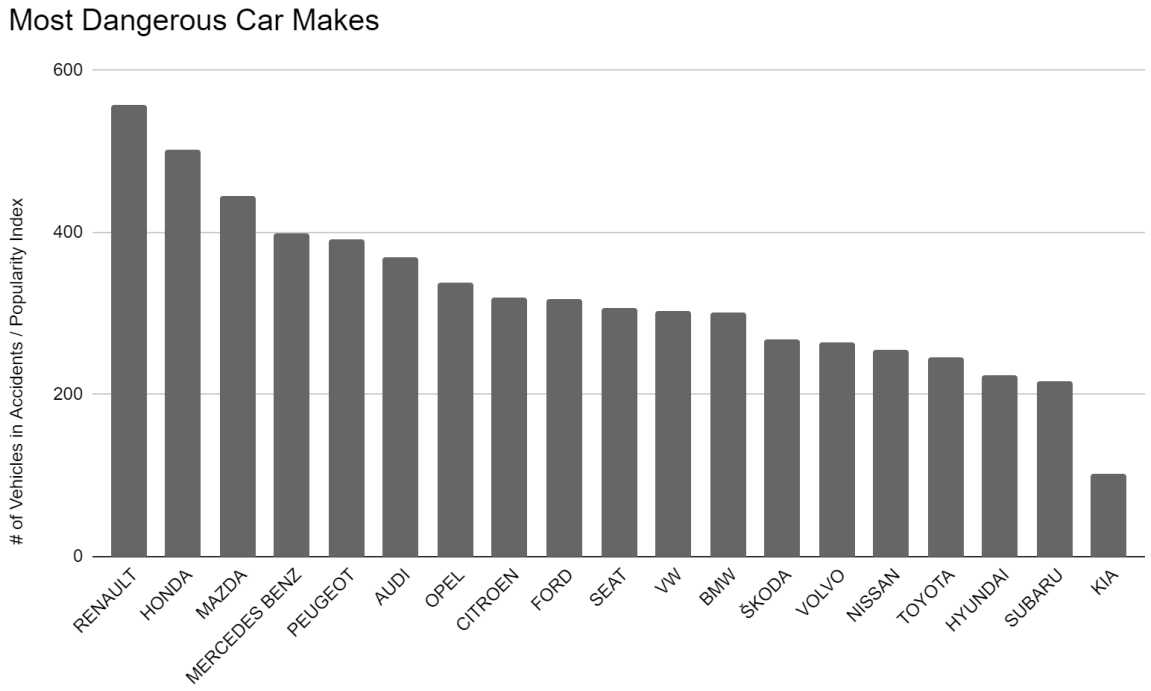

Figure 11. An approximation of the most dangerous car makes to drive in Lithuania.

However, these results are not to be taken for granted as the car make population in the country was only an estimation from 2022 data. In order to get more realistic results, a

yearly surveillance data of car make population in Lithuania should be used to make more correct assumptions.

Conclusions

Lithuania has come a long way in reducing tragic traffic incidents, which cost many lives and substantial economic resources, but there is still a lot of progress to be made in the upcoming years. To accelerate the present downward traffic accident trend, Lithuania has to address many issues that come along the way. Like, prioritizing the most dangerous road sections and “black spots” in the country for road safety engineering or establishing educational pedestrian programs for primary school children. Also, sticking with and continuing practices that clearly showed positive results in recent years, for example, LED road lighting system modernization. Clearly this is no easy task as the traffic accident problem is complex and, as Neringa's example has shown, has to be solved from many angles.

Recommendations

- Neringa's example shows that a comprehensive solution must be applied to eliminate car accident fatalities. This includes modernizing general road infrastructure, establishing traffic regulations and offering attractive alternatives.

- Road safety solutions have to be implemented with priority as there are more problematic cases than others. Especially highways going near or through densely populated areas.

- A slightly rising amount of children injuries is concerning. To address the issue, an educational approach must be taken by teachers and parents about pedestrian road safety and risk taking when beginning to drive.

- Modernized lighting systems must be furtherly implemented as they clearly save lives in the night. A priority should be aforementioned problematic road sections and crosswalks through highways. Also, educating the public about pedestrian behavior in the night and popularizing pedestrian reflector usage should be encouraged.

- Building guardrails only when they are truly needed and by using quality materials. If the road is accompanied by an open field without a ditch, then it would be safer to just drive off into the field than to hit a guardrail.

- Seatbelts save lives. Find out more ways to get people to wear them. Pitch the idea of bringing back the safety belt interlock to the EU.

- Drunk driving is still an issue as it significantly increases the probability of causing an accident. An educational/preventive measures should be implemented. Especially amongst young men as they are more willing to cause an accident both sober and drunk.

- An approximation of the most dangerous cars show that some car makers are possibly more dangerous than others. This could be food for upcoming analysis, although a more trustworthy data set should be found, which would truly represent the car make population in Lithuania.

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