**Analysis of Driving Accident Data Report**

April 2024

**Company Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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# Introduction

Road traffic accidents constitute a significant global public health concern, with devastating impacts on individuals, families, and societies at large. According to the World Health Organization (WHO), approximately 1.35 million people lose their lives each year due to road traffic crashes, and an additional 20 to 50 million sustain non-fatal injuries, many of which result in permanent disabilities. These accidents not only cause immense human suffering but also impose substantial economic burdens, costing nations around 3% of their gross domestic product.

The disproportionate burden of road traffic injuries falls on low- and middle-income countries, where over 90% of fatalities occur despite these countries accounting for only 60% of the world's vehicles. Within high-income countries, individuals from lower socioeconomic backgrounds are at a heightened risk of being involved in road traffic accidents.

Various factors contribute to the occurrence of road traffic accidents, including speeding, driving under the influence of alcohol or drugs, non-use of safety measures such as seat belts and helmets, distracted driving, unsafe road infrastructure, and inadequate post-crash care. The WHO advocates for a holistic approach to road safety, emphasizing the importance of addressing these factors through interventions spanning multiple sectors, including transportation, law enforcement, health, and education.

The Safe System approach, endorsed by WHO, emphasizes the need to design transport systems that are forgiving of human error and prioritize the safety of all road users. This approach underscores the importance of safe roads and roadsides, safe speeds, safe vehicles, and safe road users in preventing fatal crashes and reducing serious injuries.

In light of the alarming global toll of road traffic accidents, there is a pressing need for comprehensive strategies aimed at preventing these incidents. Effective interventions include designing safer infrastructure, improving vehicle safety standards, enforcing traffic laws, enhancing post-crash care, and raising public awareness. The United Nations has set an ambitious target of halving the global number of deaths and injuries from road traffic crashes by 2030, underscoring the urgency of concerted action.

This report presents an analysis of road accidents using comprehensive datasets sourced from the "Road Accidents Data 2022" by Juhi Bhojani available on Kaggle. The objective is to uncover insights into the underlying causes and circumstances surrounding traffic accidents, employing various analytical methods to facilitate evidence-based decision-making for enhancing road safety.

# Description of Analysis Methods

# Dataset Description:

The data used in this analysis was sourced from the Department for Transport (DfT) for the year 2022. The dataset, titled "Road Accidents Data 2022" by Juhi Bhojani, was obtained from Kaggle. It provides comprehensive information on road accidents reported over multiple years, encompassing various attributes such as accident status, vehicle and casualty details, demographics, and severity of casualties.

The dataset utilized in this analysis serves as a valuable resource for examining road accidents, discerning trends, and comprehending factors that contribute to accidents. With 61,352 rows and 20 columns, it offers a robust collection of information on traffic accidents reported throughout the year 2022.

This dataset provides comprehensive details on various aspects of traffic accidents, including accident status, vehicle and casualty specifics, demographics, and severity of casualties. By leveraging this rich dataset, analysts can delve into nuanced patterns, identify key factors influencing accidents, and inform evidence-based decision-making processes aimed at enhancing road safety measures.

# Dataset columns

# In the provided dataset, each column contains values represented by specific codes. Below, we define the meaning of each code within the dataset:

* **status:** The status of the accident (e.g., reported, under investigation).
* **accident\_index:** A unique identifier for each reported accident.
* **Accident\_Year:** The year in which the accident occurred.
* **Accident\_Reference:** A reference number associated with the accident.
* **Vehicle\_Reference:** Reference numbers for the involved vehicles in the accident.
* **Casualty\_Reference:** Reference numbers for the casualties involved in the accident.
* The **"Casualty\_Class"** column in the dataset denotes the class of the casualty involved in the accident. Below are the corresponding class codes and their descriptions:
  + **1:** Driver or rider
  + **2:** Passenger
  + **3:** Pedestrian
* The **"Sex\_of\_Casualty**" column in the dataset signifies the gender of the casualty involved in the accident. Below are the corresponding codes and their descriptions:
  + **1:** Male
  + **2:** Female
  + **9:** Unknown (self-reported)
  + **-1:** Data missing or out of range
* The **"Age\_Band\_of\_Casualty"** column in the dataset represents the age group to which the casualty belongs. Below are the corresponding codes and their descriptions:
  + **1:** 0 - 5
  + **2:** 6 - 10
  + **3:** 11 - 15
  + **4:** 16 - 20
  + **5:** 21 - 25
  + **6:** 26 - 35
  + **7:** 36 - 45
  + **8:** 46 - 55
  + **9:** 56 - 65
  + **10:** 66 - 75
  + **11:** Over 75
  + **-1:** Data missing or out of range
* The **"Casualty\_Severity"** column in the dataset indicates the severity of the casualty's injuries. Below are the corresponding codes and their descriptions:
  + **1:** Fatal
  + **2:** Serious
  + **3:** Slight
* The **"pedestrian\_location"** column in the dataset provides information about the location of the pedestrian at the time of the accident. Below are the corresponding codes and their descriptions:
  + **0:** Not a Pedestrian
  + **1:** Crossing on pedestrian crossing facility
  + **2:** Crossing in zig-zag approach lines
  + **3:** Crossing in zig-zag exit lines
  + **4:** Crossing elsewhere within 50m. of pedestrian crossing
  + **5:** In carriageway, crossing elsewhere
  + **6:** On footway or verge
  + **7:** On refuge, central island, or central reservation
  + **8:** In center of carriageway - not on refuge, island, or central reservation
  + **9:** In carriageway, not crossing
  + **10:** Unknown or other
  + **-1:** Data missing or out of range
* The **"Pedestrian\_Movement"** column in the dataset indicates the movement of the pedestrian during the accident. Below are the corresponding codes and their descriptions:
  + **0:** Not a Pedestrian
  + **1:** Crossing from driver's nearside
  + **2:** Crossing from nearside - masked by parked or stationary vehicle
  + **3:** Crossing from driver's offside
  + **4:** Crossing from offside - masked by parked or stationary vehicle
  + **5:** In carriageway, stationary - not crossing (standing or playing)
  + **6:** In carriageway, stationary - not crossing (standing or playing) - masked by parked or stationary vehicle
  + **7:** Walking along in carriageway, facing traffic
  + **8:** Walking along in carriageway, back to traffic
  + **9:** Unknown or other
  + **-1:** Data missing or out of range
* The **"Car\_Passeger"** column in the dataset indicates the role of the casualty as a car passenger at the time of the accident. Below are the corresponding codes and their descriptions:
  + **0:** Not a car passenger
  + **1:** Front seat passenger
  + **2:** Rear seat passenger
  + **9:** Unknown (self-reported)
  + **-1:** Data missing or out of range
* The **"Bus\_or\_Coach\_Passenger"** column in the dataset indicates the role of the casualty as a bus or coach passenger at the time of the accident. Below are the corresponding codes and their descriptions:
  + **0:** Not a bus or coach passenger
  + **1:** Boarding
  + **2:** Alighting
  + **3:** Standing passenger
  + **4:** Seated passenger
  + **9:** Unknown (self-reported)
  + **-1:** Data missing or out of range
* The **"Pedestrian\_Road\_Maintenance\_Worker"** column in the dataset indicates whether the casualty was a road maintenance worker at the time of the accident. Below are the corresponding codes and their descriptions:
  + **0:** No / Not applicable
  + **1:** Yes
  + **2:** Not Known
  + **3:** Probable
  + **-1:** Data missing or out of range
* The **"Casualty\_Type"** column in the dataset indicates the type of casualty involved in the accident. Below are the corresponding codes and their descriptions:
  + **0:** Pedestrian
  + **1:** Cyclist
  + **2:** Motorcycle 50cc and under rider or passenger
  + **3:** Motorcycle 125cc and under rider or passenger
  + **4:** Motorcycle over 125cc and up to 500cc rider or passenger
  + **5:** Motorcycle over 500cc rider or passenger
  + **8:** Taxi/Private hire car occupant
  + **9:** Car occupant
  + **10:** Minibus (8 - 16 passenger seats) occupant
  + **11:** Bus or coach occupant (17 or more passenger seats)
  + **16:** Horse rider
  + **17:** Agricultural vehicle occupant
  + **18:** Tram occupant
  + **19:** Van / Goods vehicle (3.5 tonnes mgw or under) occupant
  + **20:** Goods vehicle (over 3.5t. and under 7.5t.) occupant
  + **21:** Goods vehicle (7.5 tonnes mgw and over) occupant
  + **22:** Mobility scooter rider
  + **23:** Electric motorcycle rider or passenger
  + **90:** Other vehicle occupant
  + **97:** Motorcycle - unknown cc rider or passenger
  + **98:** Goods vehicle (unknown weight) occupant
  + **-1:** Data missing or out of range
* The **"Casualty\_Home\_Area\_Type"** column in the dataset indicates the type of area where the casualty resides. Below are the corresponding codes and their descriptions:
  + **1:** Urban area
  + **2:** Small town
  + **3:** Rural
  + **-1:** Data missing or out of range
* The **"Casualty\_IMD\_Decile"** column in the dataset represents the Index of Multiple Deprivation (IMD) decile for the casualties' home areas. Below are the corresponding codes and their descriptions:
  + **1:** Most deprived 10%
  + **2:** More deprived 10-20%
  + **3:** More deprived 20-30%
  + **4:** More deprived 30-40%
  + **5:** More deprived 40-50%
  + **6:** Less deprived 40-50%
  + **7:** Less deprived 30-40%
  + **8:** Less deprived 20-30%
  + **9:** Less deprived 10-20%
  + **10:** Least deprived 10%
  + **-1:** Data missing or out of range
* The **"LSOA\_of\_Casualty"** column represents the Lower Layer Super Output Area (LSOA) associated with the casualty's location.

