



The Impact of Human Behavior, Weather Conditions and Over-Speeding on Road Accidents: A Data Driven Study of Catalonia's Traffic Situation

January 30, 2024 Written By: [Owais Ahmad](#)

Introduction:

This analysis explores how traffic accidents have changed in Catalonia over the past 12 years. The report shares the main results and recommendations with both decision-makers and the public to enhance road security in Catalonia and in general.

Overview of Traffic Accidents, Fatalities, and Serious Injuries in Catalonia from 2010-2021:

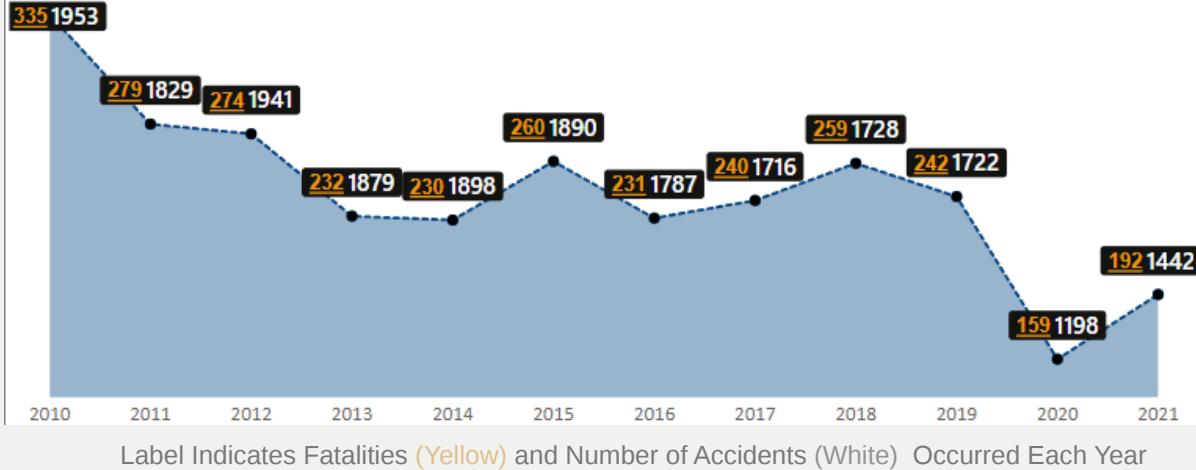
▼ Accidents & Fatalities

- **Accidents & Fatalities Trend:** The number of accidents declined from 2010 to 2013, then reached its maximum in 2015. In 2020, there was a big drop in both accidents and fatalities by ~43%, but the fatality rate did not change standing still at 13.5%.
- **Possible Causes:** This could be attributed to **reduced traffic** in year 2020 due to COVID-19 lockdowns or other safety measures implemented.
- **Implications:** The drastic reduction in accidents suggests that fewer people were on the roads, possibly due to lockdowns. The stable fatality rate indicates that while

there were fewer accidents, their **severity** or the **response** to them did not significantly change.

Number of Accidents & Fatalities in Catalonia's Road Accidents Significantly Decreases in the Year 2020

There were Fewer Accidents in 2020 than in 2019 as it Dropped ~43% However Fatality Rate kept Stable at ~13.5%.

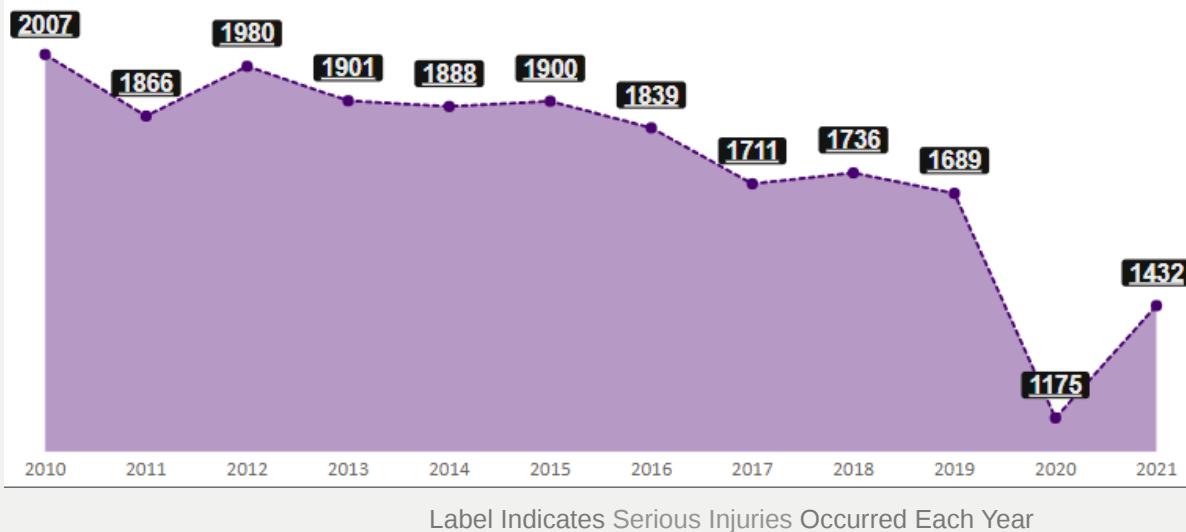


▼ Fatal Accidents & Serious Injuries

- Serious Injuries Trend:** Serious injuries followed the same downward trend as accidents, which fell by 43% in year 2020. This implies that some factors, such as reduced traffic, improved road conditions, or enhanced safety measures, contributed to the decline in serious injuries.

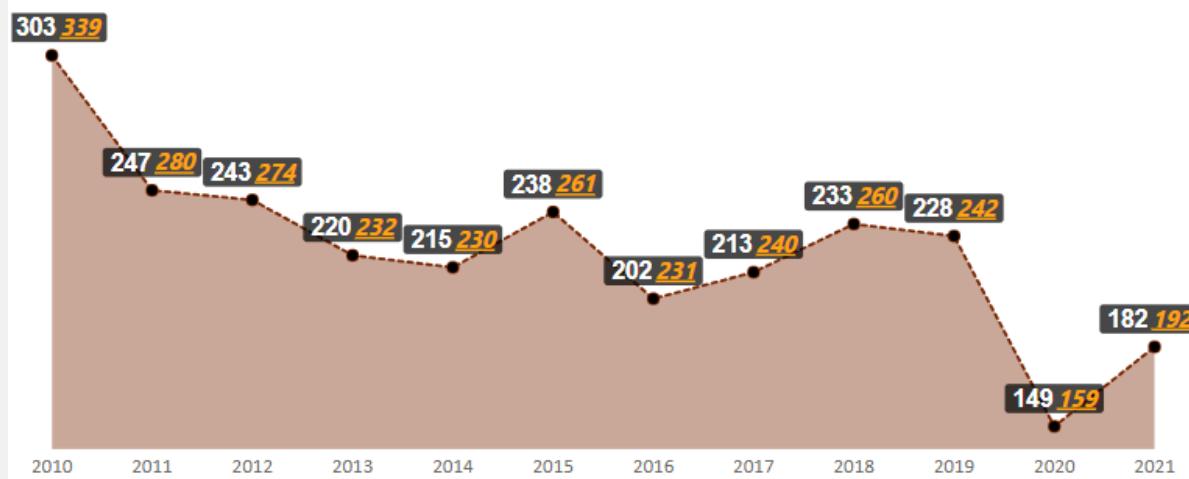
Serious Injuries Due to Road Accidents Significantly Decreases in the Year 2020

There were Fewer Serious Injuries due to Road Accidents in 2020 than in 2019 as it dropped ~43%



- Fatal Accident's Trend:** Fatal accidents record staggering ~108% fatality rate in Catalonia Region. A 35% drop in fatal accidents from 2019 to 2020, but an increase again in fatalities by mid-2021. The fatality rate remains high at ~108%, meaning that more than one person died per fatal accident on average.

Fatal Accidents Record Staggering ~108% Fatality Rate In Catalonia
Number of Fatal Accidents were Significantly Dropped ~35% in Year 2020 keeping the Fatality Rate at ~108%



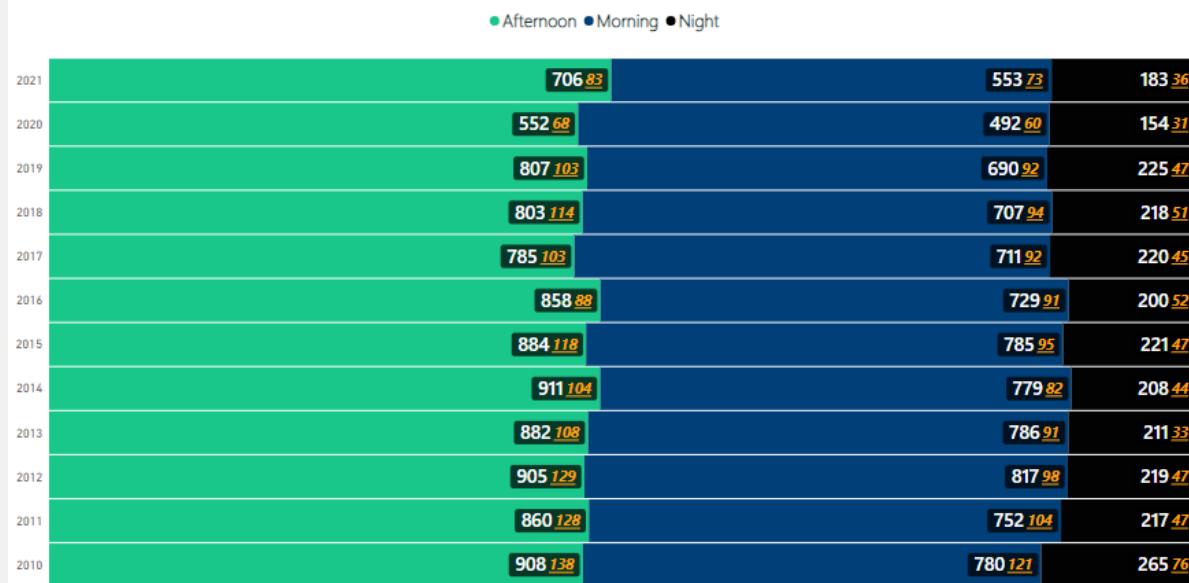
- This implies that despite the reduction in the number of fatal accidents, the severity and impact of those accidents were very high, resulting in more deaths than accidents.

