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Analysis of Body Impact and the Role of Passive Safety Systems in Driver Injuries in Car-to-Car Collisions

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A B S T R A C T

Car-to-car collisions in Indonesia remain one of the leading causes of driver injuries. To date, vehicle safety evaluations have primarily focused on physical vehicle damage and environmental factors, while the characteristics of injuries sustained by drivers inside the cabin based on firsthand experience have rarely been analyzed. This study aims to analyze the relationship between injury severity, the location of the first point of impact, on the body, and the use of passive safety systems as a basis for developing recommendations for Advanced Driver Assistance Systems (ADAS) features. This study uses a quantitative approach based on an online questionnaire distributed to 100 car drivers in Indonesia who have been involved in car-to-car collisions. Data analysis was conducted descriptively using cross-tabulation and the Chi-Square test to examine relationships among injury severity, body impact location, and use of passive safety systems (seat belts and airbags). The results showed that 52% of respondents sustained minor injuries, 36% were uninjured, and 17% sustained severe injuries. The most common impact locations were the upper body (28%) and the head (23%). Statistical test results showed that the use of passive safety systems was not significantly associated with a reduction in injury severity ($p = 0.078$), but was significantly associated with the location of the impact ($p = 0.001$), which directly influenced injury severity ($p = 0.026$). Based on the analytical framework of these injury characteristics, the Forward Collision Warning (FCW), Automatic Emergency Braking (AEB), Intelligent Speed Assistance (ISA), and Proactive Passenger Protection System (PPS) features are recommended as top priorities for ADAS to reduce collision energy prior to a crash.

Contribution to Sustainable Development Goals (SDGs):
SDG 3: Good Health and Well-being
SDG 9 : Industry, Innovation and Infrastructure
SDG 11: Sustainable Cities and Communities
SDG 12: Responsible Consumption and Production

1. INTRODUCTION

1.1. Research Background

Traffic accidents remain one of the leading causes of fatalities and injuries in Indonesia. Among various types of collisions, accidents involving four-wheeled vehicles and above account for a significant number of cases, including minibuses with 97,518 cases, medium trucks with 59,406 cases, pickup trucks with 39,883 cases, passenger vans with 20,303 cases, passenger sedans with 10,329 cases, and other types of four-wheeled vehicles (PUSIKNAS, 2025). The high number of these incidents highlights the need for more effective measures to reduce the impacts of traffic accidents.

Several studies have shown that human factors remain the dominant cause of traffic accidents. Baran et al. (2024) [1] revealed that approximately 90% of accidents are caused by human error, including traffic violations such as speeding, maintaining insufficient following distance, and a lack of driver

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awareness. In addition to human factors, environmental conditions also contribute to increasing accident risks, such as heavy rain, fog, slippery roads, and inadequate road lighting, which reduce visibility and delay driver responses, thereby increasing the likelihood of accidents [2]. These findings indicate that traffic accidents are influenced by multiple factors; therefore, an approach is needed that focuses not only on identifying accident causes but also on minimizing the severity of driver injuries when accidents cannot be avoided.

To date, efforts to reduce the impacts of accidents have largely relied on passive safety systems, such as seat belts and airbags. Along with the development of vehicle technology, attention has shifted toward active safety systems, or Advanced Driver Assistance Systems (ADAS), which are designed to help drivers prevent collisions. Various studies have shown that ADAS technologies, such as Autonomous Emergency Braking (AEB), can reduce the risk of collisions and mitigate injury severity through early detection of potential hazards and automatic braking interventions [3]. Gulino et al. (2022) [4] developed an ADAS performance evaluation method using injury risk indicators to assess the system's capability in reducing collision-related injury risks. Meanwhile, Li et al. (2024) [5] evaluated the combination of Autonomous Emergency Braking (AEB) and active seat belts on driver injuries using a biomechanical simulation approach in side-impact collision scenarios. These findings indicate that research on ADAS generally focuses on evaluating the effectiveness of safety technologies through vehicle simulations and biomechanical models.