# Data preparation

* Checking for Duplicates

Before proceeding with data cleaning, we checked for any duplicate rows in the dataset. Fortunately, there were no duplicate entries found.

* Removing Extra Columns

Next, we removed the columns that do not contribute to our analysis or contain redundant information. These columns include:

Status

1. Accident index
2. Accident year
3. Accident reference
4. LSOA of casualty
5. Vehicle reference
6. Casualty reference

# Summarization Columns and Creation of New Columns and features

In this section, we'll condense the dataset's columns, focusing on extremely precise categories. By breaking down these columns meticulously, we'll generate new columns to reflect these condensed categories. This process grants us a deeper comprehension of the intricate patterns and trends within the data. Such an approach not only streamlines the analysis but also organizes the data more effectively. Ultimately, it empowers us to make better-informed decisions and implement specific strategies to enhance road safety.

1. Summarization of Casualty Type

To simplify the analysis, we summarized the type of casualty involved in the accident into broader categories. The summarized categories, along with their respective counts, are illustrated in Figure 1. The categories are as follows:

* Car Occupant: Individuals involved in accidents while driving or riding in a car.
* Motorcycle Rider or Passenger: Individuals involved in accidents while riding motorcycles.
* Goods Vehicle Occupant: Individuals involved in accidents while riding in goods vehicles.
* Bus/Minibus Occupant: Individuals involved in accidents while riding in buses or minibuses.
* Pedestrian: Individuals involved in accidents while walking or crossing the road.
* Cyclist: Individuals involved in accidents while cycling.
* Others: Individuals involved in accidents categorized as other types not covered by the above categories.

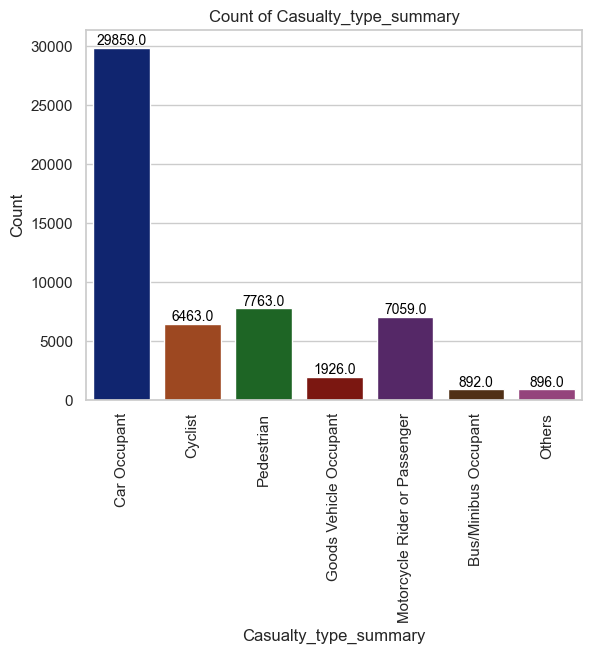


Figure 1

2. Summarization of Pedestrian Location

We categorized the pedestrian's location at the time of the accident into broader categories. The summarized categories, along with their respective counts, are illustrated in Figure 2. The categories are as follows:

* Unknown or other: Pedestrian location is unknown or falls into other unspecified categories.
* Pedestrian Crossing: Pedestrians involved in accidents while crossing at designated pedestrian crossings or zig-zag approaches.
* In Carriageway: Pedestrians involved in accidents while walking or crossing elsewhere on the carriageway.
* On Footway or Verge: Pedestrians involved in accidents while on footways or verges adjacent to the road.
* Not a Pedestrian: Individuals categorized as non-pedestrians involved in accidents.

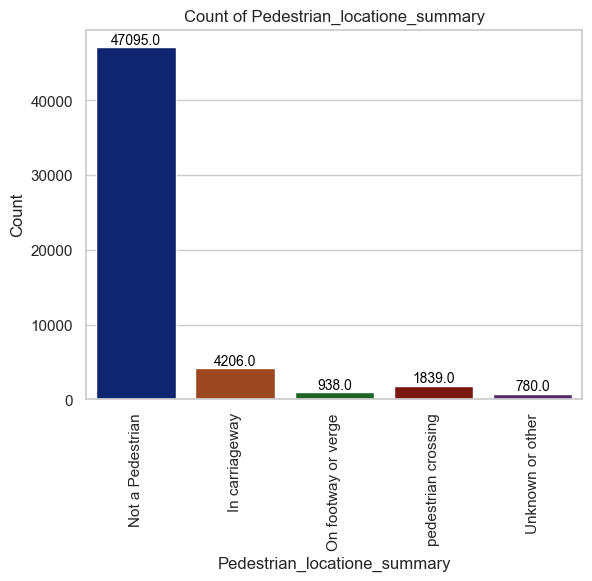


Figure 2

3. Categorization of Pedestrian Movement

We categorized the movement of pedestrians involved in the accident into broader categories. The summarized categories, along with their respective counts, are illustrated in Figure 3. These categories include:

* Not a Pedestrian: Individuals categorized as non-pedestrians involved in accidents.
* Crossing: Pedestrians involved in accidents while crossing the road.
* Stationary in Carriageway: Pedestrians involved in accidents while standing or playing in the carriageway.
* Walking in Carriageway: Pedestrians involved in accidents while walking along the carriageway, either facing or back to traffic.
* Unknown or Other: Pedestrians involved in accidents with movement patterns not fitting into the above categories.

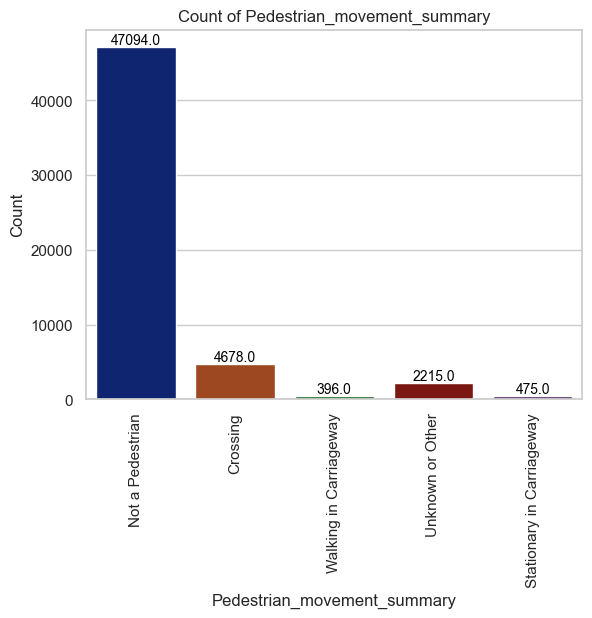


Figure 3

# 5. Identifying Masked Casualties

Based on the information provided in Pedestrian Movement column, we can derive a new feature indicating whether the casualties are masked or unmasked.

# 4. Summarization of Casualty IMD Decile

We categorized the Index of Multiple Deprivation (IMD) decile categories into broader summaries using the provided function. These summaries help in simplifying the analysis and understanding the deprivation levels of casualties. The summarized categories, along with their respective counts, are illustrated in Figure 4. The categories are as follows:

* Most deprived: Represents the most deprived decile categories.
* Moderately deprived: Represents moderately deprived decile categories.
* Less deprived: Represents less deprived decile categories.
* Least deprived: Represents the least deprived decile categories.

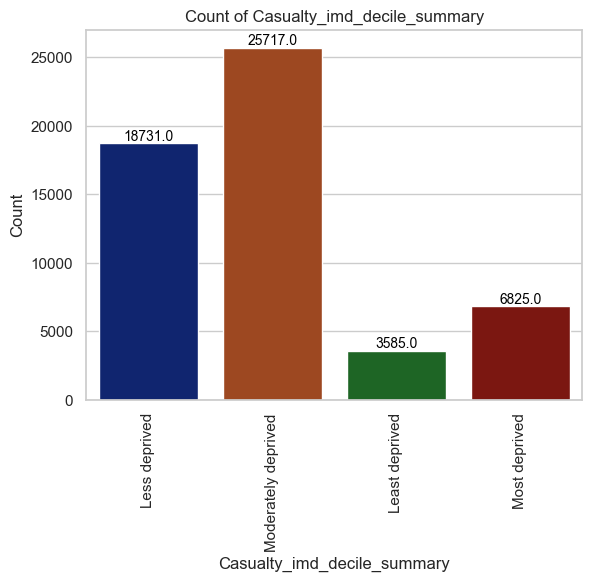


Figure 4

# 5. Combining fetal and serious

In research pertaining to driving accidents, fatalities and serious injuries are often analyzed together under the term "killed or seriously injured" (KSI). Therefore, in our dataset, we have introduced a new column where we amalgamate instances of serious injuries and fatalities.