When Do Accidents Occur Most

▼ Most Accident-Prone Times: Afternoon and Morning Risks:

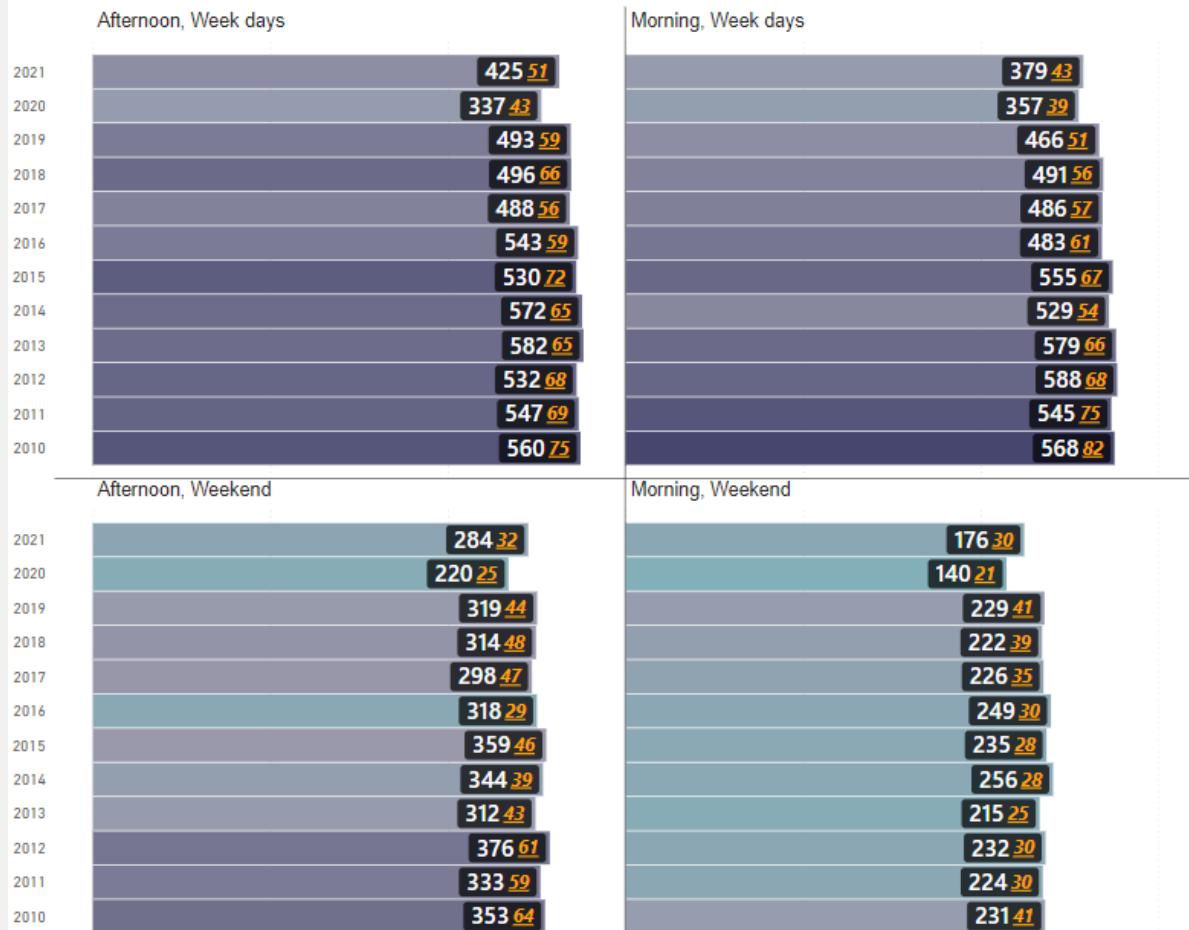
Around 47% of the accidents happen in the afternoon and 40% in the morning, which are the peak hours of traffic. This suggests that factors such as congestion, distraction, fatigue, and stress may contribute to the high incidence of accidents during these times.

Catalonia's Morning Alert : Around 47% of the Accidents Happen in Afternoon and 40% in the Morning
Night-Time Incidents Results in Fatalities at a Significantly Higher Rate of ~22% compares to Morning or Afternoon ~13%



Catalonia's Morning Alert : Around 47% of the Accidents Happen in Afternoon and 40% in the Morning

Night-Time Incidents Results in Fatalities at a Significantly Higher Rate of ~22% compares to Morning or Afternoon ~13%



Night Time Dangers: Night-time incidents result in fatalities at a significantly higher rate of ~22% compared to morning or afternoon ~13%. This implies that driving at night is more hazardous due to factors such as low visibility, impaired drivers, and lack of emergency services.



Recommendations could include increasing public awareness about the heightened risk of nighttime driving, enhancing street lighting, and law enforcement presence during these hours to mitigate risks.

When to Drive with Caution: Exploring the Patterns of Accidents in Catalonia's Road Sections

▼ How Road Sections Affect Accident Outcomes

- **Accident Distribution:** The majority of accidents occur “In section” (6542 accidents), followed by “Within intersection” (3707 accidents), and least occur when “Arriving or leaving intersection up to 50m” (499 accidents). However, 12% of fatalities occur “In section”, 7% “Within Intersection”, and 6% when “Arriving or leaving Intersection up to 50m”

Traffic Accidents and Fatalities Across Catalonia's Road Intersections

Around 12% of the Fatalities occurs at Road's "In section Zone" followed by 7% "Within Intersection" and 6% in "Arriving or leaving Intersection up to 50m".

In section

6542

Number of Accidents



Within intersection

3707

Number of Accidents



Arriving or leaving intersection up to 50m

499

Number of Accidents



This implies that the “In section” zone is the most dangerous and prone to accidents, as well as the most fatal. The “Within intersection” zone is also risky, but less so than the “In section” zone. The “Arriving or leaving intersection up to 50m” zone is the safest, but still has a significant fatality rate compared to the number of accidents.



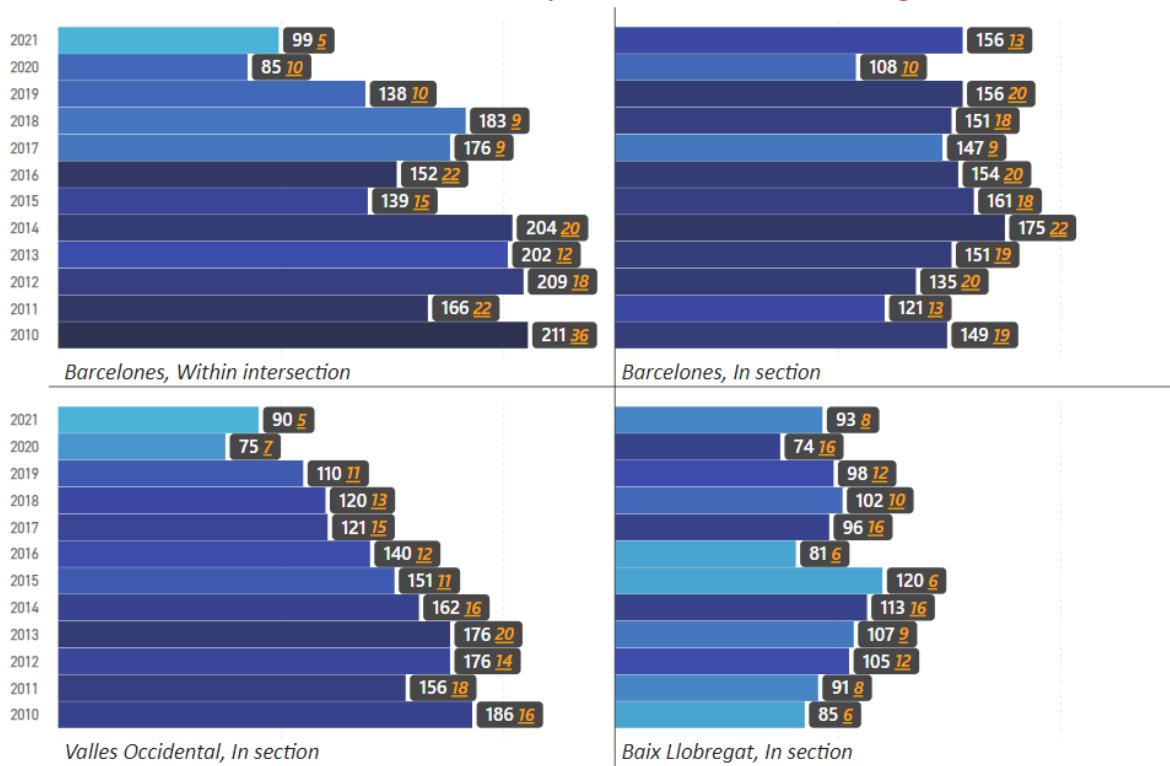
Recommendations: Recommendations could include implementing stricter traffic control measures and safety protocols in the “In section” zones, improving signage, and considering redesigns for problematic intersections to reduce accident rates.

▼ Can You Guess the Most Fatal Road Intersection Zone in Catalonia?

- **Accident Distribution:** The study depicts the number of traffic accidents and fatalities in different counties and road sections in Catalonia from 2011 to 2021. **Barcelones** has the highest incidence of traffic accidents, particularly within intersections. Valles Occidental, Baix Llobregat, and Maresme follow in section zone with the average fatality rate of ~10.5%.

Quantifying Correlation Between Traffic Accidents and Fatalities Across Catalonia's Counties and Road Sections

Barcelona Leads in Traffic Accidents, Followed by Valles Occidental, Baix Llobregat and Maresme.



There may be a positive correlation between population density and traffic accidents, as more people and vehicles increase the likelihood of collisions. However, other factors such as road network characteristics, driver behavior, and environmental conditions may also influence the accident rates.

- This implies that the intersections in **Barcelones** are particularly hazardous and that there is a need for enhanced safety measures in these identified areas.



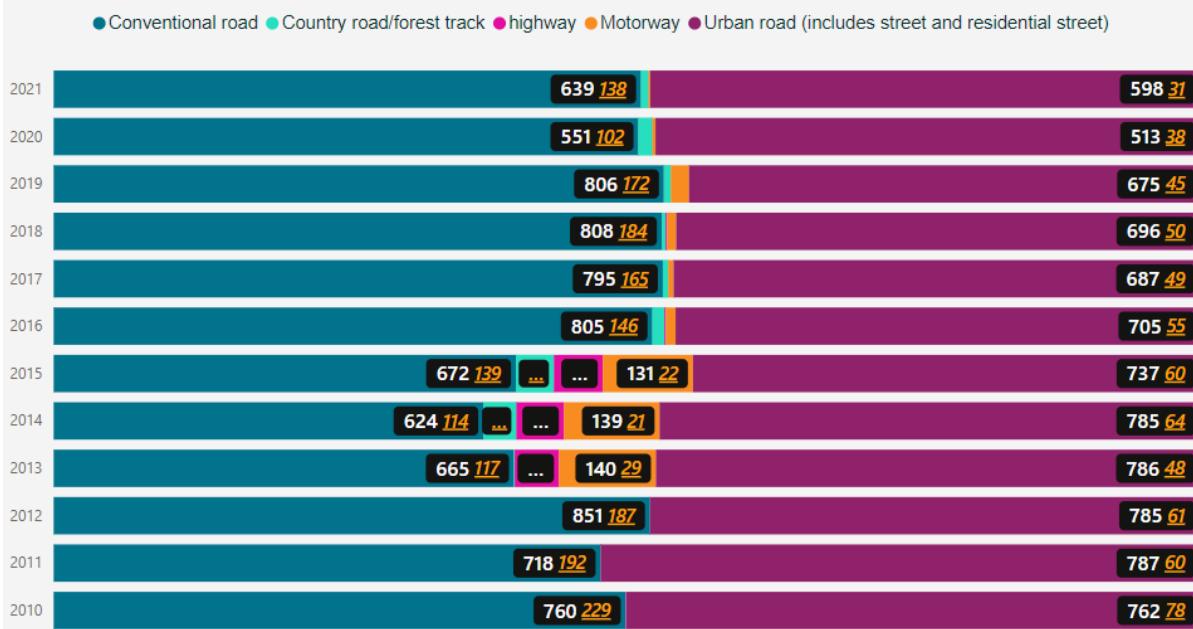
Recommendations: Implement stricter traffic regulations and enhanced enforcement in **Barcelones'** intersections. Study the specific causes of accidents to tailor prevention strategies effectively. Enhance public awareness campaigns on road safety.

▼ The Challenges and Opportunities of Improving Road Safety in Catalonia

- Conventional roads witness an average of ~21% fatalities, while urban areas record ~7%. This indicates that conventional roads are more dangerous and risky than urban roads, despite having fewer accidents overall.

