AUTOMOBILES AND SAFETY

1 Introduction

The number of fatalities within 24 hours of a traffic accident in 2022 was 2,610, the lowest total since the statistics were first maintained in 1948 for a sixth consecutive year. Nevertheless, Japan has a higher percentage of pedestrian and cyclist fatalities among vulnerable road users than other countries, as well as frequent accidents stemming from mistakes by elderly drivers. These circumstances continue to present a bleak outlook on achieving the government target of reducing fatalities to 2,000 or less by 2025. Achieving that target will require intensified cooperation between the public and private sectors, as well as the accelerated adoption of concrete integrated three-part measures that incorporate pedestrians, drivers, and the society.

2 Accident Trends and Measures

2. 1. Traffic Accident Trends

Annually, the number of traffic accident fatalities (within 24 hours of the accident) peaked at 16,765 in 1970, before falling to 8,466 in 1979 following a range of measures to enhance safety. Traffic accident fatalities then began to trend back upward, peaking again at 11,452 in 1992. Since the year 2000, the number of fatalities saw an increasingly gradual drop, reaching 4,113 in 2014. In 2015, fatalities rose to 4,117, a first increase in 15 years. However, in 2022, that number decreased by 1.0% from the previous year to 2,610, reaching the lowest number for a second consecutive year since statistics were first maintained in 1948. The number of traffic accidents and injuries (including fatalities) has fallen since reaching a peak in 2004. In 2022, the number of injuries was 356,601, 1.5% less than in the previous year, and the number of traffic accidents was 300,839, a 1.4% decrease compared to the previous year (Fig. 1).

The characteristics of fatal traffic accidents in 2022 are presented below.

(1) Number of Fatalities per Road User Status

The total of 2,610 fatalities in 2022 breaks down to 955 pedestrian fatalities (up 1.5% from the previous year, 36.6% of the total), 870 fatalities when riding inside a vehicle (up 1.2% from the previous year, 33.3% of the total), and 339 while riding a bicycle (down 6.1% from the previous year, 13.0% of the total). Although the number of fatalities has decreased by about 40% over the past 10 years, their proportions have remained almost unchanged, indicating that vulnerable road user fatalities are still high at about 50% (Fig. 2). Moreover, the number of pedestrian fatalities rose compared to the previous year for the first time since 2015. Despite that slight increase in pedestrian fatalities, pedestrian and cyclist deaths have trended downward over the previous five years. This is attributed to the effectiveness of people–vehicle–society integrated three-part safety measures such as initiatives to encourage pedestrians and cyclists to follow the rules of the road, the increased adoption of pedestrian- and cyclist-aware collision mitigation braking systems, and ongoing road infrastructure improvements.

(2) Number of Fatalities per Age Range

Breaking down traffic accident fatalities by age (Fig. 3) shows that there were 1,471 fatalities of people aged 65 or older in 2022, amounting to 56% of the total. These fatalities have exceeded half of the total every year since 2012. By status, elderly people 65 or older accounted for 48.0% of pedestrian fatalities, more than double the 21.9% for people under 65. Elderly people 65 or older also accounted for 63.0% of pedestrian and cyclist fatalities, indicating that a high proportion of victims consists of elderly vulnerable road users (Fig. 4). At the same time, the absolute number of vehicle occupant fatalities among the elderly is also high, and there is an urgent need for integrated three-part safety measures.

2. 2. Traffic Accident Measures

In March 2021, the Japanese government introduced the *Eleventh Fundamental Traffic Safety Program*, which