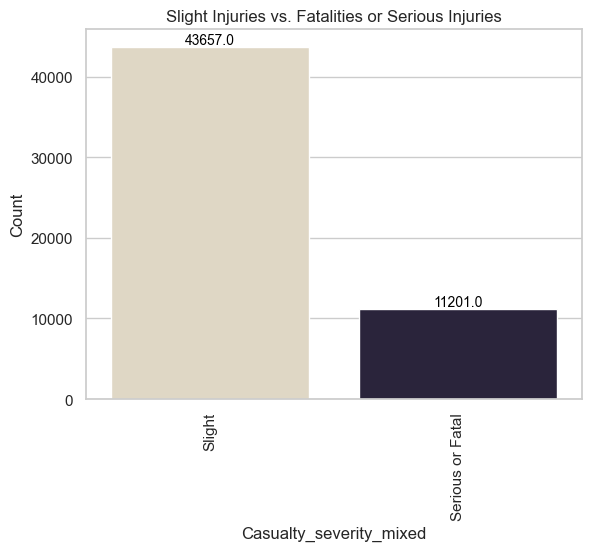


Figure 5

# Handling Missing Values

In this dataset, the only numerical column is the "age" column, which contains 1068 missing values. The distribution of this column, as shown in Figure 5, indicates a right-skewed distribution. Therefore, we opt to impute the missing values using the median. Additionally, after imputing missing values in the "age" column, we will update the "age\_band\_of\_casualty" column accordingly to ensure consistency and fill any missing values in this column.

As for other columns with missing values, we prefer to remove them entirely from the dataset.

This approach ensures that we maintain the integrity of the age data while eliminating rows with missing values in other columns, thereby minimizing potential biases in our analysis.

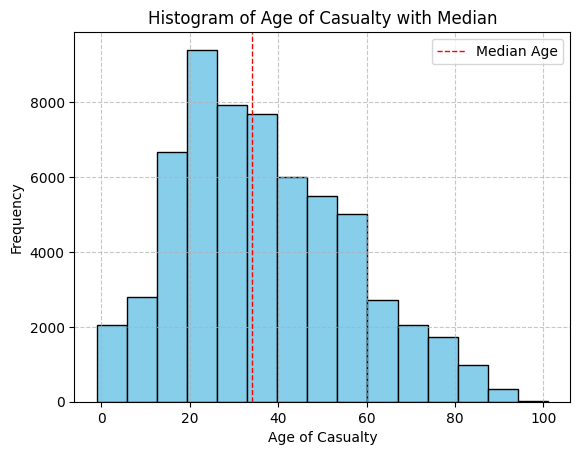


Figure 6 Distribution of age\_of\_casualty Column

# Exploratory Data Analysis

The purpose of this report is to conduct exploratory data analysis (EDA) on the provided dataset containing information about road traffic casualties. The dataset encompasses various attributes such as casualty class, age, sex, severity, among others. Our analysis aims to glean insights into the characteristics of different types of casualties and uncover potential patterns or trends.

Pedestrians, alongside motorcyclists, horse riders, and pedal cyclists, represent some of the most vulnerable user groups on the road. Unlike car users, they lack the protection of a vehicle body, making them more susceptible to injuries and accidents. Additionally, their smaller size and visibility make them harder for other drivers to detect on the road, further increasing their vulnerability

Our approach in this section begins with an examination of the overall information within the dataset. Subsequently, we delve into specific casualty types such as pedestrians, car occupants, motorcycle riders or passengers, analyzing each separately to discern underlying patterns.

1) Overall Analysis

The results depicted in the figure illustrate that approximately 62 percent of the casualties are male. Furthermore, the majority of casualties fall within the age range of 26 to 55 years old.

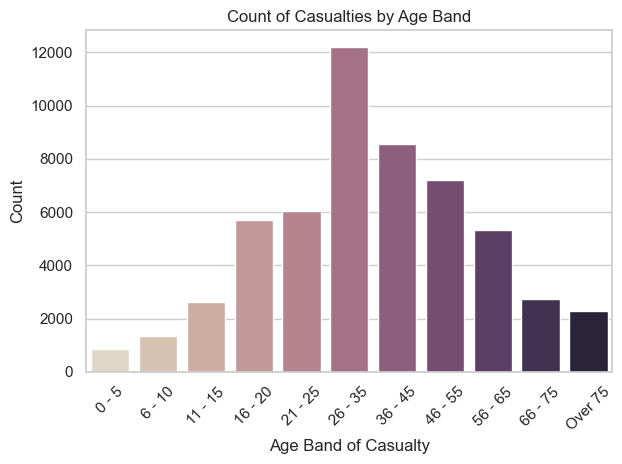
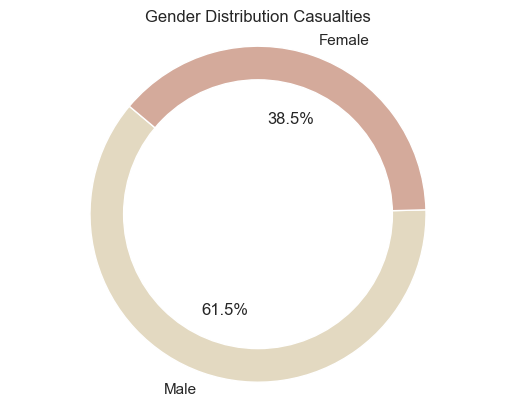
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Figure 7

According to the figure depicting the percentage of fatal or serious and slight casualties for each casualty type, the following observations were made:

**Motorcycle Rider or Passenger: 33%**

Motorcyclists and their passengers constitute the highest percentage of fatal and serious casualties, accounting for 33% of all such incidents. Factors such as high speeds, lack of protective barriers, and vulnerability to impacts contribute to the heightened risk for motorcycle riders and passengers.

**Pedestrian: 31%**

Pedestrians represent the second-highest percentage of fatal and serious casualties, comprising 31% of the total. Pedestrians are particularly vulnerable due to their lack of physical protection and exposure to vehicle-related hazards, emphasizing the importance of pedestrian safety measures.

**Cyclist: 25%**

Cyclists account for a significant portion of fatal and serious casualties, constituting 25% of the total. Factors such as sharing road space with motor vehicles, limited visibility, and the absence of protective enclosures contribute to the increased risk for cyclists.

**Car Occupant: 14%**

Car occupants experience the lowest percentage of fatal and serious casualties, accounting for 14% of the total. The relatively lower risk for car occupants can be attributed to the protective features of modern vehicles, including seat belts, airbags, and structural integrity, which mitigate the severity of injuries in the event of accidents.

These findings underscore the varying levels of risk associated with different modes of transportation and highlight the need for targeted interventions and safety measures to address specific vulnerabilities among road users. Efforts to improve road safety should prioritize the implementation of measures tailored to each casualty type, with a focus on mitigating identified risk factors and enhancing protective measures.