Navigating Risk: Catalonia's Conventional Roads and Residential Streets Account for Majority of Accidents

Conventional Roads Witness an Average of ~21% Fatalities, while Urban Areas Record ~7%

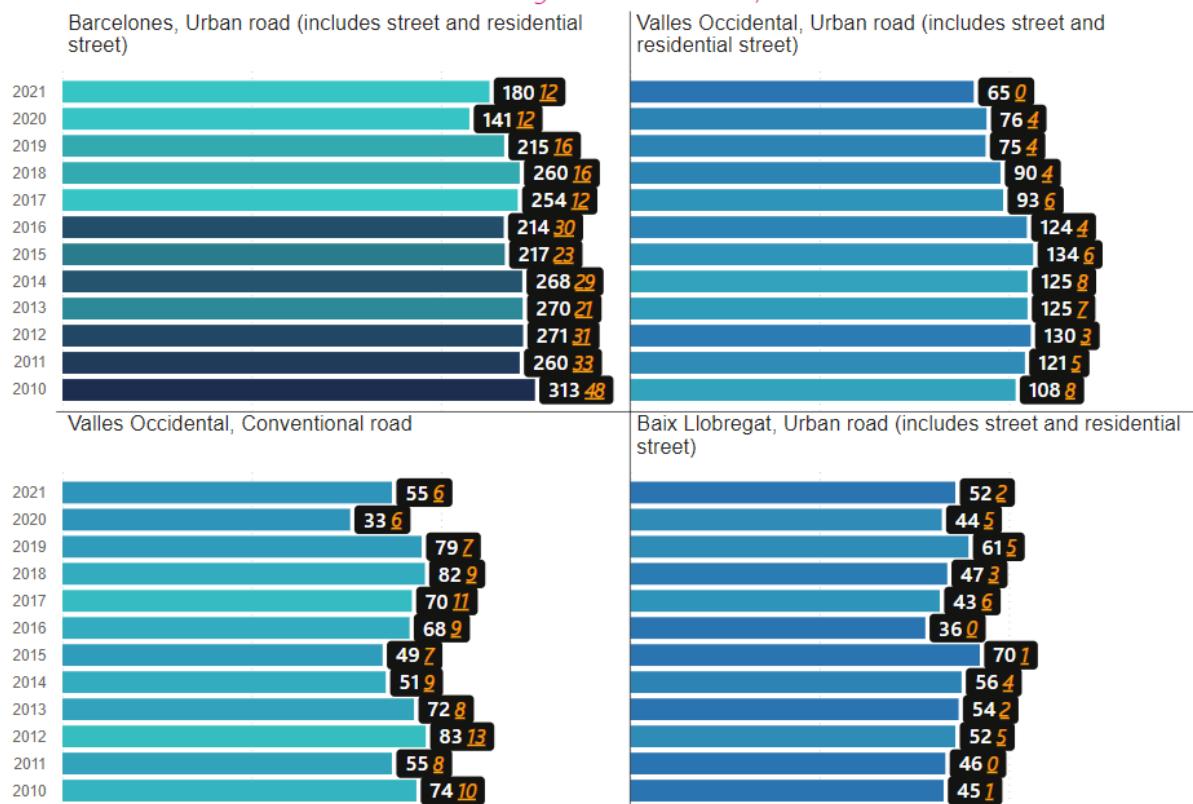


Label Indicates Total Fatalities (Yellow) and Number of Accidents (White) Occurred Each Year

- Barcelones (Urban Road) consistently has the highest number of traffic accidents in Catalonia, with a significant increase over the years. Valles Occidental (Urban Road) also shows a notable number of accidents but less than Barcelones. Conventional Roads in Valles Occidental have fewer accidents compared to urban areas.

Navigating Risk: Catalonia's Conventional Roads and Residential Streets Account for Majority of Accidents

Conventional Roads Witness an Average of ~21% Fatalities, while Urban Areas Record ~7%





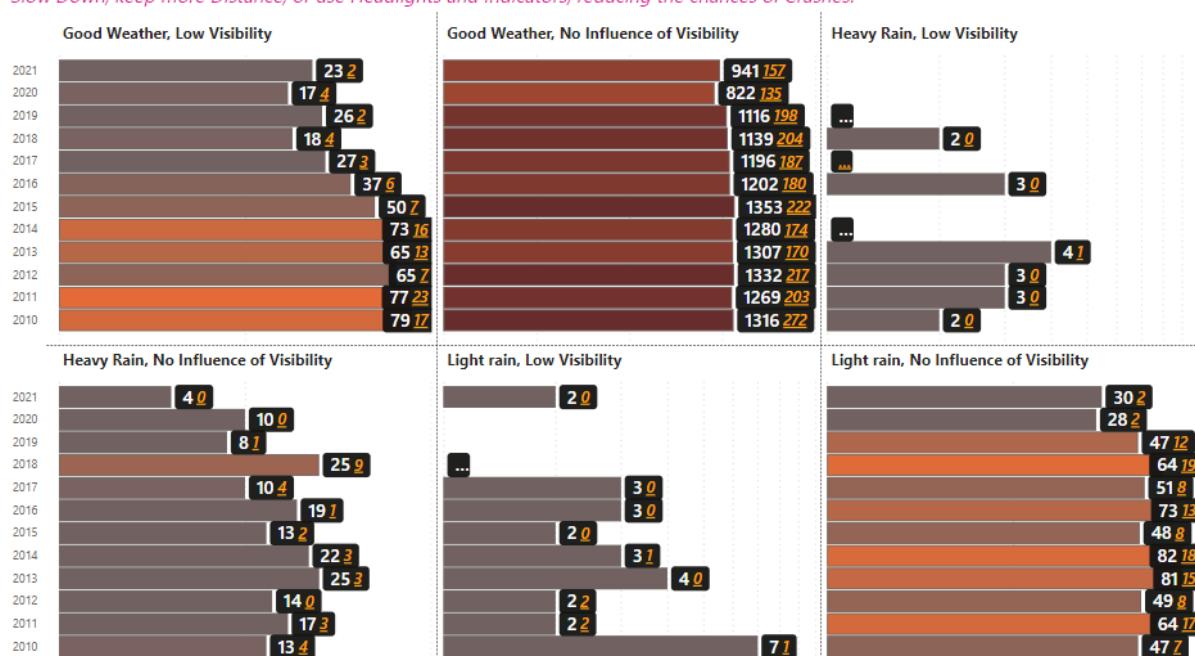
Implications and Recommendations: There is a need for enhanced safety measures and traffic management in urban areas, especially in Barcelones, where the accident rate is very high. The specific causes of high accident rates in these areas should be investigated and targeted interventions should be implemented. Some possible measures include improving road infrastructure, enforcing traffic rules, and raising awareness about road safety. For conventional roads, the high fatality rate suggests that the severity of the accidents is higher, which may be due to factors such as speed, visibility, road conditions, and emergency response. These factors should be addressed and improved to reduce the impact of accidents on conventional roads.

▼ When Good Weather is Bad News: The Hidden Dangers of Driving in Clear Visibility

- **Accident Frequency:** Highest number of road accidents occurs during good weather with no influence of visibility, followed by light rain with no influence of visibility. The lowest number of accidents occurs during low visibility conditions, regardless of whether it is raining or not.
- **Fatality Rate:** Around 76% of the fatality rate is recorded where there was no influence of visibility and weather, suggesting that drivers might be less cautious and more prone to speeding, overtaking, or ignoring traffic rules in such conditions.

The Effect of Weather Conditions and Visibility on Road Accident Frequency

Around ~16% of Fatality Rate Recorded where there was no Influence of Visibility and Weather; this condition leads to more Accidents and Deaths, they might Speed at >90 km/hr, Overtake or Ignore Traffic Rules. Drivers are more cautious when Visibility is Reduced. They might Slow Down, keep more Distance, or use Headlights and Indicators, reducing the chances of Crashes.



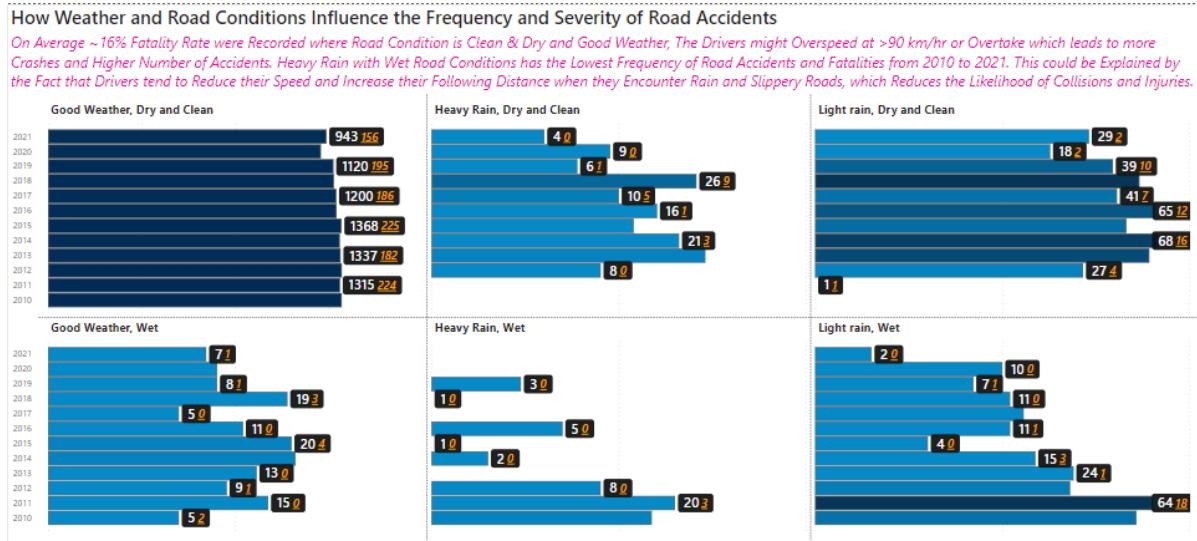
- Weather and visibility are not the only factors affecting road safety, but also driver behavior and attitude. It also suggests that drivers are more aware and careful when visibility is reduced, as they might slow down, keep more distance, or use headlights and indicators to reduce the chances of crashes.



Recommendations: Encouraging the use of public transportation or alternative modes of travel to reduce traffic congestion and pollution.

▼ How Drivers Behave Differently Under Different Weather and Road Scenarios

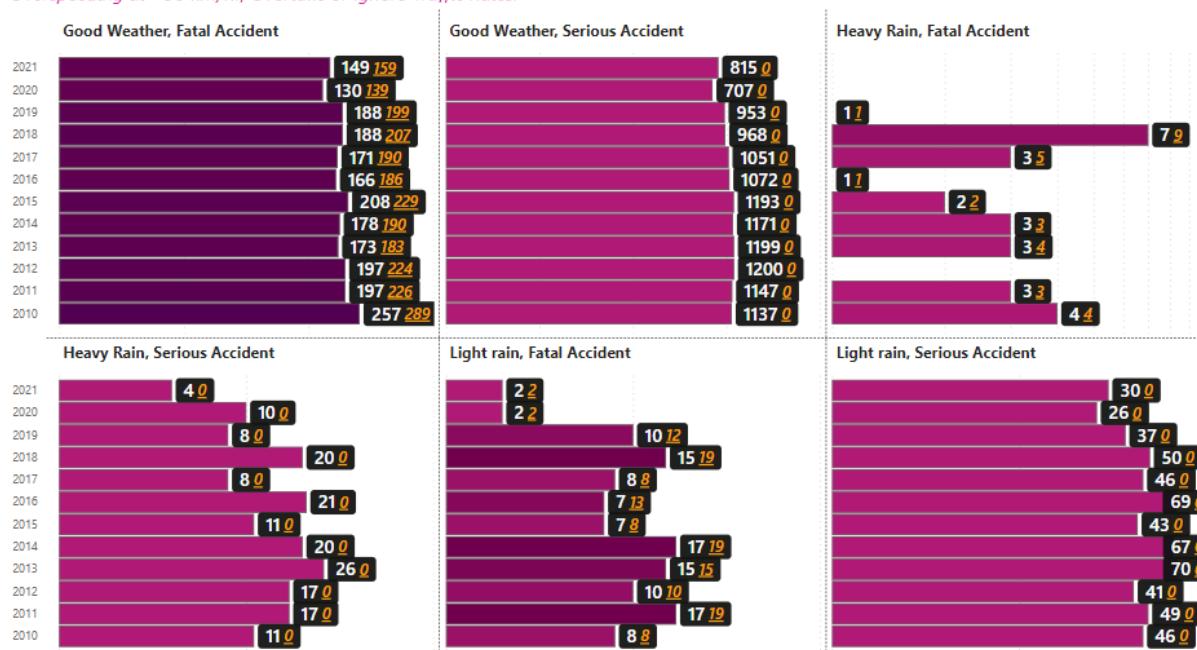
- **Accident Frequency and Severity:** Number of accidents and fatalities are higher in good weather and dry & clean road conditions, compared to rainy and wet road conditions. This indicates that drivers might be overconfident and drive recklessly in favorable conditions, leading to more crashes and deaths.
- **Driver Behavior and Attitude:** Drivers are more cautious and responsible when they encounter rainy and wet roads, as they tend to reduce their speeds, increase their following distance, and use appropriate signals and lights. This reduces the likelihood of collisions and injuries.