However, previous studies have primarily discussed accidents from external vehicle factors, such as the effects of weather conditions, damaged roads, road lighting, or driver characteristics assessed through the Driver Behavior Questionnaire (DBQ) [1], [2]. In contrast, studies on vehicle safety systems have mainly evaluated the effectiveness of active and passive safety technologies using vehicle simulations, crash tests, or biomechanical models [4], [6]. These approaches can explain injury mechanisms and evaluate the effectiveness of safety technologies; however, they have not yet provided a comprehensive understanding of driver injury characteristics based on direct experiences from real-world accidents. Therefore, although studies on accident causes and the effectiveness of safety technologies have been widely conducted, the relationship between the location of the first body impact, the use of passive safety systems, injury severity, and their implications for selecting ADAS features remains insufficiently explored, particularly in car-to-car collisions in Indonesia.

Identifying which body part is struck first is crucial because it provides insight into the injury mechanisms experienced by drivers. This information is not only useful for evaluating the effectiveness of passive safety systems but also for determining the most appropriate active safety technologies to reduce injury risks in car-to-car collisions in Indonesia.

Firsthand data from the victim's perspective can reveal hidden types of injuries that are often not visible in external video recordings or from the condition of the vehicle's body. Therefore, this study aims to analyse the relationship between injury severity, the location of the first point of impact on the body, and the use of passive safety systems, using questionnaire data from drivers involved in vehicle-to-vehicle collisions in Indonesia. The analysis was conducted using descriptive statistics, cross-tabulation, and the Chi-Square test The research results were then used as a basis for formulating recommendations for active safety systems or Advanced Driveɑı Assistance Systems (ADAS) features that are relevant to the characteristics of driver injuries in car-to-car accidents in Indonesia.

1.2. Literature Review

1.2.1. Road Traffic Safety

Road safety refers to a condition free from the risk of accidents caused by human, vehicle, road, or environmental factors, as stipulated in Law No. 22 of 2009 on Road Traffic and Transportation. Efforts to improve safety are carried out not only through the provision of infrastructure and law enforcement but also through the development of vehicle technologies that reduce the likelihood of accidents.

The Indonesian government aims to reduce accident fatality rates through the National Safety Master Plan (RUNK), making the implementation of vehicle safety technologies one of the key strategies for improving road transport safety. Lucci et al. (2021) [7] state that improving traffic safety requires an approach capable of reducing the risk of injury before a collision occurs, while Elvik et al (2025) [8] explain that the effectiveness of road safety is greatly influenced by the quality of the safety management system implemented.

Collisions between vehicles are among the most common types of accidents on highways and significantly impact the safety of both drivers and passengers. Santos et al. (2023) [9] state that traffic accidents remain the leading cause of death among people aged 5-29 worldwide. In addition to causing fatalities, accidents also result in economic losses in the form of medical costs, lost productivity, and long-term social impacts on victims and their families [10]. Therefore, understanding the mechanisms by which drivers sustain injuries is a critical aspect in the development of vehicle safety technology.

1.2.2. Factors Contributing to Traffic Accidents

Traffic accidents in Indonesia are influenced by a combination of human, vehicle, and road environment factors. Although fatal accidents more frequently involve two-wheeled vehicles, collisions between cars are also a problem that requires attention because they have the potential to cause serious injuries to drivers and passengers [11]. Identifying injuries sustained by car drivers is a crucial step in formulating prevention strategies and safety policies capable of reducing the number of accidents on public roads [10].

Human factors are the dominant cause of traffic accidents because drivers have direct control over their vehicles. Baran et al. (2024) [1] state that the majority of traffic accidents are influenced by human error, such as driving at high speeds, maintaining unsafe following distances, and a lack of vigilance. In addition, environmental conditions such as heavy rain, fog, slippery roads, and poor street lighting also increase the risk of accidents by reducing visibility and slowing drivers' reaction times [2].

In addition to human and environmental factors, vehicle condition also plays a role in determining the severity of accidents. Vehicle defects, such as brake system failure of damage to critical vehicle components, can increase the risk of serious injury in the event of a collision. Therefore, regular

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vehicle maintenance and inspections are key measures for reducing the risk of accidents [12].