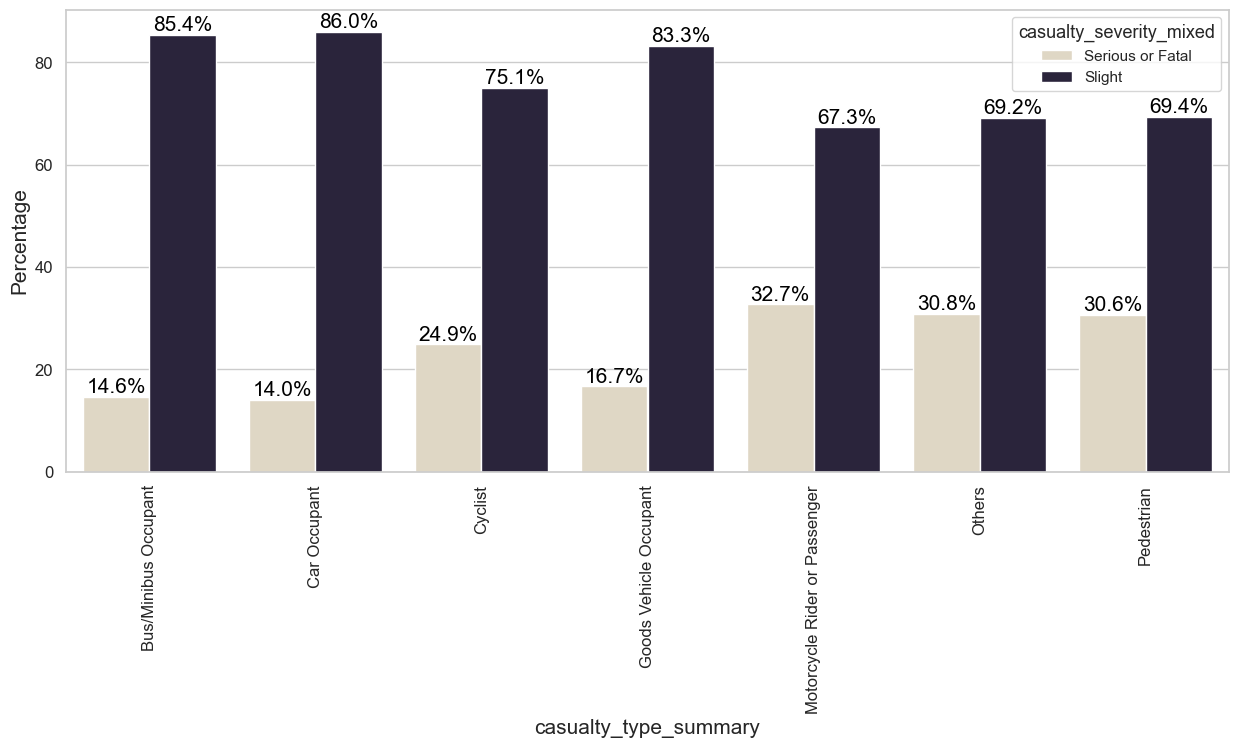
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Figure 8

According to the figure illustrating the percentage of males and females in different casualty types, notable observations were made regarding the distribution of genders across various categories. Notably, the percentage of females in the bus/minibus occupant category increased significantly compared to other categories. Interestingly, it is the only category where the percentage of females exceeds that of males.

This observation suggests a potential gender disparity in bus/minibus occupant casualties, warranting further investigation into the underlying factors contributing to this phenomenon. Possible reasons for this discrepancy may include differences in travel patterns, seating preferences, or exposure to risk factors between male and female occupants of buses and minibuses.

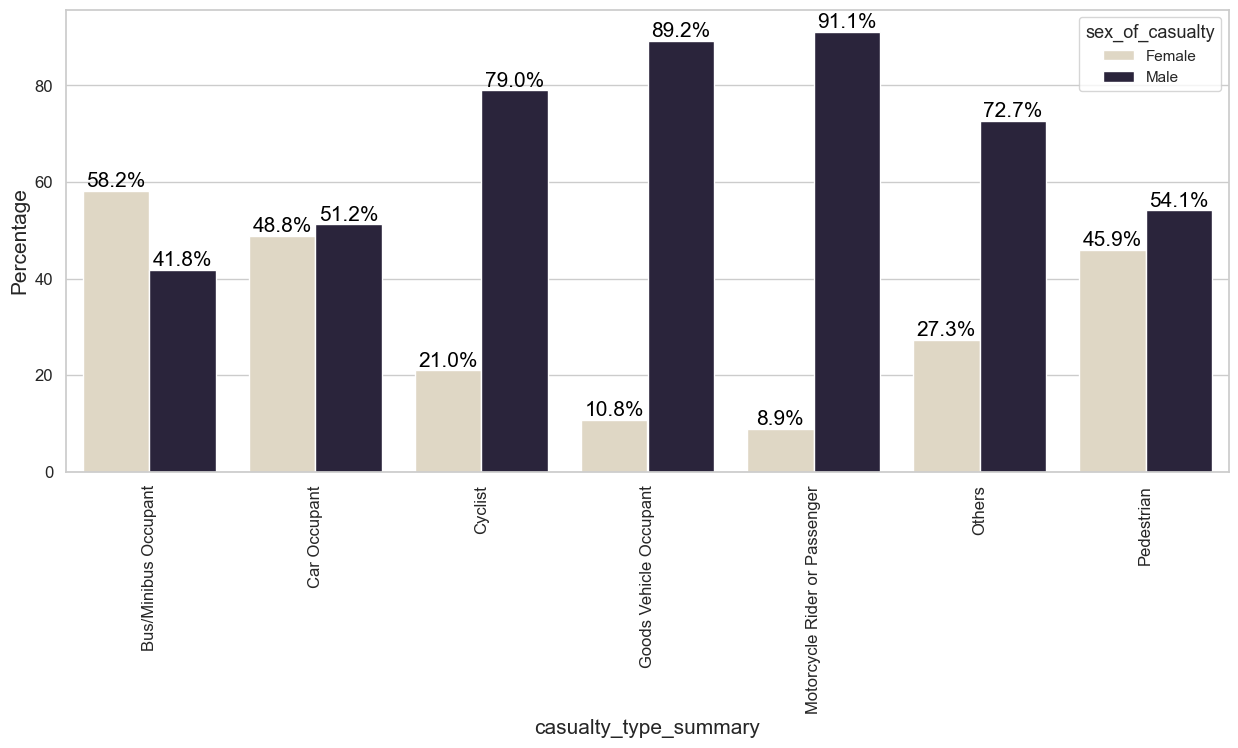


Figure 9

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Figure 10

2) Pedestrian Casualties Analysis

Pedestrians represent a vulnerable group on the road, and analyzing pedestrian casualties provides valuable insights into the factors contributing to pedestrian safety.

The analysis of pedestrian casualties reveals a significant correlation between pedestrian injuries and the age group of 11-15 years old (Figure). This age group stands out as the most affected demographic compared to other age bands. Here's a detailed examination of the findings:

* The plot illustrates a notable increase in the number of casualties between the ages of 11 and 15.
* This age group accounts for the highest number of pedestrian injuries, indicating a vulnerability that requires attention and targeted interventions.

Analysis of Pedestrian Movement by Age Group (Figure 6):

* Figure 6 shows that a considerable percentage (77%) of pedestrians in the 11-15 age group are involved in crossing activities, compared to the overall pedestrian population (60%).
* This suggests a higher likelihood of exposure to road hazards during crossing maneuvers for adolescents in the 11-15 age group.

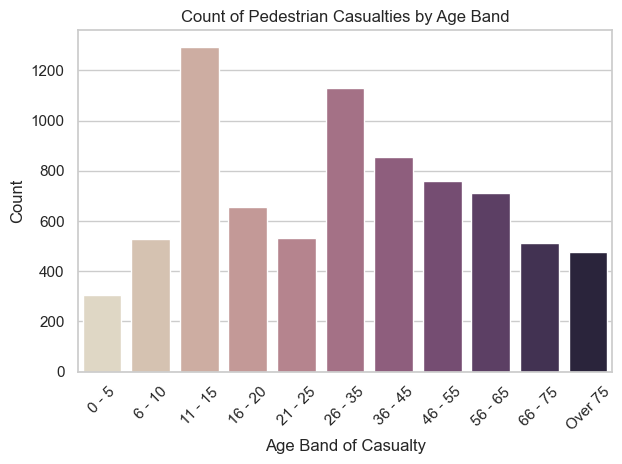


Figure 11 Plot of Pedestrian Casualties by Age Band

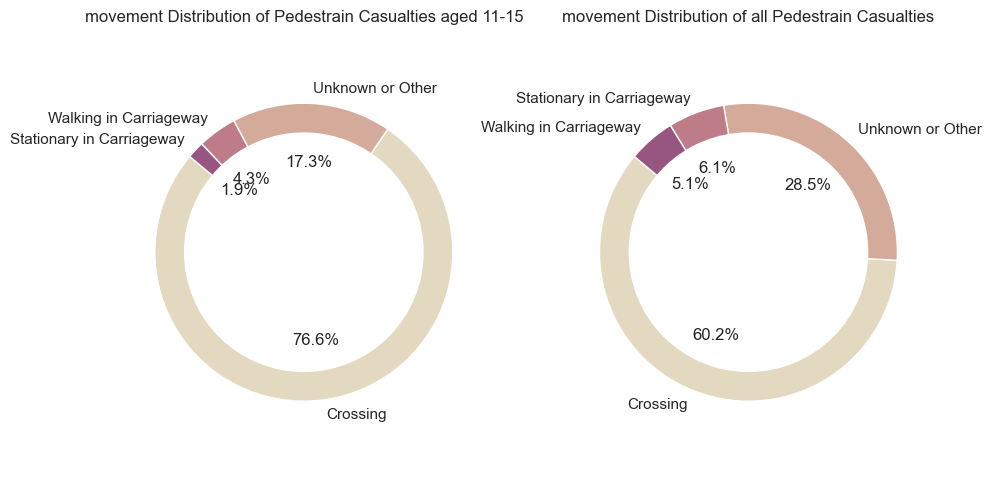


Figure 12

Reasons for Increased Pedestrian Injuries Among 11-15 Age Group:

Developmental Factors: Adolescents in the 11-15 age group may still be developing cognitive and motor skills, leading to difficulties in assessing traffic risks and making safe crossing decisions.