- Weather and road conditions are not the only factors influencing road safety, but also driver behavior and attitude. It also implies that there is a need to address the issue of overconfidence and risk-taking among drivers, especially in good weather and dry & clean road conditions.

The Effect of Weather Conditions on the Severity and Frequency of Road Accident

A Staggering ~110% Fatality Rate were Recorded in a Clean Good Weather Condition, The possible causes of this Tragic Incident include Overspeeding at >90 km/hr, Overtake or Ignore Traffic Rules.



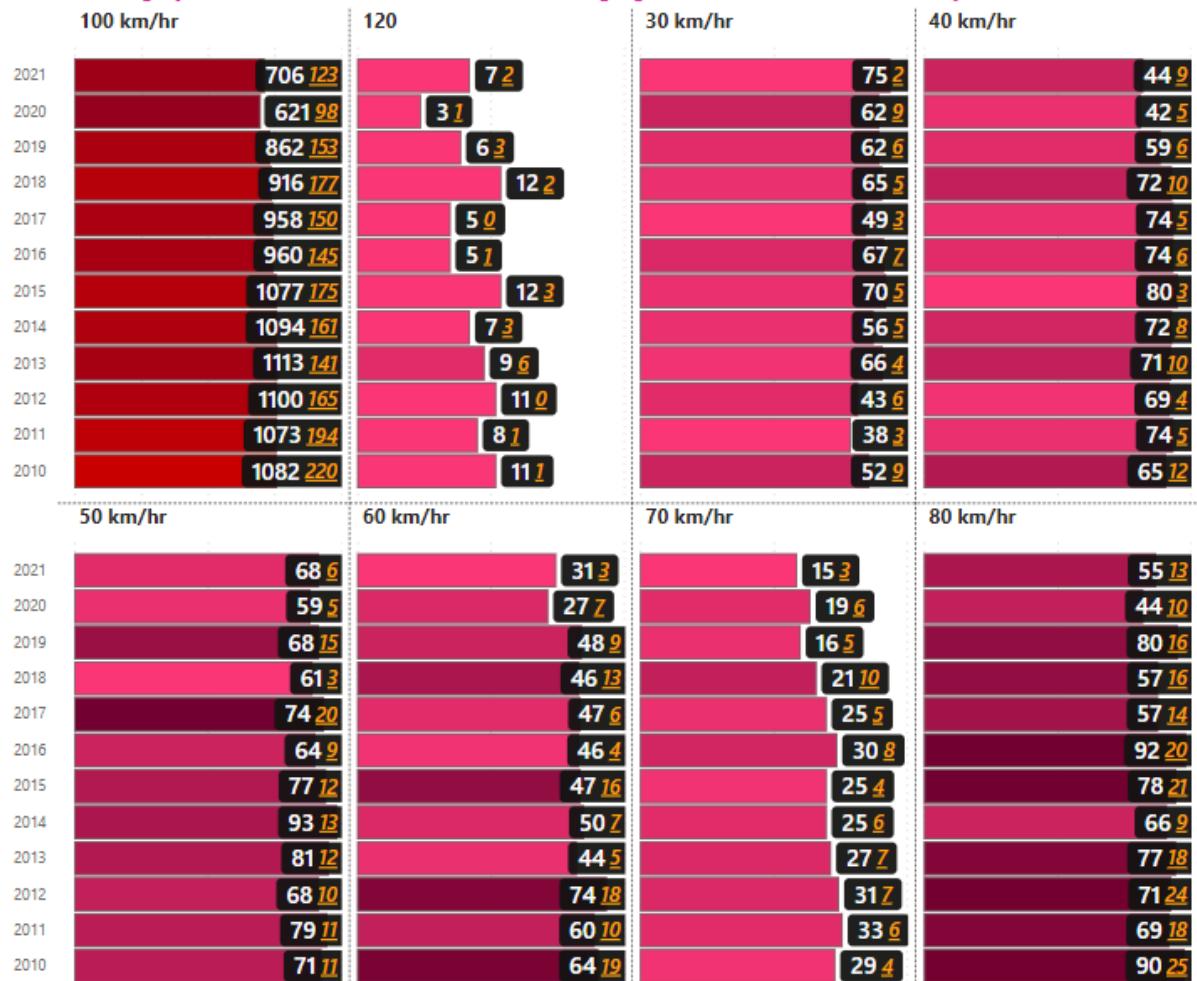
Recommendations: Enhancing driver education on adapting speeds and driving techniques according to different weather and road conditions.

▼ How Conventional Roads with 100 km/hr Speed Limit Became Death Traps for Drivers

- The data depicts a clear correlation between higher speed limits and increased fatality rates. It is evident that as the speed limit increases to 100 km/h, the number of accidents and fatalities rises significantly. Conversely, a speed limit of 30 km/h is associated with the lowest accident and fatality rates. The chart also reveals some interesting patterns at intermediate speed limits, such as a peak in fatality rates at 80 and 70 km/h, followed by a dip at 60 km/h. This could be due to various factors, such as road conditions, traffic density, driver behavior, and vehicle quality.

Speed Limits and Safety: How 100 km/h Leads to More Accidents and 80 & 70 km/h to Higher Fatality Rates, While 30 km/h is the Safest

Fatality Rates Peak at ~24% for 80 km/h and 70 km/h speed limits, followed by ~20% at 60 km/h. Remarkably, the Rate Dips to a Low of ~9% at 30 km/h, Subject to Ruminative on: at 100 km/h, Number of Accidents Highly Increases so are the Death's Rate Ranging from ~15% to ~20% Fatality Rate.



- This data underscores the critical need for reevaluating speed limits in various zones to enhance road safety. Urban areas, school zones, and residential neighborhoods could particularly benefit from reduced speed limits. Moreover, the data suggests that speed limits should be tailored to the specific characteristics of each road, rather than following a uniform standard.



Recommendations: Implement stricter speed limit enforcement measures in areas with high pedestrian traffic, such as speed cameras, radar guns, and fines

▼ The Speed-Fatality Connection: Why Lower Speed Limits Can Prevent Road Deaths

- Speed Correlation:** As speed limits decrease, so do fatality rates. For example, reducing the speed limit from 100 km/h to 80 km/h on a conventional road lowers the fatality rate by 10%, from 30% to 20%.
- Urban Roads:** For urban roads (including street and residential), a similar trend is observed, highlighting the universal applicability of this correlation.

How Speed Limits Affect Fatality Rates on Conventional Roads

Reducing the speed limit from 100 km/h to 80 km/h on a conventional road lowers the fatality rate by 10%, from 30% to 20%

	100 km/hr, Urban road (includes street and residential street)	100 km/hr, Conventional road	80 km/hr, Conventional road	50 km/hr, Conventional road
2021	396 20	303 102	54 12	58 5
2020	357 24	254 70	44 10	38 2
2019	462 32	386 119	69 15	51 12
2018	475 39	434 135	54 15	47 3
2017	497 37	454 112	53 14	58 12
2016	500 40	449 103	79 20	51 6
2015	553 43	383 101	34 15	54 7
2014	597 49	370 86	20 3	52 8
2013	623 34	377 78	32 6	59 6
2012	634 44	466 121	67 22	50 8
2011	633 50	440 144	63 18	64 9
2010	617 57	465 163	81 22	56 8
	30 km/hr, Urban road (includes street and residential street)	60 km/hr, Conventional road	40 km/hr, Conventional road	40 km/hr, Urban road (includes street and residential street)
2021	68 2	28 3	26 5	16 4
2020	56 8	27 1	24 3	17 2
2019	53 5	37 4	33 4	24 2
2018	56 5	40 10	39 5	33 5
2017	43 3	42 6	44 4	27 1
2016	58 7	39 3	42 2	31 4
2015	59 5	30 7	40 2	25 1
2014	47 3	34 4	30 3	26 3
2013	58 4	36 4	35 8	23 1
2012	40 6	72 16	48 2	21 2
2011	34 2	52 8	43 2	31 3
2010	47 8	58 17	43 8	22 4

- Safety Increase:** Lower speed limits, especially in urban areas, are associated with reduced fatalities. This suggests that speed is a major factor in road accidents and injuries.
- Consistency Needed:** There is a consistent reduction in fatalities over the years across all categories, indicating the effectiveness of speed regulations. This implies that maintaining and enforcing lower speed limits is crucial for road safety.



Recommendation: Policy Review, Consider reviewing and adjusting speed limits to enhance road safety. Based on the data, lowering the speed limit by 20 km/h could potentially save hundreds of lives per year.

▼ Road Safety in Crisis: How Girona and Barcelona Differ in Fatalities on Conventional Roads at Different Speed Limits

- Fatality Fluctuations:** The data illustrates the comparison of fatalities on conventional roads with a speed limit of 100 km/hr in Girona and Barcelona from 2015 to 2021. Girona's death rate fluctuates between 20% to 40%, peaking in 2021.
- Barcelona's Trend:** Barcelona follows with a consistent fatality rate of approximately 23%.

How Girona and Barcelona Compare in Fatalities on Conventional Roads with 100 km/hr Speed Limit

On conventional roads with a speed limit of 100 km/hr, Girona's death rate was the highest, fluctuating from 20% to 40% (with a peak in 2021). Barcelona followed, with a fatality rate of roughly 23% on the same type of roads

	Barcelona, 100 km/hr, Urban road (includes street and residential street)	Barcelona, 100 km/hr, Conventional road	Girona, 100 km/hr, Conventional road	Tarragona, 100 km/hr, Conventional road	
2021	261 11	135 41	60 24	42 12	
2020	244 19	113 33	44 11	58 16	
2019	331 22	179 44	63 19	79 35	
2018	369 29	209 62	84 27	77 26	
2017	386 29	201 44	92 18	75 25	
2016	376 32	216 38	100 17	64 32	
2015	403 30	138 22	84 17	77 39	
2014	461 39	144 28	86 11	65 23	
2013	458 24	158 23	90 22	60 13	
2012	469 33	222 45	90 25	74 19	
2011	457 37	175 40	96 35	99 44	
2010	472 47	204 56	98 35	107 51	
<hr/>					
Lleida, 100 km/hr, Conventional road		Tarragona, 100 km/hr, Urban road (includes street and residential street)		Girona, 100 km/hr, Urban road (includes street and residential street)	
2021	66 25	88 4	32 4	53 1	
2020	39 10	54 3	48 1	37 6	
2019	65 21	55 1	57 6	45 5	
2018	64 20	50 4	47 6	41 4	
2017	86 25	57 6	44 1	30 3	
2016	69 16	56 4	52 3	44 5	
2015	84 23	67 6	64 5	47 3	
2014	75 24	72 7	44 1	40 3	
2013	69 20	70 4	63 3	42 3	
2012	80 32	89 5	50 5	29 6	
2011	70 25	70 4	54 6	22 1	
2010	56 21	58 3	54 5	33 7	

- Safety Concerns:** The increasing trend, especially in Girona, indicates a significant safety concern that needs immediate attention.
- Consistency Issue:** The consistency in Barcelona's fatality rate suggests underlying issues not addressed over the years.