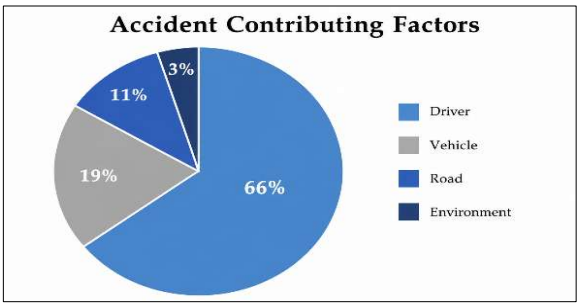

Fig 1. Factors Contributing to Road Traffic Accidents

1.2.3. Risky Driving Behavior and Driver Safety

In addition to technical factors, driver behavior also plays a significant role in increasing the risk of accidents and the severity of injuries. Unsafe driving behaviors, such as not wearing a seaf belt, driving above the speed limit, and performing dangerous maneuvers, can increase the likelihood of accidents and serious injuries.

Ref. [7] Explain that loss of vehicle control due to risky driving behaviour is one of the main causes of accidents resulting in severe injuries. These findings are supported by Baran et al. (2024) [1], who show that driver behavior remains the dominant cause of traffic accidents. Meanwhile, Elvik et al (2025) [8] explain that improvements in traffic safety depend nof only on driver behavior but are also influenced by the quality of the road safety policies and management systems that are implemented.

1.2.4. Collision Biomechanics and Vehicle Occupant Protection

Collision biomechanics is the field that studies the human body's response to impact forces during accidents. Biomechanical analysis is used to understand the mechanisms of injury occurrence, thereby becoming the basis for the development of more effective vehicle safety systems.

[13] evaluated the combination of Autonomous Emergency Braking (AEB) and active seat belts using biomechanical simulations in side-impact collision scenarios. The results showed that the combination of these two systems reduced injury risk indicators for the driver's head, neck, and chest by reducing vehicle speed before impact.

In addition, Kang et al. (2022) [14] evaluated the effectiveness of Proactive Safety Seat (PSS) integrated with the Autonomous Emergency Braking (AEB) system. The results showed that the system reduced head and neck movement before impact, thereby improving vehicle occupant protection during emergency braking. These findings indicate that modern safety technologies not only function to prevent collisions but also prepare the driver's body position to be safer when collisions cannot be avoided.

1.2.5. Accident Detection and Prevention Technologies

The development of automotive technology has led to various active safety systems (Advanced Driver Assistance Systems/ADAS) that help drivers prevent collisions. These systems utilize sensors, cameras, radar, and software to detect potential hazards and provide warnings or automatic interventions. According to Abdul Khalid et al. (2021) [15], several active safety technologies that have been implemented in passenger vehicles include Anti-lock Braking System (ABS), Electronic Stability Control (ESC), Lane Keeping Assistance (LKA), Blind Spot Detection (BSD), and Autonomous Emergency Braking (AEB).

One of the widely developed ADAS technologies is Autonomous Emergency Braking (AEB). This system works by utilizing radar and cameras to monitor vehicle distance, speed, and potential collisions in front of the vehicle. When the system detects a collision risk and the driver does not respond, AEB will automatically apply braking to reduce vehicle speed or avoid a collision.

Various studies have shown that the effectiveness of ADAS is not only measured by its ability to prevent collisions but also by its ability to reduce the risk of injuries to drivers and passengers. Gulino et al. (2022) [4] developed an ADAS performance evaluation method using injury risk indicators to assess the system's capability in reducing collision-related injury risks. Furthermore, [13] demonstrated that the combination of AEB and active seat belts can reduce driver injury risks through a biomechanical simulation approach. The study by Kang et al. (2022) [14] also showed that integrating the Proactive Safety Seat with the AEB system can improve vehicle occupant protection during the pre-impact phase.

In addition to Forward Collision Warning (FCW) and AEB, active safety systems also include Lane Departure Warning (LDW), Intelligent Speed Assistance (ISA), Traffic Sign Recognition (TSR), and Proactive Passenger Protection System (PPS), which are designed to reduce the likelihood of accidents while minimizing injury severity when collisions cannot be avoided.