Risk-Taking Behavior: Adolescents are more prone to engage in risk-taking behaviors, such as crossing streets without using designated crosswalks or disregarding traffic signals, which increases their vulnerability to pedestrian accidents.

Increased Independence: Adolescents may begin to travel independently, leading to greater exposure to road hazards and a higher likelihood of pedestrian accidents, especially in urban environments with complex traffic patterns.

Peer Influence: Peer pressure and social dynamics may influence adolescents to engage in unsafe pedestrian behaviors, such as darting across streets or walking distractedly while using electronic devices.

Lack of Pedestrian Education: Insufficient pedestrian education programs tailored to the developmental needs of adolescents may contribute to a lack of awareness about safe pedestrian behaviors and road safety practices.

The analysis shows that the most common age groups among masked pedestrians are 6-15.

Implications:

This indicates that children and adolescents in these age ranges are more prone to accidents while walking on the road, especially when their visibility is masked.

Recommendations:

To address this issue:

* Increase pedestrian safety education targeting children and adolescents.
* Encourage parental supervision, especially for younger children.
* Improve infrastructure with better pedestrian crossings and lighting.
* Engage communities to raise awareness and develop effective safety strategies.

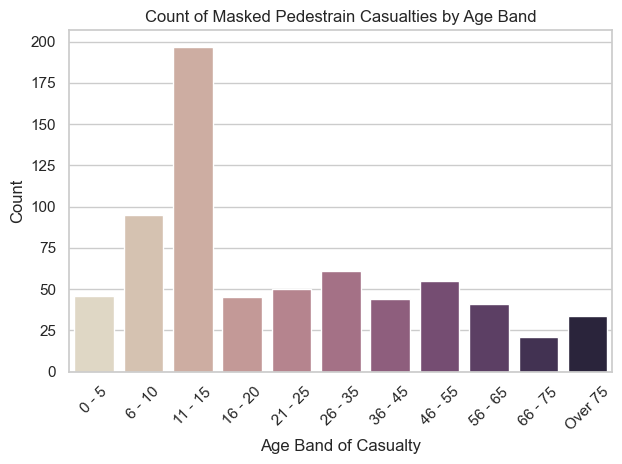
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Figure 13

Comparing the percentages of fatal and serious casualties among pedestrian road maintenance workers (figure 14) and all pedestrians (figure 15) by their location reveals a significant trend: the percentage of serious and fatal casualties increases notably when workers are located on footways or verges. This observation suggests a heightened risk for road maintenance workers of experiencing severe injuries or fatalities when engaged in activities adjacent to roadways, such as on footways or verges.

The implications of this trend are profound. The increased incidence of serious and fatal casualties among road maintenance workers on footways or verges underscores the inherent dangers associated with performing maintenance tasks in close proximity to vehicular traffic. Factors such as limited separation from moving vehicles, inadequate visibility, and potential distractions further compound the risks faced by workers in these locations. Addressing these challenges is crucial to ensuring the safety and well-being of road maintenance workers and reducing the occurrence of severe injuries or fatalities in the course of their duties.

In conclusion, proactive measures are needed to mitigate the risks faced by road maintenance workers on footways or verges. This may involve implementing enhanced safety protocols, providing adequate training and protective equipment, and redesigning work procedures to minimize exposure to vehicular traffic. By prioritizing the safety of road maintenance workers and implementing targeted interventions, we can work towards creating safer working environments and reducing the incidence of severe injuries or fatalities in this vulnerable population.

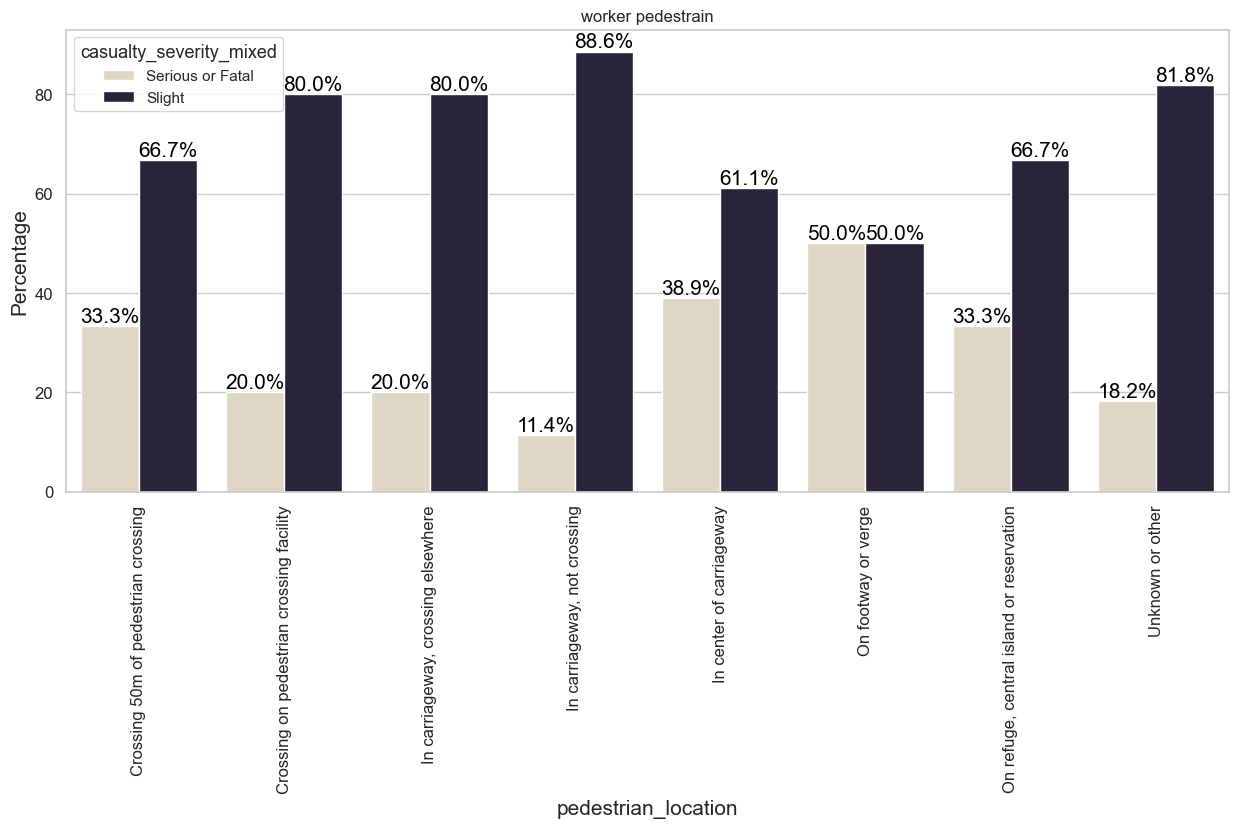


Figure 14 distribution of pedestrian locations for worker pedestrians based on casualty severity