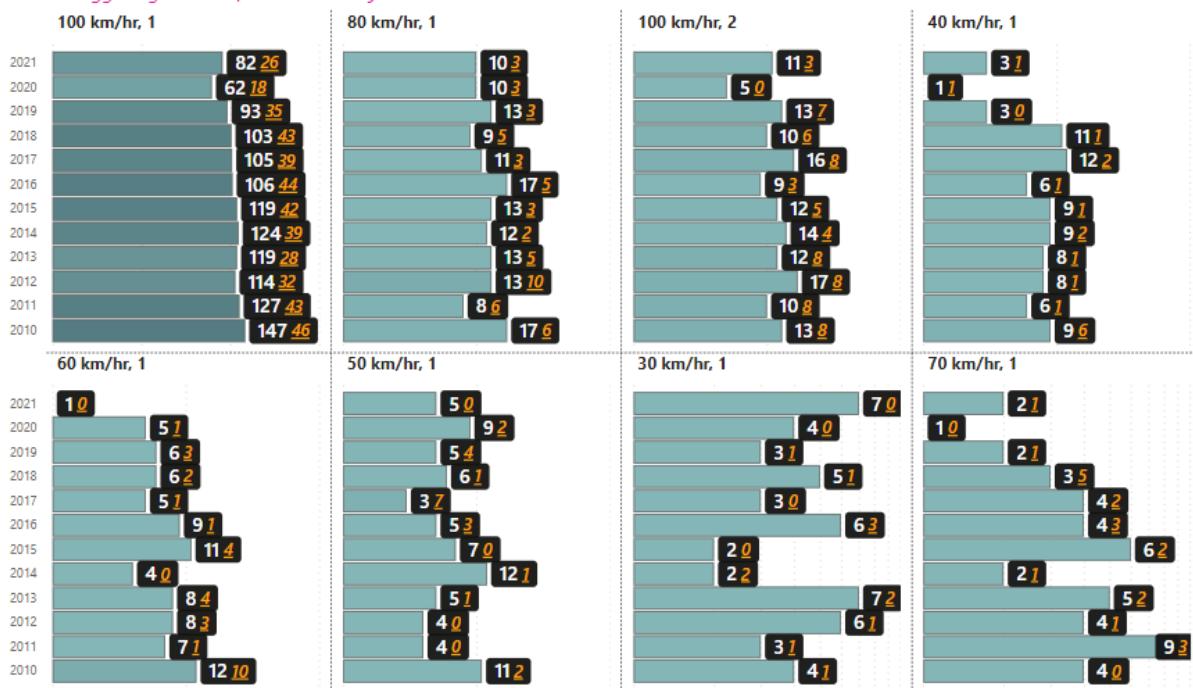
Recommendations: Safety Measures: Implement enhanced safety measures, including stricter traffic rules and improved road conditions in Girona to curb the increasing trend. Conduct an in-depth analysis to understand the consistent fatality rate in Barcelona and develop tailored solutions.

▼ Unraveling the Heavy Vehicle Crash Crisis

- Fatality Increase:** A significant increase in fatalities in accidents involving heavy vehicles over a decade. The fatality rate is notably higher at 100 km/hr recorded 32%.
- Speed Correlation:** There's an evident correlation between speed and the number of deaths. Lower speeds (30-50 km/hr) have fewer fatalities, while mid-range speeds (60-80 km/hr) show a spike.

The Deadly Toll of Heavy Vehicle Crashes: How Many Lives Are Lost in Heavy Vehicle Accidents?

The Average Fatality Rate Across the Long-Decade was ~32% for One Heavy Vehicle being in the Road, ~54% for Two Heavy Vehicles, and a Staggering ~113% for Three Heavy Vehicles.



- Public Safety:** The rising number of deaths, especially at specific speed intervals, necessitates urgent attention.
- Policy Review:** Current road safety policies and regulations might not be effectively addressing the risks associated with heavy vehicle crashes.



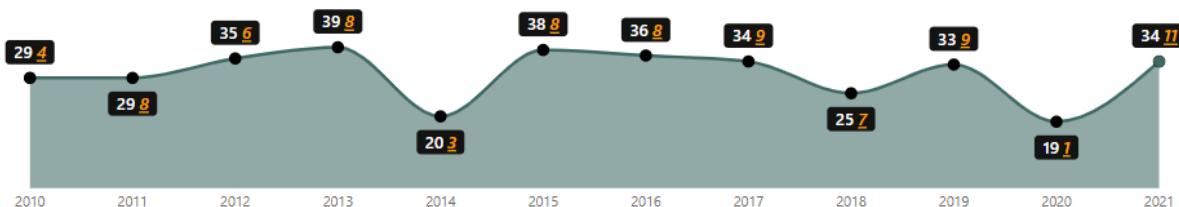
Recommendations: Speed Regulation Implement stricter speed limits for heavy vehicles, especially in zones where the fatality rate is highest. Incorporate advanced technologies to monitor and control vehicle speeds automatically to enhance road safety.

▼ 2021 Spike in Motorcycle Fatalities

- Accident Increase:** Significant increase in motorcycle fatalities in 2021, contrasting sharply with the record low observed in 2020. In 2020, only one rider died out of 19 accidents, while in 2021, there were 11 fatalities out of 34 accidents, most of the incidents happened at 100 km/hr speed limit.
- Death Rate:** The death rate soared to approximately ~32% (highest ever recorded in double digits), indicating a drastic change and raising concerns about bike safety.

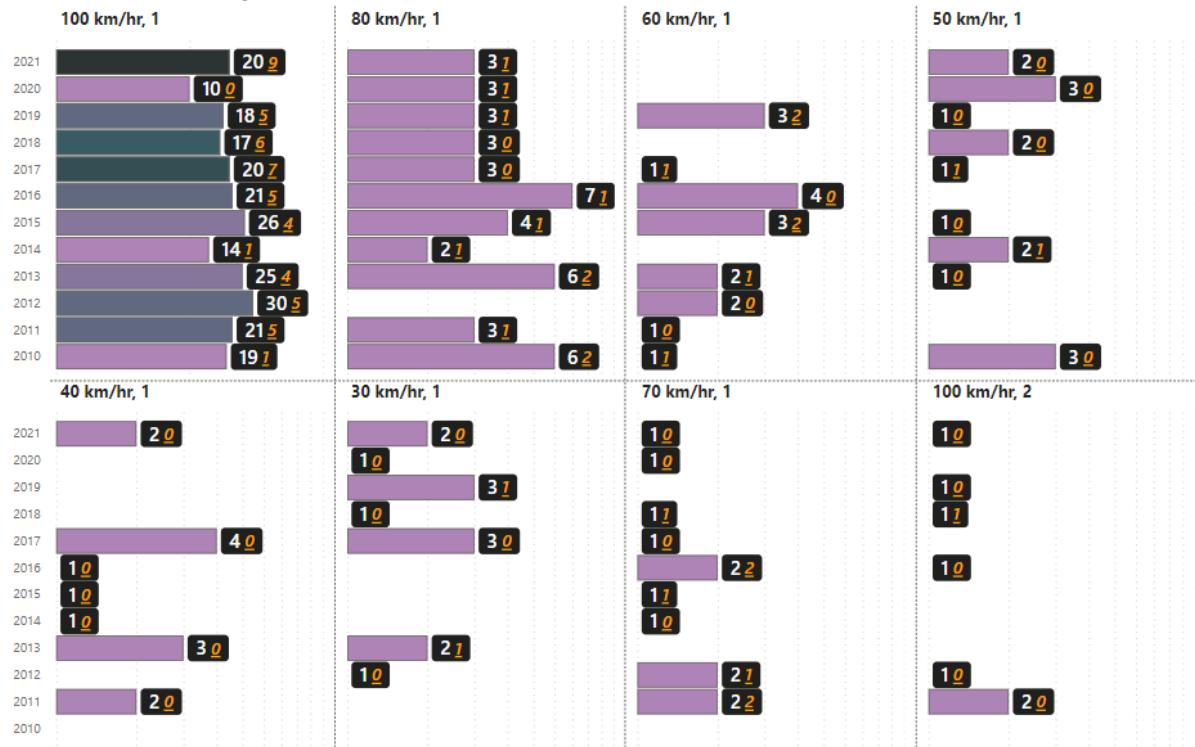
Why Did 2020 and 2021 Differ So Much in Motorcycle Crashes?

The Year 2020 saw a Record Low in Motorcycle Fatalities, with only ONE of the Rider Involved in Crashes Dying out of 19 Accidents. However, 2021 was a Different Story, as the Death Rate Soared to ~32% (Highest Ever Recorded in Double Digits), Out of 34 Accidents, 11 Lost their Lives in Deadly Crashes. . What Caused this Drastic Change in Bike Safety?



- **Safety Concerns:** This spike implies that there might have been changes or lapses in road safety measures, riding behaviors, or other external factors impacting rider safety.
- **Policy Review:** It necessitates an urgent review of current policies and safety protocols to address this alarming increase effectively.

The Shift in Motorcycle Accidents from 2020 to 2021*



Recommendations: Conduct comprehensive audits on road and traffic conditions to identify potential hazards or issues that could be contributing to the increased fatality rate.



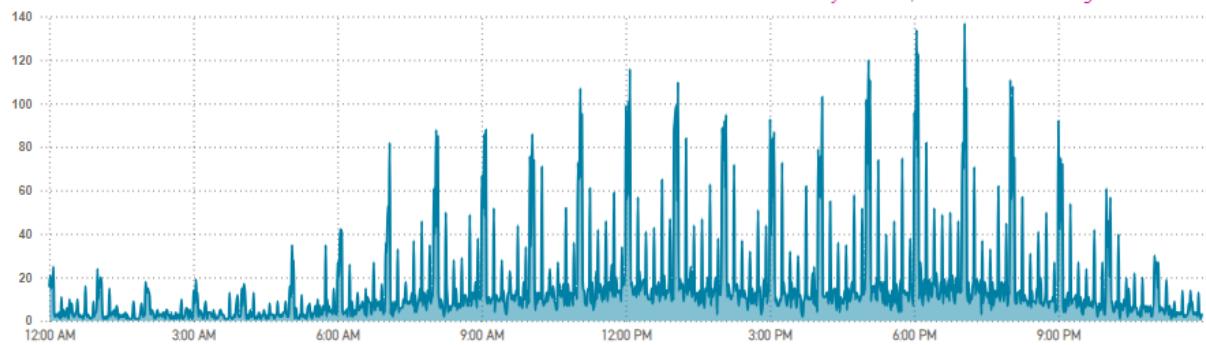
Training Enhancement: Enhance rider training programs focusing on defensive driving and emergency handling to equip riders with skills to navigate dangerous situations effectively.

▼ The Perils of the Clock: How to Navigate the Road During The Most Accident-Prone Hours

- **Accident Peaks:** Highest number of road accidents occurs between 5 PM and 7 PM, followed by a smaller peak between 10 AM and 12 PM.