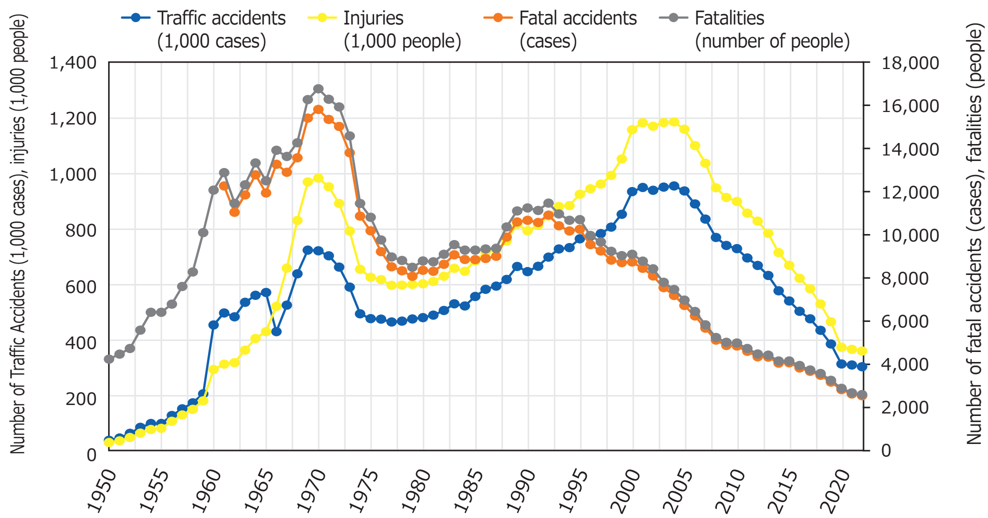

Fig. 1 Number of Traffic Accidents, Injuries, Fatal Accidents, and Fatalities

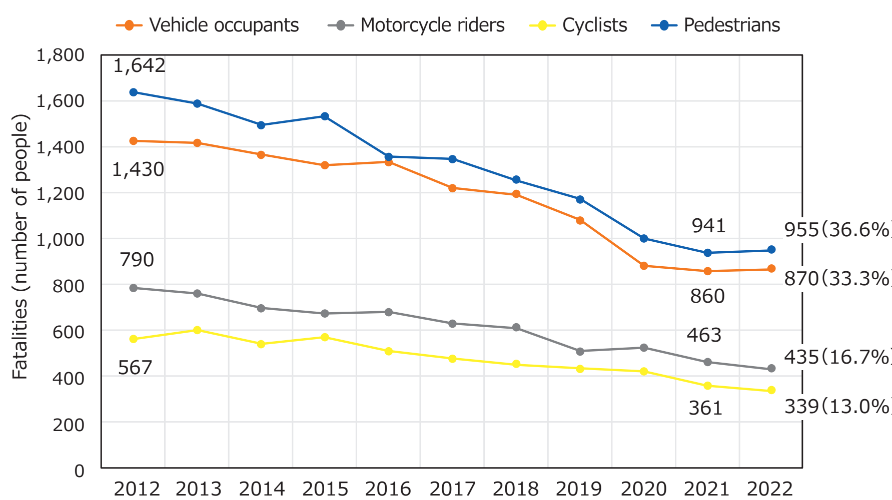

Fig. 2 Fatalities per Road User Status

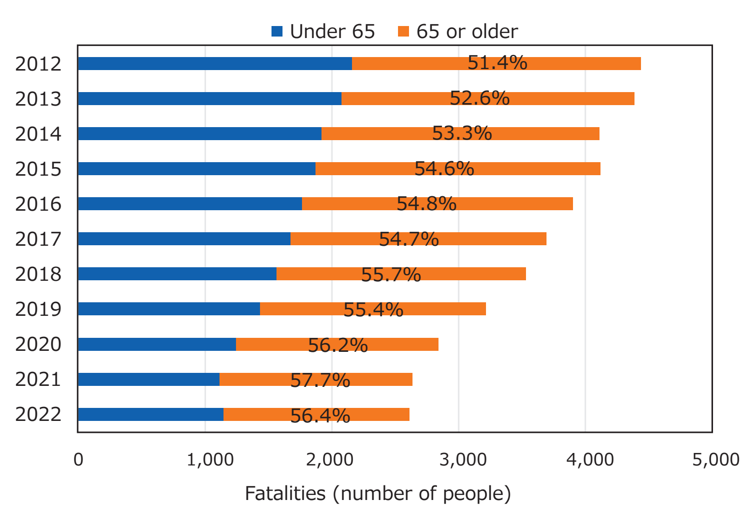

Fig. 3 Breakdown of Traffic Accident Fatalities by Age Group

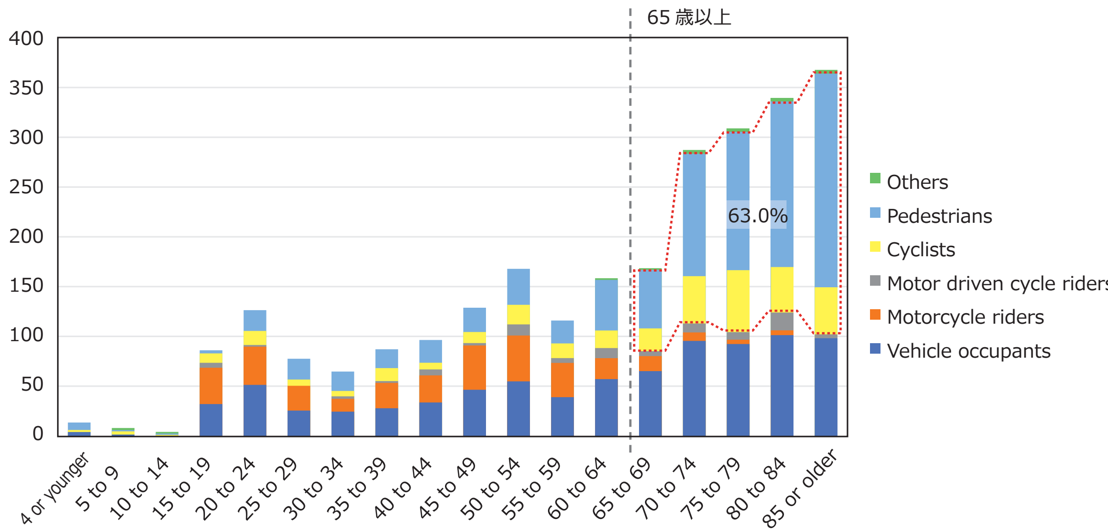

Fig. 4 Fatalities Per Age Range and Road User Status

included targets to realize the world's safest road traffic environment, reduce the number of traffic accident fatalities within 24 hours of the accident to 2,000, and reduce the number of traffic accident fatalities and injuries to 22,000 by 2025. Following up on that program, the MLIT released the *Vehicle Safety Measures for Building a Society Free from Road Traffic Accidents* report in June 2021. These measures take a long-term perspective on vehicle safety and set the ambitious goal of aiming to eliminate, around 2035, all fatal accidents that are caused by newly released vehicles and can be addressed using automobile technology. The four pillars of those measures are described below. This section gives an overview of the four pillars and describes the attendant initiatives. Trends concerning vehicle assessments and the progress of those initiatives are covered in Section 2.3.

(1) Ensuring Pedestrian, Cyclist and other Road User Safety

In the road traffic environment, pedestrians and cyclists find themselves in a more vulnerable position than vehicles or other forms of mobility. Many fatal pedestrian accidents occur at night. The most common accidents involve a vehicle driving straight colliding with a pedestrian crossing the road, while the next most common accidents are right turns at intersections, followed by left turns at intersections. This means vehicles should recognize or detect pedestrians early, even at night, and avoid a collision. On top of that, the key to next-level safety measures, will be to find ways to reduce collision speed to reduce fatalities or the degree of serious injury, even when a collision is unavoidable. Consequently, automakers are developing and deploying technologies such as advanced headlights that automatically use high-beams and quickly alert the driver to pedestrians and cyclists at night, as well as collision mitigation braking systems with a broader scope of detection and response scenarios.

(2) Ensuring Vehicle Occupant Safety

In an aging society with a declining birthrate, it is important to ensure the safety of children and the elderly. Among the elderly, the gradual loss of human tissue resilience that accompanies aging increases the risk of death or injury in an accident and leads to a higher percentage of fatal chest injuries. Consequently, automakers are working to develop airbags, seat belts, and other restraint system technologies, as well as to optimize load setting and develop adaptive control.