Based on the characteristics of each technology, each ADAS feature serves a different mitigation function depending on the accident conditions encountered. Therefore, the selection of active safety features needs to be adjusted based on body impact patterns, the effectiveness of passive safety systems, and the severity of injuries experienced by drivers. This approach serves as the basis of this study to formulate recommendations for the most appropriate active safety systems in car-to-car collisions.

1.3. Research Objective

This study aims to analyze the characteristics of driver injuries based on body impact location and the use of passive safety systems in car-to-car collisions as a basis for recommending appropriate Advanced Driver Assistance Systems (ADAS) technologies.

2. MATERIALS AND METHODS

This study used a quantitative approach with primary data collected through an online questionnaire distributed using Google Forms to car drivers in Indonesia who had experienced car-to-car collisions.

The research instrument was developed based on a literature review regarding driving safety, driver injury characteristics, and vehicle safety systems. Before being used in the main study, the instrument was subjected to a content validity test (Content Validity Index/CVI) by two experts, yielding an S-CVI/Ave value of 0.98, indicating that all questionnaire items had a very good level of relevance.

Table 1. Results Of the Content Validity Test

Content Validity Index	Nilai
S-CVI/Ave	0.98
S-CVI/UA	0.96

The content validity of of the the instrument instrument was assessed using the Content Validity Index (CVI). According to Davis (1992), an I CVI value of 0.80 indicates adequate validity for two raters Meanwhile, Polit and Beck (2006) as well as Lynn (1986), as cited by Anggara and Abdillah (2023) [16], state that an S-CVI value of 0.90 indicates a high level of agreement among experts regarding the instrument's relevance. Furthermore, the reliability test was conducted using Cronbach's alpha in IBM SPSS Statistics, yielding a value of 0.909, indicating that the instrument has very good internal consistency.

The questionnaire collected information on three main variables: injury severity, the location of the initial impact on the body, and the use of personal protective equipment or passive safety systems, which were grouped into four categories: seat belt only, airbag only, seat belt and airbag, and no personal protective equipment used. Injury severity was grouped into three categories: no injury, minor injury, and severe injury.

The sample size for this study was determined using the Lemeshow formula for an unknown population, which indicated a minimum required sample size of 96 respondents, with 4 additional respondents included as a reserve sample, resulting in a total of 100 respondents. The questionnaire link was distributed via social media platforms, including WhatsApp, Telegram, Facebook, and TikTok, ensuring that respondents came from across Indonesia. Before completing the questionnaire, respondents were provided with an explanation of the study's objectives, data confidentiality, and their right to discontinue participation if they were unwilling to do so. Respondents included in this study had to meet the following criteria: having experienced at least one car-to-car accident, being located in Indonesia, and completing the questionnaire in full. Respondents who had never been involved in a car-to-car accident, were not the driver at the time of the accident, or provided incomplete answers were excluded from the analysis. Verification of accident experience was conducted using screening questions at the beginning of the questionnaire, ensuring that only respondents who met the criteria could proceed.

Data analysis was performed using IBM SPSS Statistics Descriptive analysis was used to describe respondent characteristics and the distribution of each research variable Next, a cross-tabulation analysis was conducted to describe the distribution of injury severity based on the location of the first point of impact on the body and the use of passive safety systems The relationships between variables were then analyzed using the Chi-Square test. The results of this analysis were used to formulate recommendations for Advanced Driver Assistance Systems (ADAS) features that align with the identified injury characteristics.

3. RESULT AND DISCUSSION

3.1. Driver Injury Characteristics and Body Impact Location

Drivers who had been involved in a car-to-car collision indicated that the majority of respondent sustained minor injuries (52%), followed by those who sustained no injuries (36%), and those with severe injuries (17%). The distribution of injury severity based on the location of the first point of impact on the body is shown in **Figure 2.**

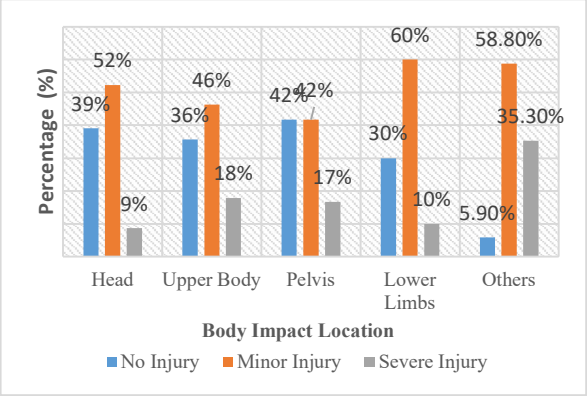

Fig 2. Distribution of Driver Injury Severity to Body Impact Location

A chi-square test was conducted to determine the relationship between the location of the first point of impact on the body and the severity of injury. The results of the analysis are presented in Table 1.