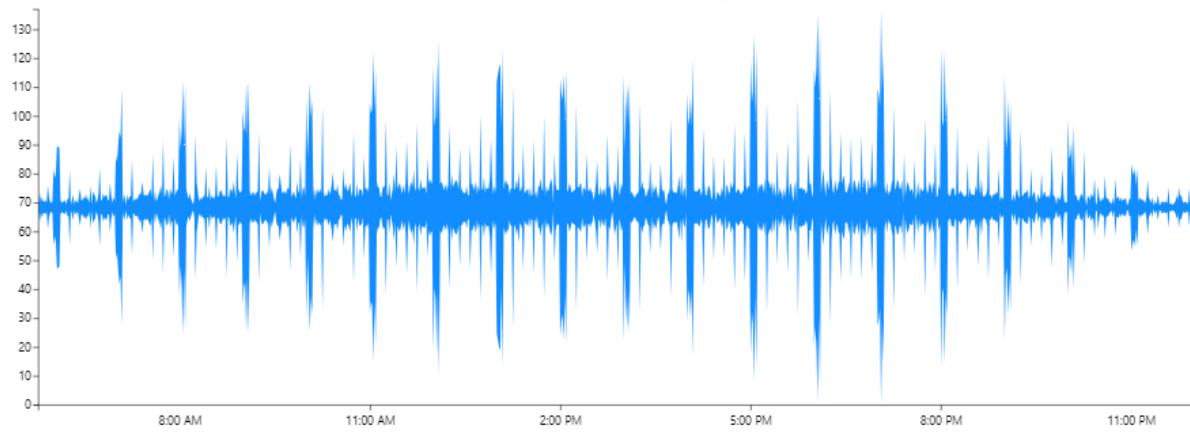
The Perils of the Clock: How to Navigate the Road During the Most Accident-Prone Hours

Between 5 PM and 7 PM and Between 10 AM and 12 PM are the Times when Accidents are Most Likely to Occur, with the Former Being the Worst



- **Quiet Hours:** The early hours of the morning, specifically between midnight and 5 AM, record the lowest accident rates.

Number of Accident by Hour of Day: A Stream Graph



- **Rush Hours:** The evening peak coincides with the end of the workday when many are commuting home, indicating rush hour traffic increases accident risk.
- **Morning Caution:** Late morning also presents heightened danger, possibly due to increased commercial and personal vehicle movement.



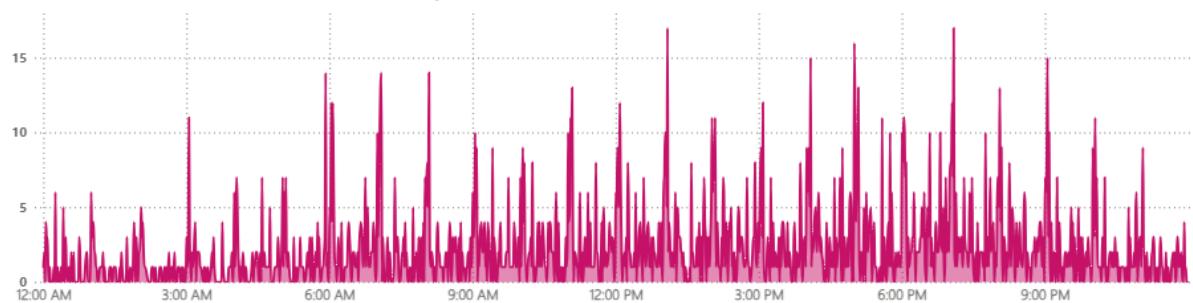
Recommendations: Alternate Timing Consider traveling outside of these peak hours to reduce accident risk. Implement additional safety measures during these times, such as enhanced law enforcement presence and public awareness campaigns.

▼ Fatal Hours

- **Peak Periods:** A significant increase in road fatalities around 6 AM, 12 PM, and between 3 PM to 6 PM. These could be attributed to rush hours when traffic volume is high.
- **Distribution:** At least One Motorcycle and One Heavy Vehicle were involved in 3% of the Fatalities, while at least One Motorcycle was involved in 23% and at least One Heavy Vehicle was involved in 20% of the Fatalities.

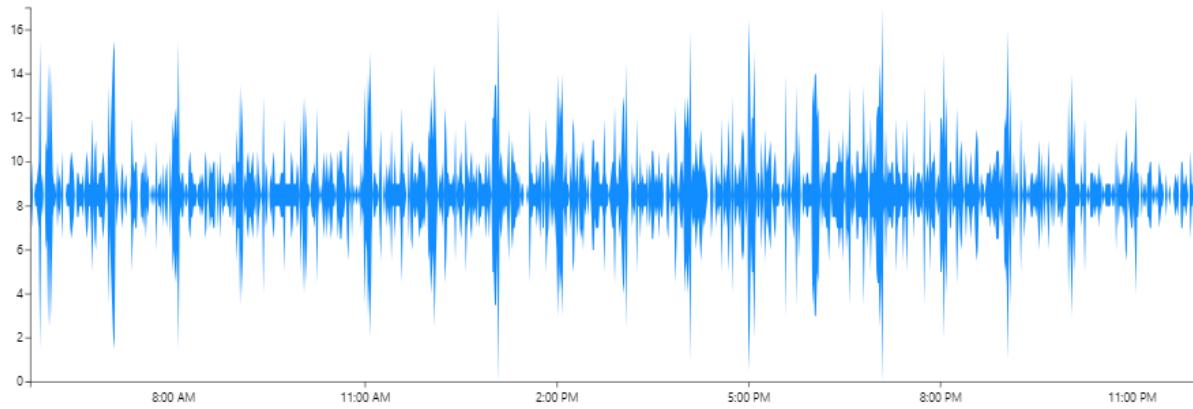
Fatal Hours: The Hourly Distribution of Road Fatalities

At least One Motorcycle and One Heavy Vehicle were Involved in ~3% of the Fatalities, while at least One Motorcycle was Involved in ~23% and at least One Heavy Vehicle was Involved in ~20% of the Fatalities.



- **Low Incidents:** The early morning hours from midnight to around 5 AM have relatively fewer incidents. This could be due to less traffic volume during these hours.

Fatalities by Hour of Day: A Stream Graph



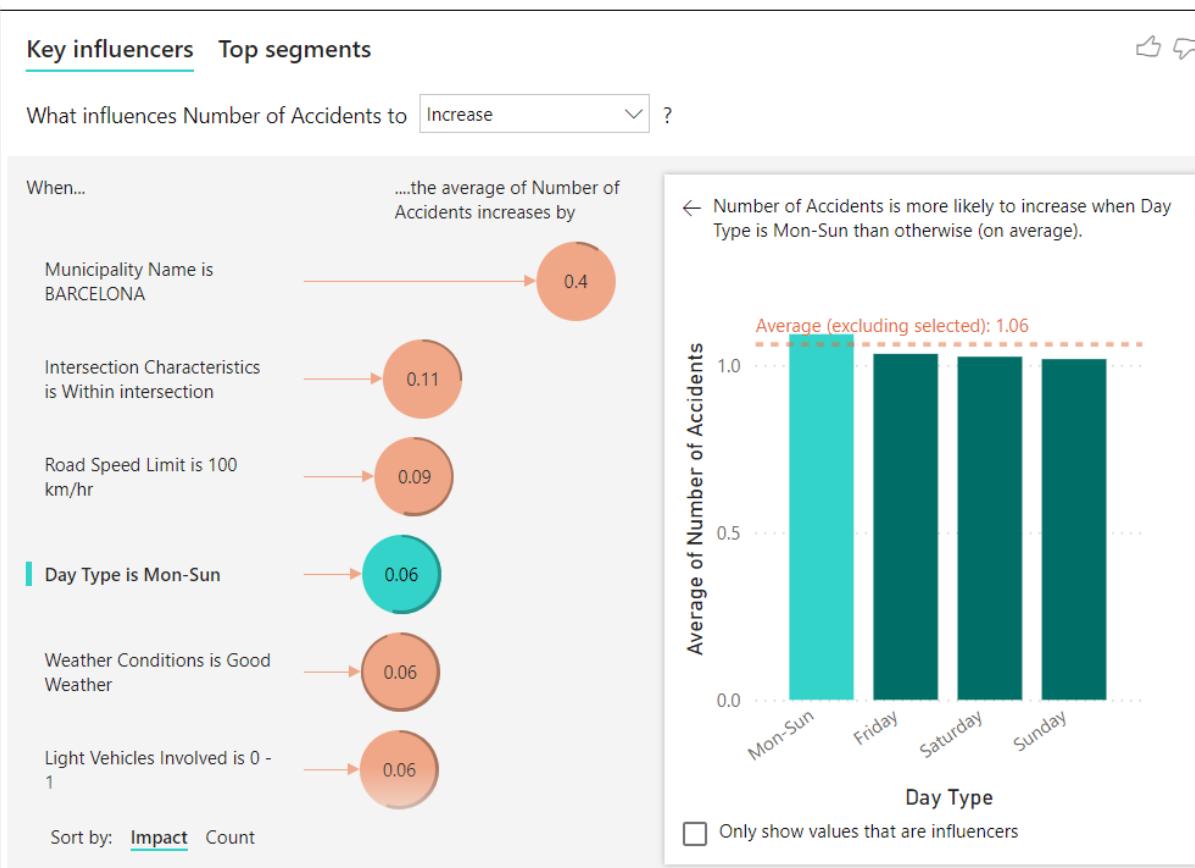
- **Safety Concerns** The identified peak periods indicate times of increased risk for both motorcyclists and heavy vehicle operators.
- **Awareness Gap:** There might be a lack of awareness or adherence to safety protocols during these peak periods.



Recommendations: Implement targeted safety campaigns during identified peak periods to raise awareness about the increased risk of accidents. Explore traffic management solutions like alternate routing or staggered work hours to reduce traffic volume during peak periods.

▼ Summing Up: Factors Affecting Accidents and Fatalities, Unraveling the Key Drivers

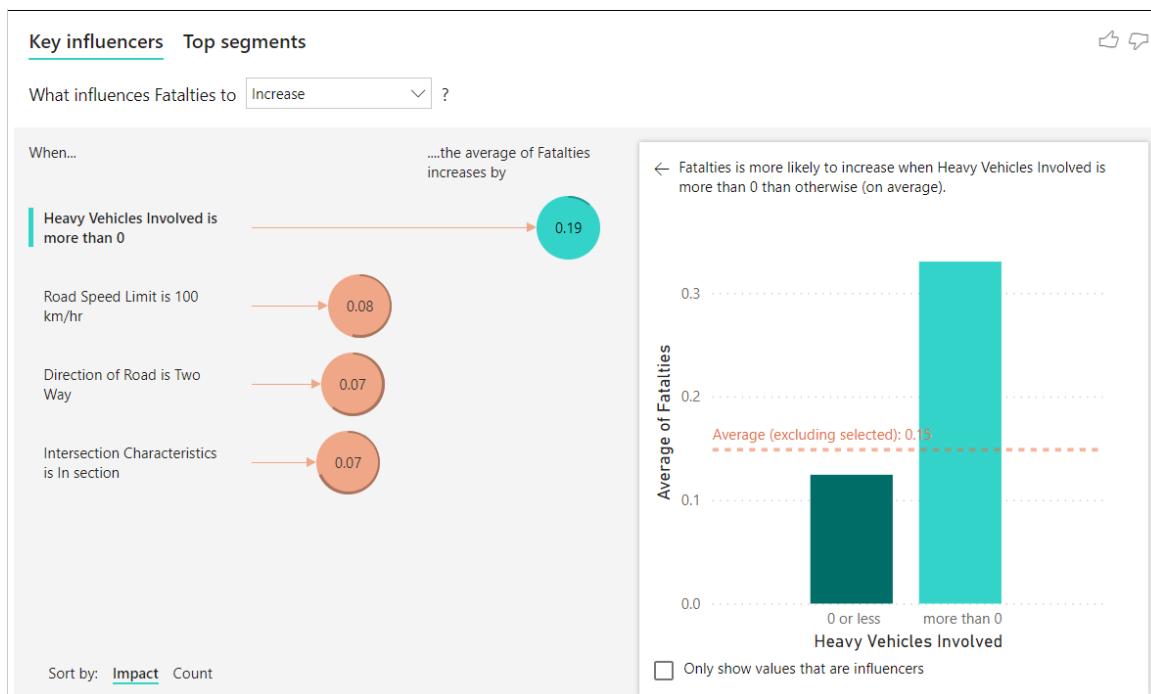
- **Location Influence:** Accidents increase by 0.4 on average when they occur in Barcelona, indicating a significant impact of location on accident numbers.
- **Intersection Impact:** The presence of intersections increases accidents by an average of 0.11, highlighting the need for enhanced safety measures at these points.
- **Speed Factor:** A road speed limit of 100 km/hr is associated with a 0.09 increase in accidents, suggesting that higher speeds may lead to more accidents.