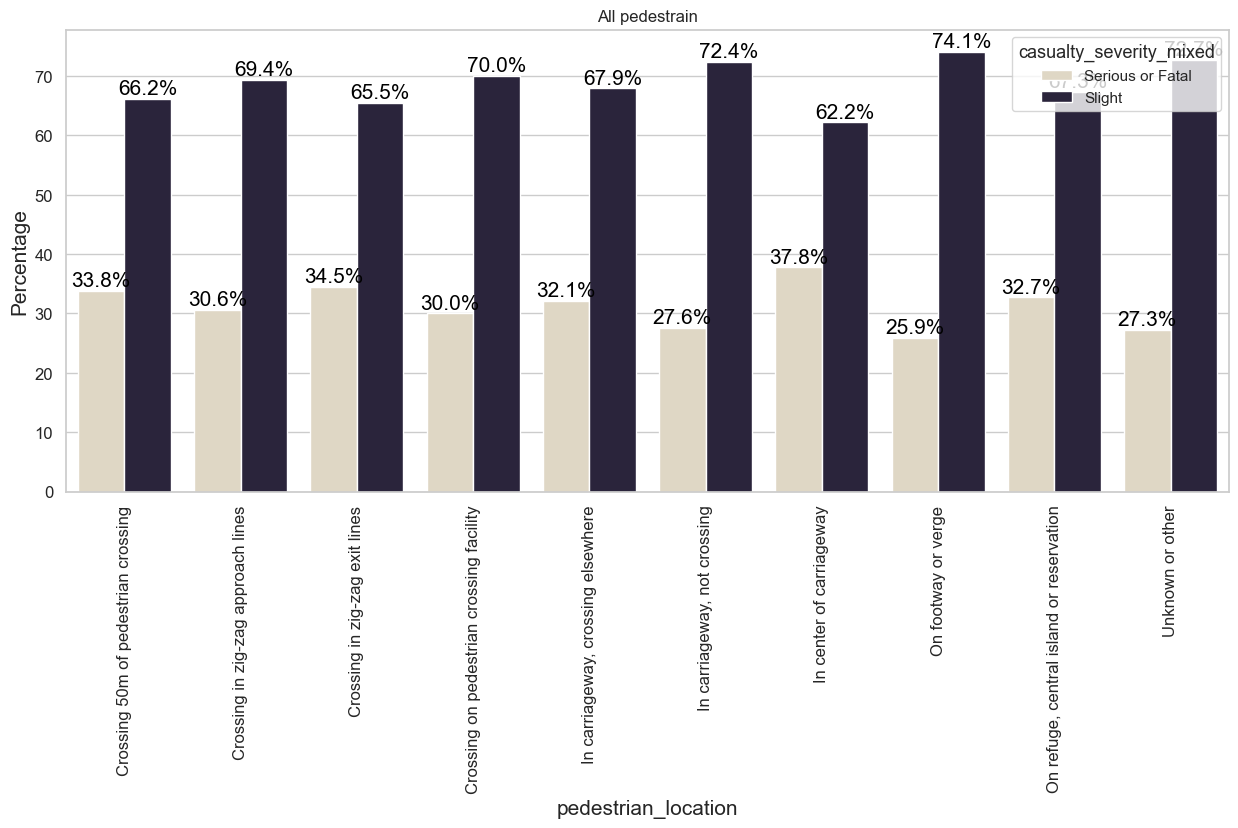


Figure 15 distribution of pedestrian locations for all pedestrians based on casualty severity

3) Motorcycle Rider or PassengerCasualties Analysis

Figure 17 depicts the distribution of casualty types for motorcycle riders or passengers based on casualty severity. The observation that Motorcycle over 500cc Rider or Passenger has the highest percentage of serious or fatal casualties compared to other types of motorcycles raises several potential reasons:

* Speed and Power: Motorcycles over 500cc typically boast more powerful engines and can reach higher speeds compared to smaller motorcycles. Increased speed contributes to more severe accidents in the event of collisions or loss of control.
* Rider Experience: Riders of motorcycles over 500cc might possess more experience and confidence, leading to a tendency to ride at higher speeds or take more risks. This increased confidence might result in a higher likelihood of being involved in serious accidents.
* Safety Equipment: Riders of smaller motorcycles, such as those with engines under 125cc, might prioritize safety gear such as helmets, protective clothing, and motorcycle safety courses. Conversely, riders of larger motorcycles may harbor a false sense of security due to the size and power of their bikes and may be less likely to prioritize safety equipment.
* Visibility and Handling: Larger motorcycles may exhibit different handling characteristics and visibility compared to smaller ones. This could potentially make them more challenging to maneuver in certain situations, leading to a higher risk of accidents, especially in congested urban areas or on winding roads.
* Risk-taking Behavior: Riders of motorcycles over 500cc may exhibit a higher propensity for risk-taking behavior, such as aggressive riding, lane splitting, or exceeding speed limits, which can increase the likelihood of serious accidents.
* Impact Dynamics: In the event of a collision, motorcycles over 500cc may impart greater force due to their size and weight, leading to more severe injuries for the rider or passenger involved.

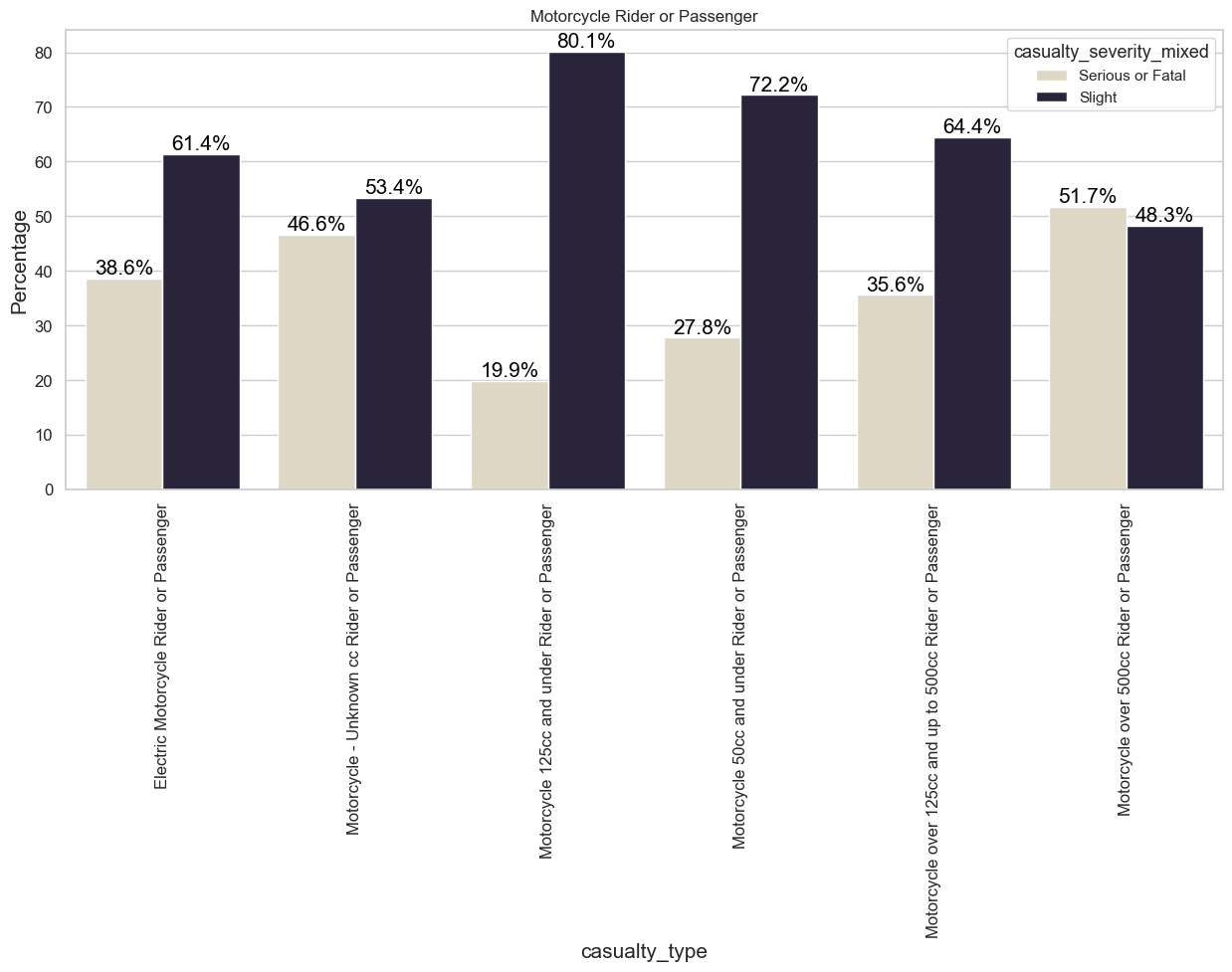
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Figure 16 distribution of casualty types for motorcycle riders or passengers based on casualty severity

The finding that in urban areas, the percentage of fatal and serious casualties for Motorcycles over 500cc increases to 50% (as shown in Figure 17) from the percentage of 29% across all motorcycles (as shown in Figure 18) suggests several potential reasons for this discrepancy:

* Traffic Density and Congestion: Urban areas typically exhibit higher traffic density and congestion, elevating the risk of accidents for motorcycles, particularly those with larger engines. Navigating through congested urban streets can be challenging, thereby increasing the likelihood of accidents with severe outcomes.
* Intersection Accidents: Urban environments frequently feature numerous intersections and junctions where collisions are more prone to occur. Motorcycle accidents at intersections tend to be more severe due to the higher speeds involved and the potential for multiple points of impact.
* Vulnerable Road Users: Urban areas are populated by various vulnerable road users such as pedestrians and cyclists, whose presence complicates navigation through traffic for motorcyclists. Collisions involving vulnerable road users are more likely to result in serious or fatal injuries.
* Rider Behavior and Speed: In urban settings, riders of Motorcycles over 500cc may be inclined to ride at higher speeds due to the open road conditions or the desire to maneuver through traffic swiftly. Increased speeds in urban environments escalate the severity of accidents when they occur.
* Road Design and Infrastructure: Urban roads may incorporate design features such as narrow lanes, sharp turns, or inadequate signage, posing additional challenges for motorcyclists, especially those riding larger motorcycles. Poor road infrastructure increases the likelihood of accidents and exacerbates their severity.
* Driver Awareness and Visibility: Drivers in urban areas may exhibit reduced attentiveness to motorcycles, particularly larger ones, amidst the multitude of other vehicles and distractions present in urban traffic. Diminished driver awareness and visibility heighten the risk of accidents for motorcyclists, resulting in more severe outcomes.
* Emergency Response Time: Emergency response times in urban areas may be prolonged due to traffic congestion and accessibility issues, delaying medical assistance for injured motorcyclists and potentially exacerbating their outcomes in severe accidents.
* Enforcement of Traffic Laws: Enforcement of traffic laws, such as speed limits and lane splitting regulations, may vary in urban areas, influencing the behavior of motorcyclists and other road users. Inadequate enforcement can promote riskier riding practices and a higher incidence of serious accidents.