Table 1. Results of the Chi-Square Test: Driver Injuries vs. Body Impact Location

Analyzed Variables	***p-value***	Description
Body impact location × Injury severity	**0.026**	Significant

The results of the chi-square test indicate that there is a significant association between the location of the first impact on the body and the severity of injury ($p = 0.026$). These findings suggest that the body part that first sustains an impact is associated with the severity of injury experienced by the driver.

Impacts to the upper body were the most most common location of impact experienced by drivers, followed by impacts to the head lower body, and impacts to multiple body parts simultaneously These results indicate that the chest, shoulders, and head are the body parts most vulnerable to injury in car-to-car collisions.

From a biomechanical perspective, when a vehicle suddenly decelerates in a collision, the driver's body continues moving forward due to inertia. Although seat belts can restrain some of the body's movement, the head and chest may still strike the steering wheel, dashboard, or windshield if the impact energy is sufficiently high. This situation makes the head and upper body the most common sites of injury.

These research findings align with those of Abbas et al. [3] who explain that the majority of driver injuries occur during & "second collision" that is, when the driver's body strikes the vehicle's interior after the initial collision has occurred Additionally, Hariyani et al. (2023) [17] report that mild head injuries are among the most common types of injuries sustained by traffic accident victims.

These results indicate that the characteristics of the body impact location must be considered in the development of vehicle

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safety systems, as each body's part has a different level of vulnerability to impact energy.

3.2. *Passive Safety Systems and Driver Injuries*

The relationship between the use of passive safety systems and driver injury severity is presented in Figure 3.

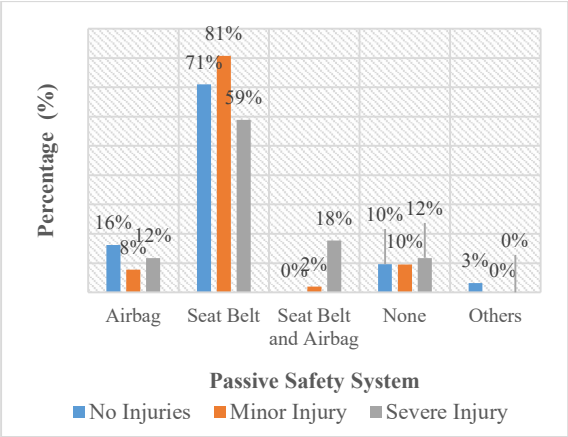

Fig 3. Passive Safety Systems and Driver Injury Severity

A chi-square test was conducted to determine the relationship between passive safety systems and injury severity. The results of the analysis are presented in Table 2

Table 2. Results of the Chi-Square Test: Passive Safety Systems and Driver Injury Severity

Analyzed Variables	***p-value***	Description
Passive safety systems × Injury severity	0.078	No significant association

Based on the chi-square test results, the relationship between the use of passive safety systems and injury severity is not statistically significant ($p = 0.078$). However, descriptively, respondents who used a combination of seat belts and airbags tended to experience less severe injuries than those who used only seat belts. These findings indicate a trend toward better protection when using a combination of both passive safety systems, although this relationship has not yet been statistically proven.

Biomechanically, seat belts work by prolonging the body's deceleration time, thereby reducing the force exerted on the body Airbags function by dispersing the impact energy over a wider area of the body. The combination of these two systems allows for a more even distribution of impact forces, potentially reducing the risk of more severe injuries.

The results of this study are consistent with the research by Kushari and Aniwattakulchai [18] which states that seat belts serve to restrain the driver's body movement during a collision and reduce the severity of injuries. That study also reported that proper seat belt use can reduce the risk of severe injury by approximately 40-60%. However, head impacts can still occur due to residual body movement during a high-energy vehicle collision. This condition may explain why some respondents in this study still sustained injuries despite wearing seat belts.