- **Day Influence:** Accidents are more likely to occur from Monday to Sunday (0.06 increase), indicating that every day has almost equal risk.
- **Weather Effect:** Good weather conditions are associated with a slight increase (0.06) in accidents, contrary to expectations that bad weather increases accident risk.
- **Vehicle Role:** The involvement of light vehicles contributes a minor increase (0.06) in accidents, pointing towards vehicle type as a less significant factor.
- The data suggests that location-specific factors like being in Barcelona or near intersections significantly influence the number of accidents. Surprisingly, good weather conditions also show an increased number of accidents, which could be due to increased traffic during favorable weather.

▼ Factors that Influence Fatalities

- **Vehicle Impact:** The involvement of heavy vehicles increases fatalities by a significant margin, indicating a strong correlation between heavy vehicle accidents and increased deaths.
- **Speed Influence:** A road speed limit of 100 km/h slightly influences the increase in fatalities, suggesting that higher speeds can lead to more severe accidents.



- **Direction Relevance:** Two-way roads have a moderate impact on increasing fatalities, implying complexities and challenges associated with navigating these roads.
- **Intersection Concerns:** Intersection characteristics also play a role in increasing fatalities, pointing towards potential design or navigational issues at intersections.
- **Safety Measures** Enhanced safety protocols and regulations are required for heavy vehicles to mitigate the risk of fatal accidents. **Speed Review:** Reevaluating speed limits, especially on two-way roads and intersections, could contribute to reducing fatalities



Recommendations: Implement specialized training programs for heavy vehicle operators focusing on safety protocols and defensive driving techniques. Invest in improving road infrastructure, including redesigning complex intersections and implementing stricter speed limits where necessary.



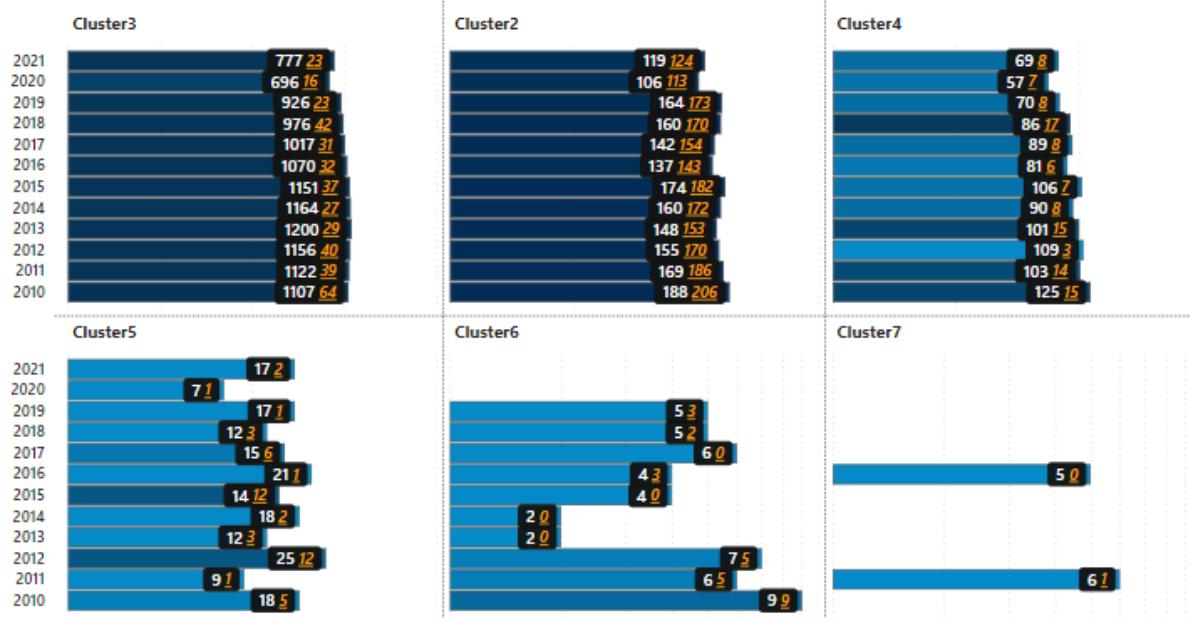
Recommendations: Implement enhanced safety protocols and traffic management systems within Barcelona and especially at intersections. Consider reviewing and potentially lowering the speed limits where necessary to ensure road safety. Develop public awareness campaigns about road safety applicable for all days of the week and especially during good weather conditions when people might be complacent.

▼ A Cluster Based Analysis of Accidents and Fatalities Data Segmented by Speed Limits, Heavy Vehicles Involvement, Regions and Periods

- Cluster Comparison:** Cluster2 has the highest death rate of 107% with number of accidents ranging from 106-188, meaning that more people died than were involved in accidents. Out of these, 73% of accidents happened at a speed limit of 100 km/hr. On the other hand, Cluster3 has the largest number of accidents, but a relatively low death rate of about 2.5% with ~70% of accidents happened at 100 km/hr speed limit.

Road Accidents Trends: A Cluster-Based Approach to Examine what Leads to those Accidents and Fatalities

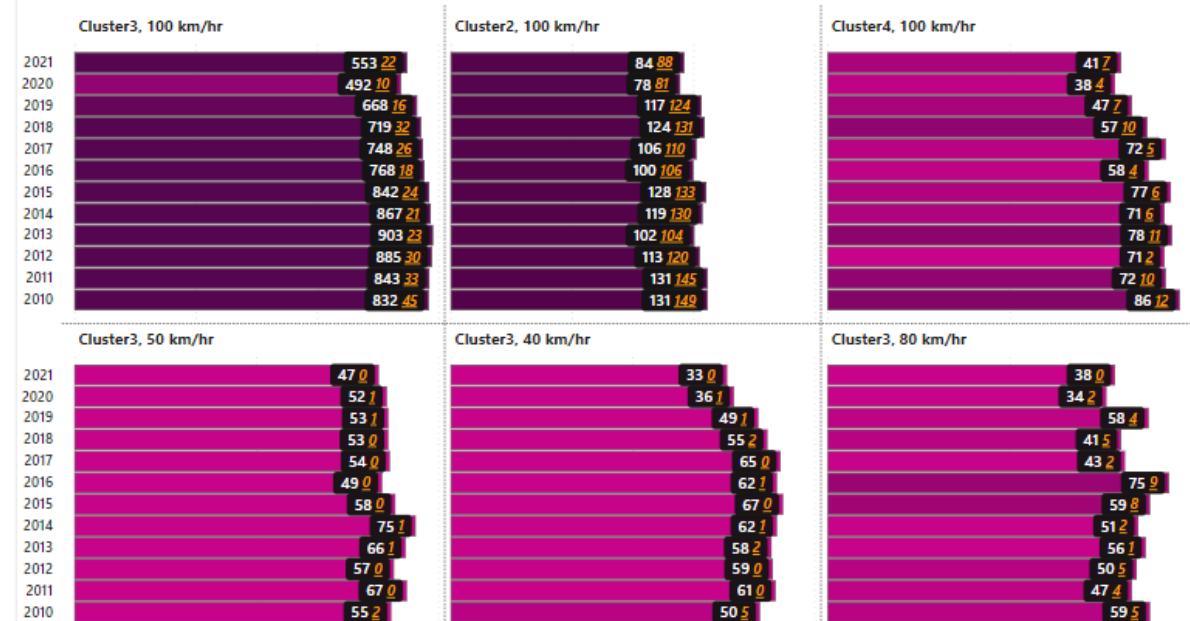
Cluster2 has the Highest Death Rate of 107%, out of which 73% of Accidents happened at 100 km/hr Speed Limit followed by Cluster4 with Fatality Rate of ~9%. Cluster3 has Higher Number of Accidents, More than ~70% of these Accidents happened at 100 km/hr Speed Limit with a Fatality Rate of ~2.5%



- Speed Factor:** A common factor across the clusters is the prevalence of accidents at a speed limit of 100 km/hr. This suggests that this speed limit is associated with a higher risk of accidents and fatalities, regardless of other cluster characteristics.

How to Stay Alive on the Road: The Dangers of Overspeeding and How to Prevent It

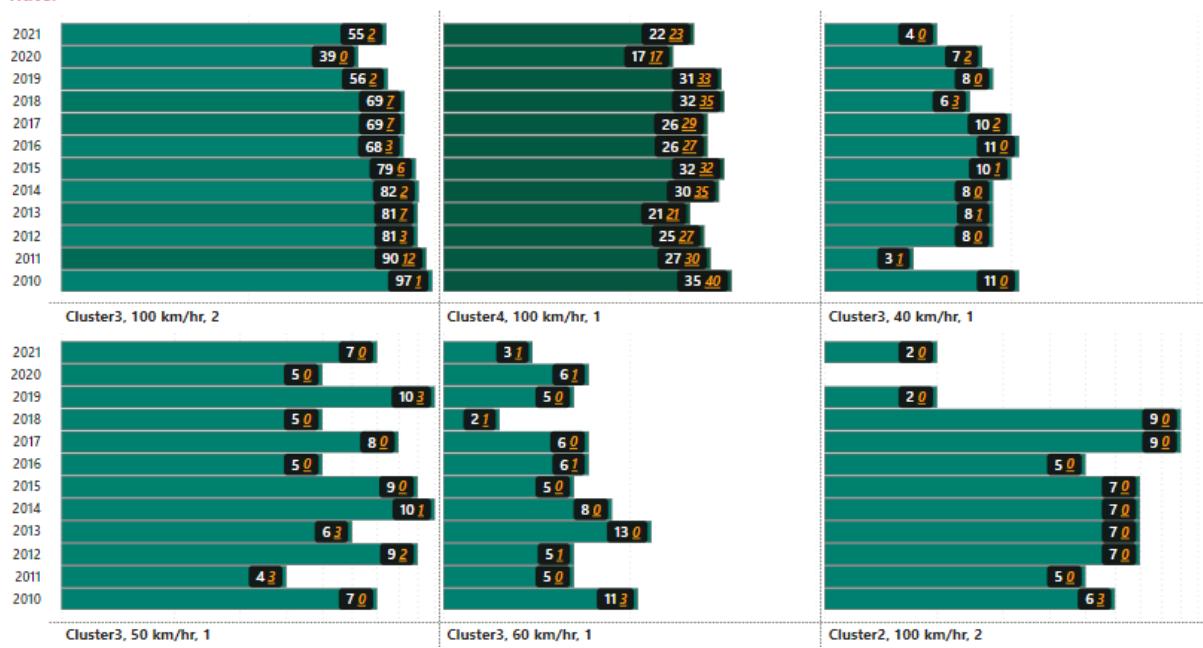
The speed limit of 100 km/hr was the most common factor in accidents, resulting in a fatality rate of around 2.5%. However, the same speed limit also had a very high fatality rate of 104% for a smaller number of accidents. This was mainly due to the involvement of heavy vehicles



- Despite the high accident rate at 100 km/hr, there's a notable spike in fatality rates at this speed limit. This anomaly is attributed to the involvement of heavy vehicles.