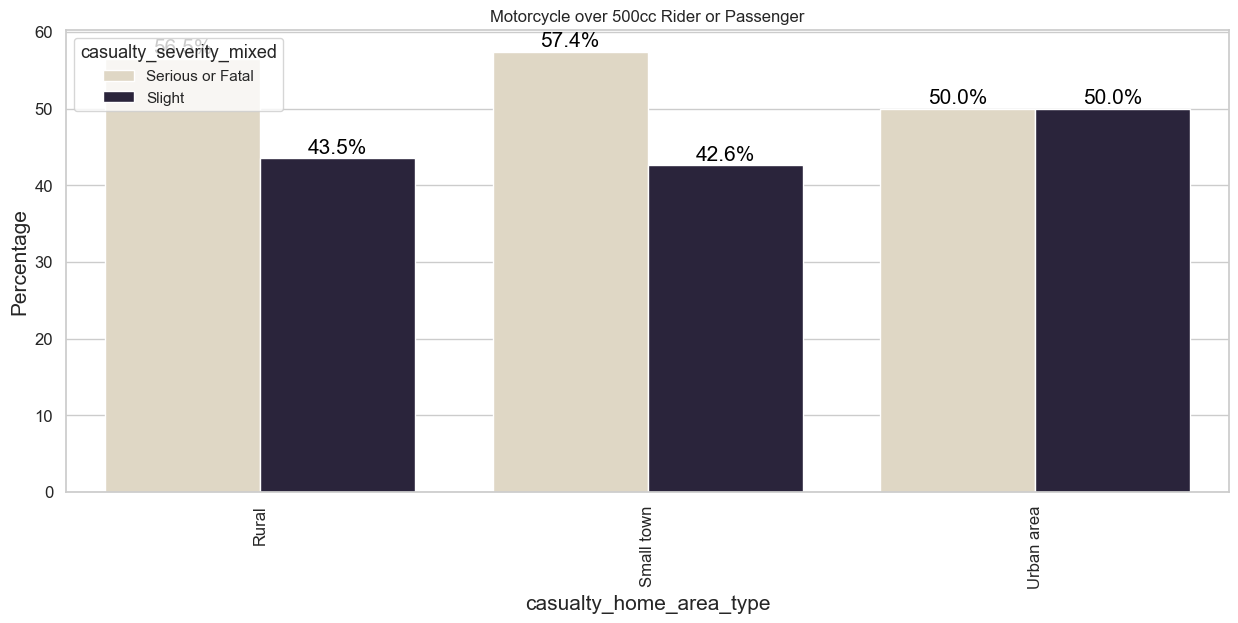


Figure 17 distribution of home area types for motorcycle riders or passengers with motorcycles over 500cc based on casualty severity

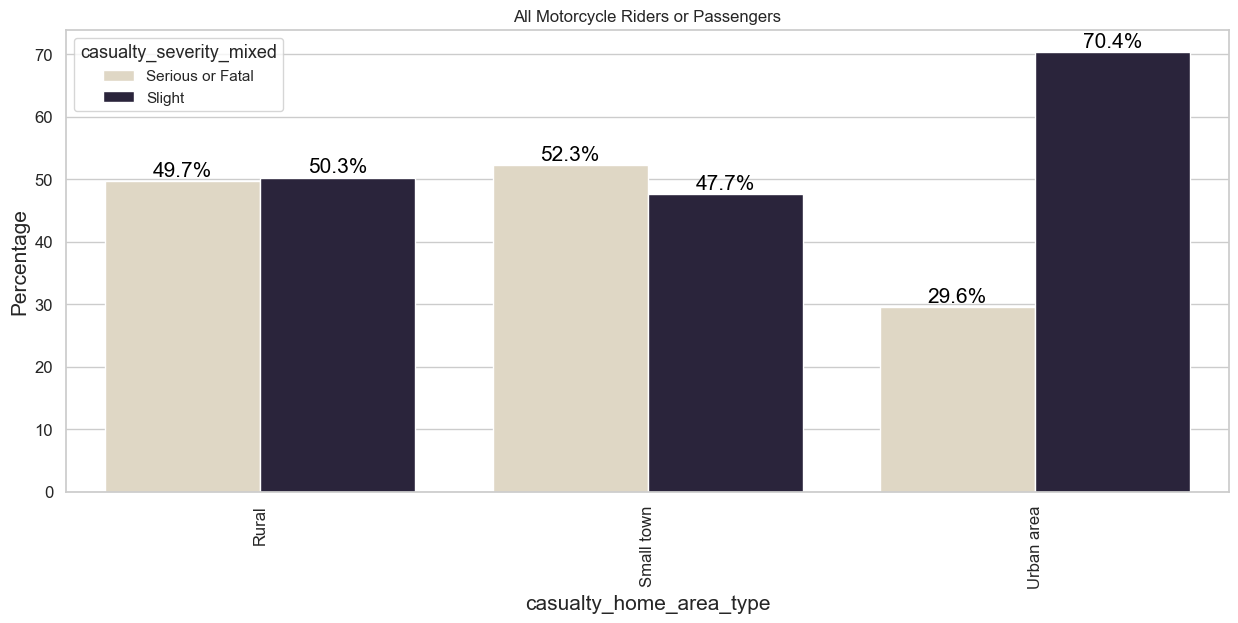


Figure 18 Plot the distribution of home area types for all motorcycle riders or passengers based on casualty severity.

4) Bus/Minibus Occupant Casualties Analysis

According to Figure 19, it was found that standing passengers have the highest percentage of serious casualties among Bus/Minibus occupants, followed by alighting passengers.

Reasons for Standing Passengers Having the Highest Percentage of Serious Casualties:

* Lack of Seating Restraints: Standing passengers typically lack the safety restraints provided by seats, making them more vulnerable to injury in the event of sudden stops, sharp turns, or collisions.
* Impact Dynamics: In the event of a collision or sudden braking, standing passengers are at a higher risk of being thrown off balance or colliding with other passengers or objects within the bus/minibus, leading to more severe injuries.
* Crowded Conditions: Standing passengers often experience crowded conditions during peak travel times, which can increase the likelihood of accidents due to reduced stability and limited space for movement or bracing against impacts.
* Difficulty in Evacuation: In emergency situations such as accidents or vehicle fires, standing passengers may face challenges in quickly evacuating the bus/minibus compared to seated passengers, potentially prolonging exposure to danger and increasing the severity of injuries.

Reasons for Alighting Passengers Having a High Percentage of Serious Casualties:

* Vulnerability During Disembarkation: Alighting passengers are in a vulnerable position as they disembark from the bus/minibus, particularly when crossing busy streets or navigating uneven terrain on sidewalks. This increases the risk of falls, trips, or collisions with other vehicles or pedestrians, resulting in serious injuries.
* Distraction and Reduced Awareness: Alighting passengers may be distracted or preoccupied with disembarking procedures, such as retrieving belongings or checking for approaching vehicles, leading to a decreased awareness of their surroundings and an increased susceptibility to accidents.
* Encounters with Vehicles: Alighting passengers are exposed to potential hazards from passing vehicles, especially if they need to cross multiple lanes of traffic to reach their destination. This exposes them to the risk of being struck by vehicles, resulting in serious injuries or fatalities.
* Rushed Exiting: In busy urban environments, alighting passengers may feel pressured to exit quickly to avoid delaying the bus/minibus or inconveniencing other passengers, leading to hurried movements and increased susceptibility to accidents.
* These factors highlight the importance of addressing safety measures for both standing and alighting passengers to reduce the incidence of serious casualties among Bus/Minibus occupants.