(3) Preventing Serious Accidents to Emphasized in Light of Social Circumstances

Severe accidents with a strong social impact include those caused by elderly or other drivers who make driving errors such as inappropriate steering operation or pressing the wrong pedal. Automakers have been deploying technologies that detect erroneous operations by detecting objects ahead or behind using cameras, sonar, or other sensors, as well as enhancing the functions of those technologies, to address the issue of pedal misapplication. For its part, the government has begun formulating safety standards for technologies related to pedal misapplication at the World Forum for Harmonization of Vehicle Regulations (WP.29) of the United Nations Economic Commission for Europe. At the same time, the government started accepting applications for driver's licenses only valid for "safety support cars" in May 2022 as part of its measures against traffic accidents involving elderly drivers. This license exclusive to safety support cars only allows driving ordinary motor vehicles equipped with safe driving support technologies (safety support cars). It is hoped that the number of people making use of this system will increase.

(4) Promoting the Utilization and Appropriate Use of Automated Driving-Related Technologies

It is essential for all drivers to correctly understand the purpose and limits of driving safety support devices, and use them appropriately, to proactively prevent traffic accidents. The seventh phase (2021 to 2025) of the Advanced Safety Vehicle (ASV) government-industry-academia project to developed advanced safety vehicles (ASVs) has defined "the further promotion of ASVs in anticipation of advances in automated driving" as a key theme. The following four points form the basis for assessments of technical requirements, basic design, and other elements: (a) defining an effective strategy to promote the correct understanding and use of existing ASV technologies that are now available to anyone, (b) evaluating how and when safety technologies should prioritize system operation over driver operation, (c) studying shared specifications for the commercialization and broader adoption of safety technologies that make use of communication and maps, and (d) finding ways to explore the scope and level of safety to install in automated vehicles.

2. 3 Vehicle Safety Assessment Trends

Vehicle safety assessments are seen as a means of accelerating the development and spread of safety technology. Vehicle safety assessments are not only carried out in Japan, the U.S., and Europe, but also in China, the ASEAN nations, and Latin America. Test items are revised and evaluations are expanded on a regular basis. Trends in Japan and around the world are presented below.

(1) Trends in Japan

Since 2022, the active safety performance evaluations of the Japan New Car Assessment Program (JNCAP) have included a bicycle collision damage mitigation brake performance evaluation. Similarly, the existing evaluation applying to vehicles in the pedal misapplication acceleration suppression device tests and evaluations will be complemented with an evaluation applying to people in 2023. In passive safety performance evaluations, new pedestrian leg protection evaluation tests based on a moving progressive deformable barrier (MPDB) test, a new frontal impact occupant protection performance evaluation using a THOR dummy, and a next-generation advanced pedestrian legform impactor (aPLI) test are under assessment and are all scheduled to begin in 2024.

(2) Global Trends

The Euro NCAP (ENCAP), which was introduced as the world's most advanced vehicle assessment program and has influenced assessments in other regions, is scheduled to receive large-scale modifications to its evaluation methods and items in 2023. A child presence detection (prevent leaving children unattended) evaluation, as well as evaluations for motorcycle-compatible AEB, oncoming vehicle-compatible AEB, and driver state monitoring that detects distraction or fatigue, will be added. A roadmap for a large-scale revision plan for 2026 and later has also been presented. The Insurance Institute for Highway Safety (IIHS) will be adding evaluations a new side impact occupant protection performance test with a higher moving deformable barrier (MBD) weight and AEB that recognizes pedestrians at night to the requirements for the 2023 TSP and TSP+ awards.

3 Research and Technology Related to Active Safety

In Japan, pedal misapplication by elderly drivers and major accidents caused by driver health issues have become social issues that draw significant interest from the general public. The section on ensuring vehicle safety in the *Eleventh Fundamental Traffic Safety Program* notes that "the succession of accidents caused by elderly drivers, as well as securing the safety of children, are both urgent issues" and discusses "making advanced safety technologies more expansive through further adoption, advances, and other enhancements". These statements highlight the view that not only the growth, but also the broader deployment, of active safety technologies and automated driving technologies are crucial. Automakers, as well as universities and other research institutions, have focused on advancing research and development in those areas, and many trends were noticeable in 2022.