Road Accidents Trends: The Deadly Combination of Speed and Heavy Vehicles

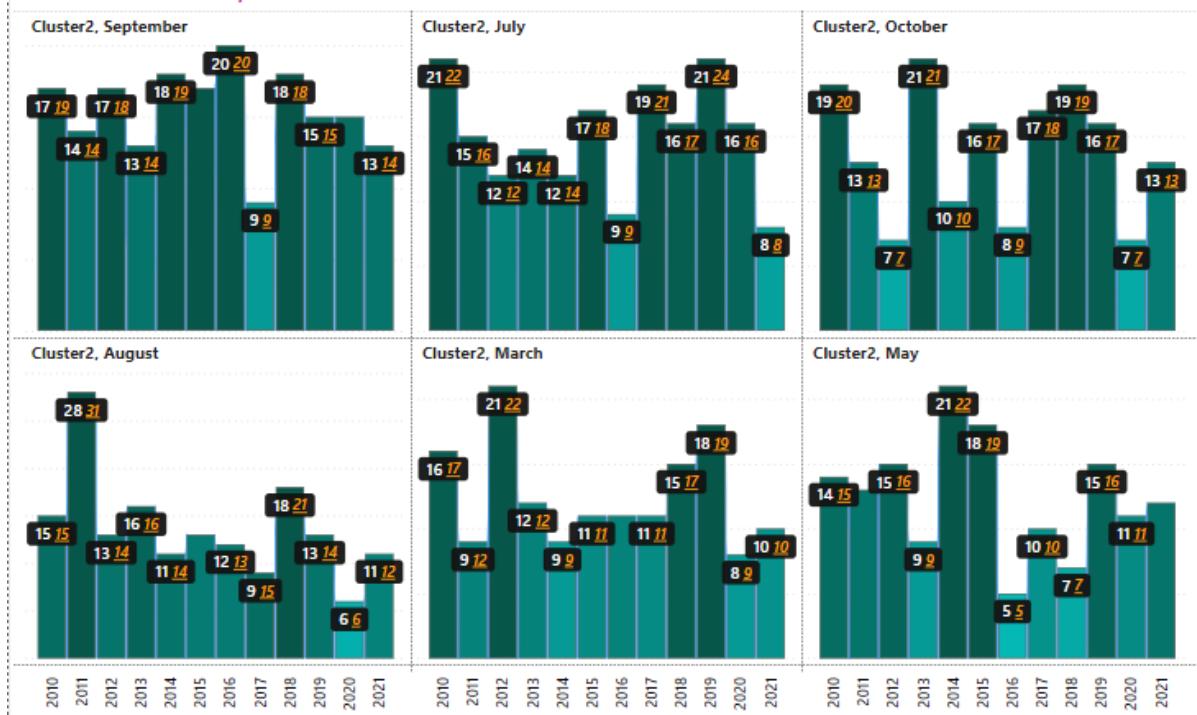
The Death Rate in Cluster2 was Extremely High at ~104% when at least One Heavy Vehicle was Involved in an Accident at 100 km/hr. This was Followed by a Lower Number of Accidents Involving Two Heavy Vehicles at the Same Speed Limit and Fatality Rate.



- Speed Factor:** Higher speeds correlate with increased fatalities. The death rate is extremely high at 104% in Cluster2 (100 km/hr, 2 heavy vehicles), indicating that speed is a critical factor.
- Safety Concerns:** The combination of high speed and heavy vehicles leads to a drastic increase in fatalities. This poses significant public safety concerns.

Road Accidents Trends: A Monthly Cluster-Based Approach to Examine what Leads to those Accidents and Fatalities

There was no Clear Trend in the Distribution of Accidents and Fatalities Across the Months of the Year. Each Month had a Similar Share of Both Accidents and Fatalities.



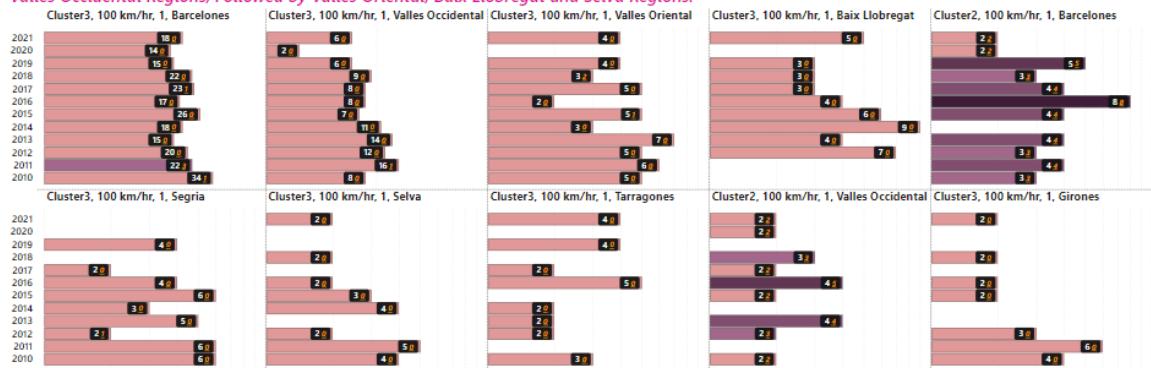
- Across all months, there is no significant fluctuation in the number of accidents and fatalities. The data remains relatively consistent, indicating that external factors like weather or holidays don't have a pronounced impact on these numbers.

▼ Road Safety in Catalonia: A Regional Comparison

- A noticeable increase in road accidents at 100 km/hr speed limit across various regions of Catalonia, with Barcelona and Valles Occidental facing the highest fatality rates in 2020 and 2021

Road Accidents Trends: A Cluster-Based Approach to Examine what Leads to those Accidents and Fatalities by Regions, Heavy Vehicles Involvement and Speed Limit

The Fatality Rate at 100 km/hr Speed Limit was the Highest in Barcelona and Valles Occidental Regions in Both 2020 and 2021. Segria and Tarragones Regions also had 100% Fatality Rate at the Same Speed Limit in those Years. The Most Accidents at 100 km/hr Speed Limit Occurred in Barcelones and Valles Occidental Regions, Followed by Valles Oriental, Baix Llobregat and Selva Regions.



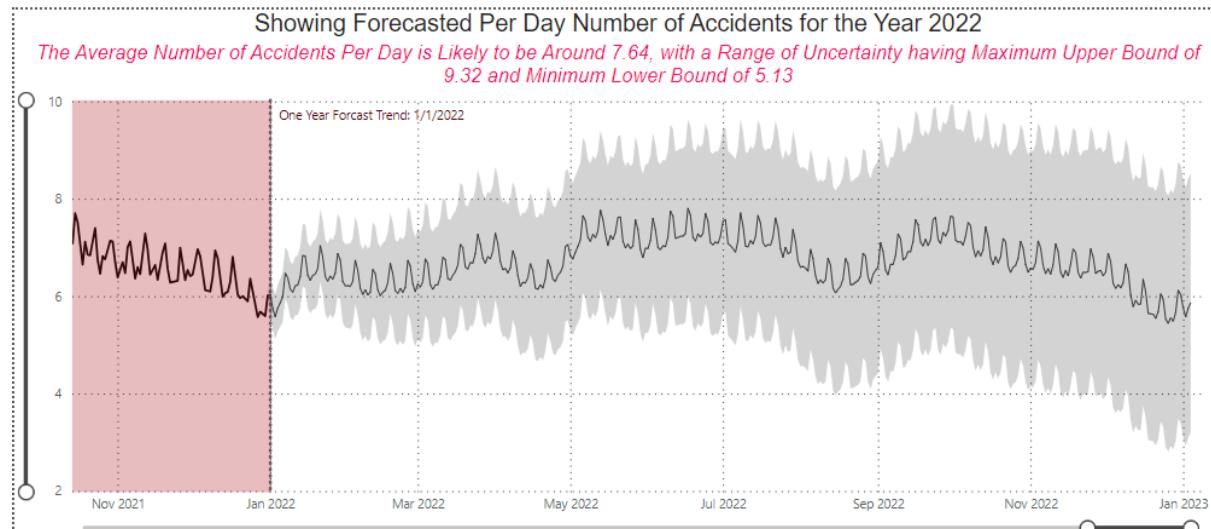
- Regional Disparities:** There are evident disparities among different regions. Barcelona and Valles Occidental consistently record higher accident rates, while others like Selva and Girones show lower numbers.
- Implications:** The uniformity of accidents at the 100 km/hr speed limit indicates potential inadequacies in speed regulation or enforcement.



Recommendations: Implement **targeted interventions** in high-risk areas like Barcelona and Valles Occidental to address unique regional challenges contributing to the high accident rate. A comprehensive review of current traffic policies, especially around speed limits to ensure they are effectively reducing accident risks.

▼ Navigating Uncertainties: A Glimpse into 2022's Accident Forecasts

- The average number of accidents per day is predicted to be around 7.64.
- There is a range of uncertainty, with a maximum upper bound of 9.32 and a minimum lower bound of 5.13.



- The data shows fluctuations, indicating variability in daily accident occurrences.
- Despite these fluctuations, there isn't a clear increasing or decreasing trend throughout the year.



Recommendations:

Resource Allocation: Allocate emergency services and resources more efficiently by preparing for the upper bound predictions to ensure readiness during peak days.

Policy Enhancement: Review and strengthen traffic and safety policies to aim at reducing the average daily accidents below the predicted figures.

▼ Time Series with Prophet

The prediction is based on Facebook's Prophet model which incorporates various factors and features like seasonality, holidays, and special events to make accurate forecasts. It's an additive model where non-linear trends fit with yearly, weekly, and daily seasonality plus holiday effects. It works well with time series data that contains strong seasonal patterns and multiple seasons.

The forecasting model I have developed is a **Prophet model** with some modifications and enhancements. The model structure consists of three main components: trend, seasonality, and holidays. The trend component captures the long-term changes in the data, such as growth or decline. The seasonality component captures the periodic patterns in the data, such as weekly, monthly, or yearly cycles. The holidays component captures the effects of special events or occasions that may affect the data, such as festivals, public holidays, or sports events.

Some of the specific features or techniques that the model utilizes are:

- **Fourier series** to model complex seasonality patterns with a flexible number of terms.
- **Automatic changepoint detection** to identify and adjust for sudden changes in the trend.
- **Prior scale** to control the flexibility of the model and avoid overfitting or underfitting.
- **Multiplicative seasonality** to handle cases where the seasonal amplitude varies with the trend.
- **Cross-validation** to evaluate the model performance and select the optimal parameters.

The factors that influenced my decision to use this model are:

- The model's **accuracy**: The model produces reliable and robust forecasts that capture the uncertainty and fluctuation in the data.
- The model's **efficiency**: The model is fast and easy to implement, requiring minimal data preprocessing and parameter tuning.
- The model's **suitability** to the data characteristics: The model can handle the non-linear trend, complex seasonality, and holiday effects in the data.
- The model's **ability** to handle the complexities of the dataset: The model can deal with missing values, outliers, and irregular intervals in the data.