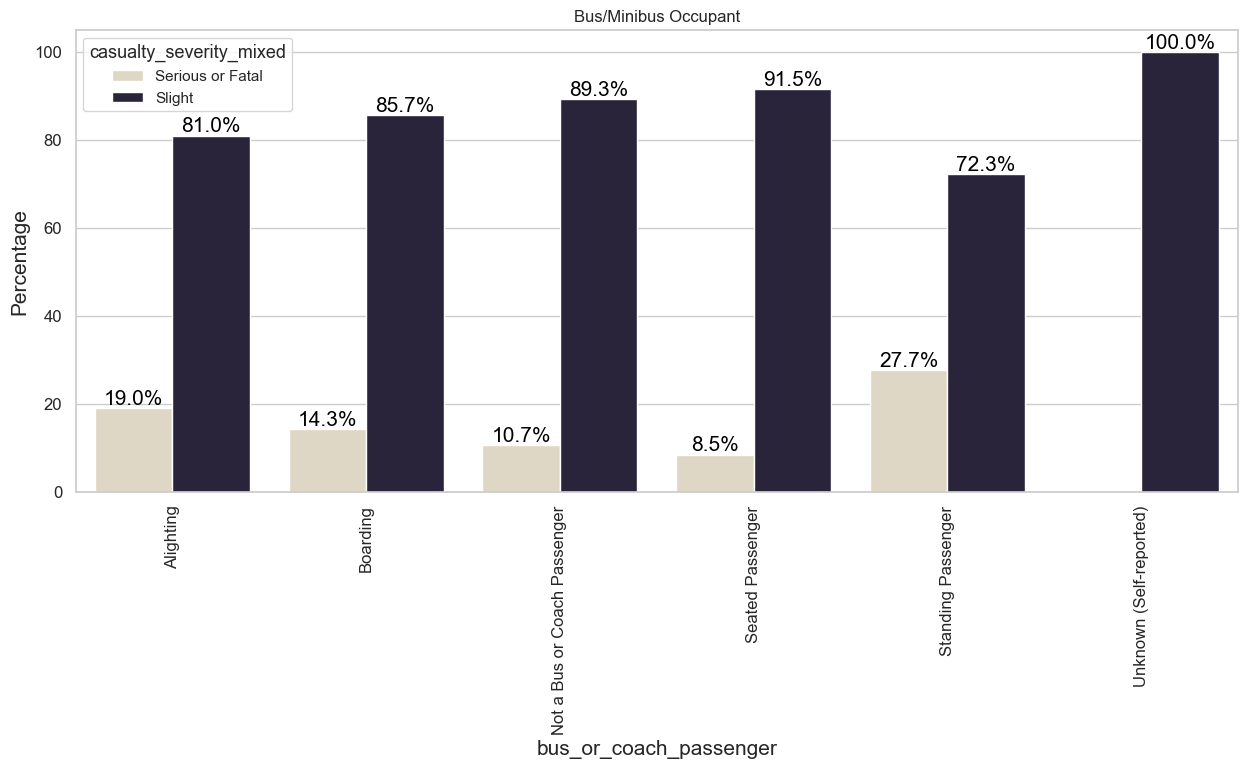


Figure 19 distribution of bus/minibus occupants status based on casualty severity

According to the results obtained for the impact of Standing Posture on Serious Casualties Among Bus/Minibus Occupants in Urban Areas, as shown in Figure 20, it was observed that in urban areas, the percentage of serious casualties for standing passengers is 14% higher compared to all other postures.

Reasons for the Higher Percentage of Serious Casualties Among Standing Passengers in Urban Areas:

1. Increased Risk of Falls: Urban bus/minibus routes often involve frequent stops and starts, sharp turns, and sudden braking, which can increase the risk of standing passengers losing their balance and falling, resulting in serious injuries.
2. Crowded Conditions: Urban buses/minibuses tend to be more crowded during peak travel times, leading to limited space for standing passengers to maintain stability. Crowded conditions exacerbate the risk of collisions with other passengers or objects within the vehicle, leading to more severe injuries.
3. Distracted Driving and Traffic Patterns: In urban environments, bus/minibus drivers may face distractions such as heavy traffic, pedestrians, cyclists, and complex road layouts. This increases the likelihood of sudden maneuvers or stops, catching standing passengers off guard and resulting in serious injuries.
4. Limited Accessibility to Seats: In densely populated urban areas, standing passengers may face difficulties accessing available seats due to overcrowding or limited seating capacity. As a result, they are forced to remain standing for extended periods, increasing their vulnerability to accidents and serious injuries.
5. Urban Infrastructure Challenges: Urban roads often feature uneven surfaces, potholes, and other infrastructure challenges that can cause instability for standing passengers. Uneven road surfaces combined with sudden vehicle movements can lead to falls and serious injuries among standing passengers.
6. Rush Hour Conditions: During rush hour in urban areas, buses/minibuses experience higher passenger volumes and faster boarding and alighting processes, increasing the risk of accidents. Standing passengers may be more susceptible to serious injuries during these peak periods due to the heightened level of activity and congestion.
7. Emergency Evacuation Challenges: In the event of emergencies such as accidents or vehicle breakdowns, standing passengers may face challenges in quickly evacuating the bus/minibus due to limited space and obstructed exits. This delay in evacuation can increase the severity of injuries sustained by standing passengers.

# Conclusion

* The exploratory data analysis (EDA) conducted on the provided dataset concerning road traffic casualties has revealed significant insights into the characteristics, trends, and risk factors associated with different types of casualties, particularly focusing on pedestrians, motorcycle riders or passengers, and bus/minibus occupants.
* Overall, the analysis underscores the varying levels of risk faced by different road user groups, with vulnerable users such as pedestrians, motorcycle riders/passengers, and standing bus/minibus passengers exhibiting higher proportions of fatal and serious casualties compared to car occupants. These findings highlight the critical need for targeted interventions and safety measures tailored to address the specific vulnerabilities and risk factors associated with each casualty type.
* For pedestrians, the analysis identifies adolescents aged 11-15 as a particularly vulnerable demographic, with factors such as developmental factors, risk-taking behavior, and lack of pedestrian education contributing to their heightened susceptibility to pedestrian accidents. Additionally, the study highlights the increased risk faced by road maintenance workers, especially when working on footways or verges adjacent to roadways.
* In the case of motorcycle riders or passengers, the analysis reveals a correlation between motorcycle engine size, casualty severity, and urban environments, with motorcycles over 500cc and urban areas exhibiting higher percentages of serious and fatal casualties. Factors such as speed and power, rider behavior, road design, and traffic density contribute to the elevated risk for motorcycle riders/passengers, particularly in urban settings.
* Furthermore, the examination of bus/minibus occupant casualties emphasizes the risks associated with standing posture and alighting procedures, with standing passengers and alighting passengers experiencing higher proportions of serious casualties. Reasons include lack of seating restraints, crowded conditions, distracted driving, and infrastructure challenges, particularly in urban environments.
* In conclusion, proactive measures are necessary to address the identified risk factors and enhance road safety for all road users, especially vulnerable groups such as pedestrians, motorcycle riders/passengers, and bus/minibus occupants. These measures may include improving pedestrian education programs, enhancing infrastructure with better crossings and lighting, enforcing traffic laws, providing adequate training and protective equipment for motorcycle riders, and implementing safety measures for standing bus/minibus passengers. By prioritizing targeted interventions and collaborative efforts across various stakeholders, we can work towards creating safer road environments and reducing the incidence of severe injuries and fatalities among road traffic casualties.

# Suggestion

Based on the insights derived from the exploratory data analysis (EDA) and the identified risk factors associated with different types of road traffic casualties, several suggestions can be proposed to enhance road safety and mitigate the risks faced by vulnerable road users:

1. Targeted Education and Awareness Campaigns:
   * Implement comprehensive pedestrian education programs aimed at adolescents, focusing on safe crossing behaviors, traffic awareness, and risk mitigation strategies.
   * Conduct public awareness campaigns highlighting the importance of wearing safety gear, obeying traffic laws, and practicing defensive riding techniques for motorcycle riders.
   * Raise awareness among bus/minibus passengers about the risks associated with standing posture and provide guidance on maintaining stability during transit.
2. Infrastructure Improvements:
   * Enhance pedestrian infrastructure by installing well-marked crosswalks, pedestrian signals, and traffic-calming measures to improve safety for pedestrians, especially in areas with high foot traffic.
   * Upgrade urban road infrastructure to address challenges such as uneven surfaces, inadequate signage, and congested intersections, thereby reducing the risk of accidents for all road users.
   * Expand dedicated cycling lanes and implement measures to separate cyclists from motor vehicle traffic, improving safety for cyclists and reducing the risk of collisions.
3. Regulatory Measures and Enforcement:
   * Enforce speed limits, particularly in urban areas and areas with high pedestrian activity, to reduce the severity of accidents and minimize the risk of pedestrian injuries.
   * Strengthen enforcement of traffic laws related to motorcycle riding behaviors, such as speeding, lane splitting, and helmet use, to promote safer riding practices and reduce the incidence of serious accidents.
   * Implement stricter regulations regarding passenger capacity and seating restraints on buses/minibuses to enhance passenger safety, particularly during peak travel times.
4. Collaboration and Stakeholder Engagement:
   * Foster collaboration among government agencies, law enforcement, transportation authorities, and community organizations to develop and implement holistic road safety initiatives.
   * Engage with schools, parents, and youth organizations to integrate road safety education into school curricula and extracurricular activities, emphasizing the importance of pedestrian safety and responsible road behavior.
   * Partner with public transportation operators to improve passenger safety protocols, enhance driver training programs, and invest in technologies that promote safer transit experiences for all passengers.
5. Research and Innovation:
   * Invest in research initiatives aimed at understanding the root causes of road traffic accidents and identifying innovative solutions to address emerging safety challenges.
   * Explore technological advancements such as intelligent transportation systems, vehicle-to-vehicle communication, and autonomous driving technologies to enhance road safety and mitigate the risks associated with human error.