Ref. [19] state that seat belts prevent the head from striking the windshield, the chest from striking the steering wheel, and the pelvis from shifting forward during a collision Furthermore, the combined use of seat belts and airbags has been shown to reduce injury and fatality rates in car accidents compared to using only one of these safety systems. This finding is consistent with the study's descriptive results, in which respondents who used both seat belts and airbags tended to sustain fewer injuries than those who used only seat belts.

Ref. [20] also reported that the majority of drivers demonstrate good compliance with seat belt use and understand the importance of wearing seat belts under various driving conditions. Nevertheless, the results of this study indicate that injuries can still occur even when drivers have used passive safety systems. The lack of a statistically significant relationship in this study is likely due to the relatively small sample size and the uneven distribution of respondents across categories of passive safety systems, which reduced the test's statistical power. Therefore, further research with a larger sample size is needed to provide stronger evidence regarding the relationship between passive safety systems and injury severity.

These findings indicate that driver protection does does not rely solely on passive safety systems but also requires technologies capable of preventing collisions before impact occurs. Ref. [21] explain that the implementation of active safety technologies such as Forward Collision Warning (FCW) and Autonomous Emergency Braking (AEB) can help reduce the risk of accidents through early warnings and automatic braking By reducing the vehicle's speed before a collision occurs, the impact energy absorbed by the driver can be minimized, thereby optimizing the effectiveness of passive safety systems. Therefore, integrating passive and active safety systems is crucial to enhancing driver protection in vehicle-to-vehicle collisions.

3.3. *Passive Safety Systems and Body Impact Loxation*

The relationship between the use of passive safety systems and the location of the driver's first body impact is presented in Figure 4.

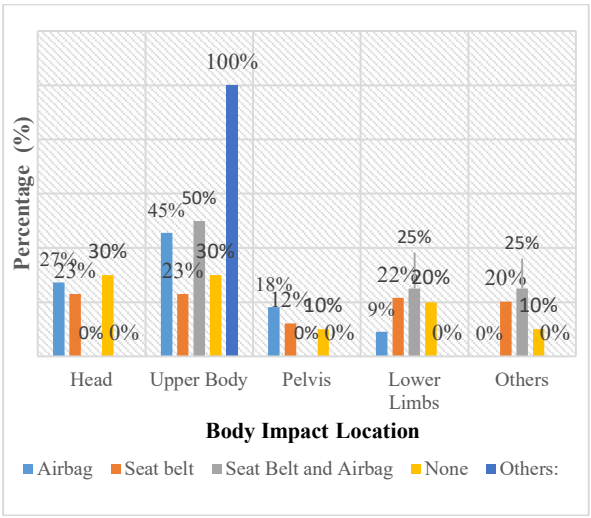

Fig 4. Personal Protective Equipment Based on Body Impact Location

A chi-square test was conducted to determine the relationship between passive safety systems and body impact locations. The results of the analysis are presented in Table 3.

Table 3. Chi-Square Test Results for Passive Safety Systems and Body Impact Location

Analyzed Variables	***p-value***	Description
Passive safety systems × Body impact location	0,001	Significant

The results of the chi-square test indicate a significant association between the use of passive safety systems and the location of the first impact on the body (p = 0.001). These findings suggest that the use of passive safety systems is associated with the impact patterns drivers experience during accidents.

Head and upper body impacts still occur among drivers who use seat belts, but the incidence of such impacts is relatively lower among respondents who use a combination of seat belts and airbags. Seat belts are designed to protect the chest, pelvis, and prevent ejection from the vehicle during a collision, while the head still tends to move forward. Consequently, head impacts car still occur, particularly in high-speed collisions. Airbags serve to reduce the risk of injury to the head and chest. This indicates that passive safety systems help reduce the risk of injury but are not yet fully capable of preventing impacts to specific body parts during a collision.