3. 1. Active Safety Technology Trends

Automakers are working to increase deployment to an expanded range of models by enhancing the performance of collision mitigation braking systems and pedal misapplication acceleration suppression devices, extending their applicable range, and reducing costs. On May 13, 2022, the National Police Agency introduced the safety support car-only driver's license to boost measures against accidents mainly involving elderly drivers. This license is only valid for vehicles equipped with a collision mitigation braking system and a pedal misapplication acceleration suppression device, and drivers can switch to this license upon request. In 2023, acceleration suppression tests for pedal misapplication relative to people will be added to the active safety performance evaluation scenarios as part of the intensifying adoption of measures against critical accidents.

Emergency driving stop systems, which slow down and stop the vehicle when the driver becomes incapacitated, are gradually becoming more common. Sales of heavy-duty sightseeing buses equipped with such systems began in July 2018, and they are now installed in passenger cars and minivan available at mass-market price points. In addition, high road safety expectations are placed on research and development of a system capable not only of slowing down and stopping the vehicle, but also of automatically moving to the road shoulder.

3. 2. Automated Driving Technology Trends

The *Public-Private ITS Initiatives & Roadmap*, a Japanese government-wide strategy regarding ITS and automated driving, was formulated in 2014. The June 15, 2021 revision laid out a vision for mobility in 2030 based on the changes in the social environment brought about by the COVID-19 pandemic. This resulted in announcing the goal of "realizing the world's first digital transportation society offering a high level of convenience stemming from safety that supports a prosperous live for its citizens". This will be achieved not only through the development of automated driving technologies, but also by coordinating applicable programs, infrastructure building, MaaS and related data, continuing to generate new value, and entrenching mobility services in the day-to-day lives of people in a manner that contributes to solving social issues involving mobility.

The Strategic Innovation Promotion Program (SIP) held the third SIP-adus field operational test project test ride event in the Tokyo Rinkai area from September 29 to October 1, 2022. Automakers, suppliers, universities and other organizations participated in the event, which featured 20 test ride vehicles equipped with the latest automated driving technologies, as well as ten exhibition vehicles. Aimed at encouraging the formulation of technical specifications in cooperative areas, standardization, and accelerated infrastructure building, as well as fostering social acceptance of automated driving, the event provided an opportunity to experience how test ride vehicles drive under real world traffic conditions.

On the legislative front, international standards on automated driving systems (Level 3) were established in June 2020. The following November, automated vehicles (Level 3) received the Ministry of Land, Infrastructure Transport and Tourism type approval for the first time. At the same time, automakers have led the way in proposing Level 2 international standards, and discussions are being held by the Working Party on Automated/Autonomous and Connected Vehicles (GRVA) and other bodies. Level 2 driving support systems are already available in many markets. The ability to use equipment that differs little from that of existing vehicles lowers their cost compared to Level 3 systems. This is expected to lead to greater adoption of mass-market price Level 2 vehicles, reduced driving burden for a greater number of drivers and a reduction in traffic accidents.

In Japan, the revised Road Traffic Act comes into effect in March 2023, and there are plans to allow Level 4 automated driving on public roads, with the goal of making automated driving services available at 40 or more locations around 2025, and 100 locations by 2030. Such services are expected to help solve the driver shortage, reduce labor costs, and provide transport for the elderly in regions with limited public transportation.

4 Research and Technology Related to Post-Accident Safety

There has been a clear decrease in accidents resulting in death or fatal injuries over the last several years thanks, perhaps, to the remarkable advances in active safety technologies and the success of assessments, safety support cars, and other measures in making safety technologies more widespread. At the same time, many issues remain unresolved. Accidents involving high speeds, for example, stand out among real world accidents. The shorter recognition and reaction time at higher speeds also makes it difficult for active safety technologies to respond to situations. Consequently, despite active safety decreasing the total number of accidents, severe accidents continue to occur. Similarly, it is difficult for active safety technologies in a vehicle to counteract accidents caused by another vehicle. Therefore, it is as necessary as ever to continue expanding the areas covered by passive safety and emergency notification systems.

4. 1. New Test Methods and Measurement Devices

Two broad changes in approach can be observed in assessments and other test methods.