These findings align with those of Abbas et al. [13] who explain that seat belts are designed to restrict the driver's body movement, thereby reducing impact between the body and the vehicle's interior. Nevertheless, passive safety systems reduce the severity of injuries but cannot fully eliminate the risk of injury to specific body parts. Therefore, driver protection requires active safety systems that reduce the likelihood of a collision.

3.4. Recommendations for Active Safety Systems

To bridge the gap between empirical statistical findings and safety technology recommendations, this study developed an analytical framework based on the injury mechanism pathway. The selection of Advanced Driver Assistance Systems (ADAS) technologies was not done generically but was mapped based on three key findings from the Chi-Square test:

Table 4. Selection of ADAS Features Based on Empirical Findings on Injury Characteristics and Collision Mechanisms

Main Data Findings	**Risk & Mechanism**	**Recommended ADAS**	**Advantages**
Limitations of Passive Systems • p = 0.078 (Passive safety systems vs. injury severity were not significantly associated). • Severe injuries remained high among seat belt users (59%) and airbag users (12%).	Vehicles collide at high speeds. Excessive impact forces can no longer be fully absorbed by seat belts or airbags.	1. **Autonomous Emergency Braking (AEB):** Automatically applies braking when the vehicle ahead stops suddenl 2. **Forward Collision Warning (FCW):** Provides early warnings when the distance between vehicles becomes too close. 3. **Intelligent Speed Assistance (ISA):** Prevents vehicles from exceeding safe speed limits.	The data indicate that the main issue is vehicle speed and high impact forces. AEB, FCW, and ISA directly reduce vehicle speed before a collision occurs.
Head and Chest as the Most Frequent Impact Locations • p = 0.001 (Passive safety systems vs. body impact location showed a significant association).	The driver's body is subjected to strong forward movement during impact.	**Proactive Passenger Protection System (PPS):** Automatically tightens the seat belt several milliseconds before a collision occurs to restrain the occupant's body position.	PPS specifically functions to protect the driver's chest and head by reducing excessive body movement and preventing contact with the steering wheel.
Impact Location and Injury Severity Relationship • p = 0.026 (Body impact location vs. injury severity showed a significant association).	Severe impacts in vital areas (head and chest) become the main causes of serious injuries among drivers.	• **Driver Monitoring System (DMS):** Monitors drivers who are drowsy or distracted. • **Lane Keeping Assistance (LKA):** Helps keep the vehicle within its lane. • **Blind Spot Monitoring (BSM):** Monitors blind spots around the vehicle.	Features such as LKA and BSM help prevent vehicles from deviating from their lanes and assist drivers in maintaining vehicle control on the road.

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3.5. Research Limitations

This study has several limitations that need to be considered wher interpreting the results. Data were collected via an online questionnaire administered through Google Forms, which may introduce recall and self-report biases. Nevertheless, the research instruments underwent validity and reliability testing and the number of respondents met the minimum sample size based on the Lemeshow formula.

4. CONCLUSION

This study shows that driver injuries in car-to-car accidents in Indonesia are dominated by minor injuries (52%), followed by non-critical injuries (36%), and severe injuries (17%). The use of passive safety systems (seat belts and airbags) was not statistically significantly associated with injury severity ($p = 0.078$). The proportion of drivers sustaining severe injuries remained high even among those who used seat belts (59%) of airbags (12%), demonstrating the limitations of passive safety systems in mitigating the impact of severe collisions.

Nevertheless, passive safety systems were significantly associated with the body location of impact ($p = 0.001$). The most common initial impact sites were the upper body/chest and the head. Since the impact location in these vital areas was found to be significantly associated with injury severity ($p = 0.026$), driver protection strategies need to be enhanced from merely absorbing the impact during the crash (in-crash) to active prevention before the collision occurs (pre-crash).

Consequently, the ADAS technologies prioritized as primary solutions are Automatic Emergency Braking (AEB), Forward Collision Warning (FCW), Intelligent Speed Assistance (ISA) and the Proactive Passenger Protection System (PPS). These features work directly to reduce speed, absorb collision energy and tighten body restraints before impact occurs, thereby drastically reducing the impact load on the chest and head. Meanwhile, Lane Keeping Assist (LKA), Blind Spot Monitoring (BSM), and Driver Attention Monitoring (DAM) are positioned as supporting features.

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