One is responding to severe situations. The IIHS side impact 2.0 test is one example. In an attempt to reproduce real world accidents, the side impact 2.0 test modified the MDB from 55 km/h and 1,500 kg to 60 km/h and 1,900 km/h. Test results are gradually being released, and only a few vehicles have obtained the top rating of *Good*. At the same time, the IIHS frontal offset impact test now includes an injury evaluation using a rear passenger dummy and stringent criteria. An x sensor has been added to the occupant evaluation part of the rear seat evaluation. The x sensor measures the height of the seat belt and is anticipated to provide evaluations that more closely damage to the human body by compensating for the chest deformation caused by dummy characteristics.

The other change involves adapting to the diversity of occupants. In the JNCAP and ENCAP, focusing on fatalities and severe injuries in accidents matching the conditions in current assessments and regulations has led to evaluating revisions to test conditions. In such cases of severe damage, the decreased tolerance of elderly people as they age, as well as variations in how individual occupants are affected due to differences in physique. In Japan, attention on chest injuries among the elderly have brought a possible revision of the full overlap frontal impact test speed under consideration. These changes stem from observations of real world conditions that indicate the high repeated seat belt loads adapted to strict evaluation requirements actually end up negatively affecting chest protection for elderly people. Additionally, the introduction of a new MPDB that includes occupant protection indices for the other vehicle in a mutual collision are being considered for the JNCAP. The MPDB is an evaluation involving setting both a modified MDB and the test vehicle in motion and having them collide. The concept of using the deformation of the sled honeycomb and evaluating deceleration characteristics as an index of damage inflicting characteristics is under assessment. Similarly, the 2030 roadmap for ENCAP hints at versatile occupant evaluations that make use of virtual evaluations. Monitoring of the far-side (protecting occupants on the side opposite the collision) impact test will begin in 2024 and the evaluation will begin in 2027. Furthermore, the introduction of an evaluation that factors in differences in physique using a finite element human body model (HBM) in 2029 is under consideration.

Standing out among changes involving measuring instruments in other test methods is the trend toward ISO standardization of the aPLI-based pedestrian protection leg test. The aPLI brings improvements to the impactor behavior after a collision, enabling the evaluations of SUVs and other vehicles with a high bumper bottom edge positions that were not possible with the previous flexible pedestrian legform impactor (flex-PLI). Efforts to establish ISO standards for the damage risk curve and aPLI certification method are underway to broaden the use of the aPLI as an effective evaluation method.

4. 2. Protection Systems

Airbags, known to everyone as a means of protecting occupants in a collision, continue to evolve to this day, over 100 years since the first patent was registered. New recent changes are the installation of rear seat airbags and of far-side airbags that deploy near the center of the vehicle to mitigate collisions between occupants. The demand for occupant detection has been prominent among changes not involving airbags. In 2022, a succession of incidents where small children were forgotten in a shuttle bus created an urgent need for measures to detect occupants in rear seats. Making the installation of safety systems in shuttle buses mandatory is under consideration, a fact that led to formulating the *Guidelines Concerning Safety System Specifications* in December. Informing consumers about whether ordinary vehicles are equipped with an occupant detection function is being assessed. In other areas, deceleration in systems such as automatic emergency brakes, control that makes use of active safety system detection functionality to help protect occupants in a collision, and various other future-oriented possibilities are being considered in the context of the entire passive and active safety spectrum.

4. 3. Automatic Accident Notification Systems

One major change in terms of post-accident safety has been the spread of systems that automatically send a notification after an accident. Automatic accident notification systems cover all steps from transmitting accident data from the vehicle immediately after the accident to operators calling back and, depending on the scope of the accident, dispatching medical helicopters or other assistance. Every minute and second between the time the accident occurs and the start of medical treatment has a direct impact on survival rates, and such systems therefore play a critical role in protecting people who suffered an injury. In Japan, the number of vehicles equipped with the D-Call Net automatic accident notification system reached 4.17 million as of December 2022, a rapid pace of adoption that reflects the high demand among the public. Expanding the D-Call Net emergency notifications to cover pedestrians and cyclists is also under consideration. In collisions with a pedestrian or cyclist, the driver is often unharmed and able to report the accident. However, in many cases, the victim is seriously injured and automatic notification is anticipated to shorten the time before treatment begins, and lead to higher survival rates.

References

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