K. Okamura, S. Ito
Institute for Traffic Accident Research and Data Analysis, Tokyo, Japan

Pedestrian Road Accidents in Japan

Abstract

This report gives an overview of pedestrian accidents on Japanese roads. Database used for the analysis is national traffic accident data based on police reports. Relevant measures and background information ranging from vehicle safety, engineering and education are briefly reviewed, and area for further improvement is discussed.

Background

In 2003, 2,332 pedestrians were killed (within 24 hours) and 85,592 were injured on Japanese roads. Pedestrian deaths represent 30% of all traffic accident deaths, the second largest category next to 4-wheeled motor vehicle occupants. For the last ten years, pedestrian deaths have been declining, but pedestrian injuries have been increasing by about 7% during the same period.

Road accident is the biggest cause of accidental deaths among children. Injury while walking is therefore also the biggest concern for child health, but it is not necessarily perceived as such. Pedestrian death, on the other hand, is often considered to be a specific problem of older people, due to the fact that 64% of fatally injured pedestrian are 65 years of age and over. It seems generally to be agreed that children and older people are the main safety target given their limited choice of transport mode other than walking due to low driving licence holding rate, immature traffic skills or physical frailty in old age. However, injury to adult pedestrians is equally important: adults account for the largest proportion of pedestrian injuries and vehicle safety measures are often based on scientific data assuming mostly adult pedestrian accidents.

Purpose and Medthod

This report aims to describe overall characteristics of pedestrian road accidents in Japan, by presenting tabulations and diagrams of selected variables from traffic accident data from 2001 to 2003. Relevant measures are briefly reviewed and area for further improvement is discussed.

National traffic accident database based on police reports is used. This database, owned by Institute for Traffic Accident Research and Data Analysis (ITARDA), has an extra set of variables linked to this. This includes vehicular details, which this report utilises. The database contains all accidents resulting in death or injury on public roads, including non-motor vehicle accidents, namely bicycle-pedestrian accidents, but do not contain pedestrian-only accidents.

Results from Accident Data

Accident Involvement and Fatality Rate by Sex and Age

As pedestrian exposure data are unavailable, relative accident risk of pedestrian is often expressed as population-based figures. As shown in table 1, risk

		Age group 6 & under	7-12	13-19	20-29	30-39	40-49	50-59	60-64	65-69	70-79	80+
Fatally injured	Male	0.93	0.49	0.25	0.58	0.67	1.07	2.08	2.98	3.73	4.92	10.96
	Female	0.28	0.43	0.09	0.20	0.13	0.29	0.83	1.59	2.67	6.10	10.56
Injured	Male	129.51	183.38	42.82	55.50	52.70	50.13	56.89	92.36	66.76	67.40	74.24
	Female	66.01	105.46	49.65	49.08	38.81	36.68	52.26	69.92	88.01	110.03	99.43

Tab. 1: Fatally injured or injured pedestrians per 100,000 population by sex and age group in 2003

	Age group 6 & under	7-12	13-19	20-29	30-39	40-49	50-59	60-64	65-69	70-79	80+
Male	0.71	0.26	0.57	1.03	1.25	2.09	3.53	4.56	5.29	6.80	12.86
Female	0.42	0.40	0.17	0.42	0.34	0.79	1.55	2.22	2.95	5.25	9.60
A fatality rate denotes fatally injured divided by fatally or non-fatally injured											

Tab. 2: Fatality rate in percentage by sex and age group in 2003

of death for pedestrian per 100,000 population is markedly high for older men and women, whilst injury risk is particularly high for boys, followed by older women and girls. Fatality rates shown in table 2 indicate that once involved in an accident older people are much more likely to die compared with younger people and that also the fatality rate is lowest for children/teenagers and rises sharply with increasing age.

Road Traffic Environment

Type of Road and Level of Injury

Eighty-two percent of pedestrian accidents occur in built-up area, 58% in densely inhabited area. Type of road may be a usable variable to express road use of casualties in relation to vehicle speed. Of this variable, 'national/prefecture (N/P) roads' and 'municipal roads' cover about 90% of where pedestrian accidents occurred. N/P roads include most arterials except for motorway and tend to be wider, sometimes multiple-lane, whereas municipal roads tend to be narrower and include many residential streets with lower speed limits of 20-40km/h. Classification based on type of road does not always coincide with these features. Nevertheless, it can be used for describing characteristics of places pedestrians may be moving about and consequences of accident. Table 3 shows the distribution of pedestrian casualties by age group[1] and type of road, plus fatality rate. Among killed/injured pedestrians, children are over-represented in accidents on municipal roads compared with adults and older people. Older pedestrians are slightly over-represented in N/P road accidents compared with adults. Fatality rate is 2.5 to 4 times higher on N/P roads than on municipal roads. Fatality rate of older pedestrians on N/P roads is strikingly high with 11%.

	Killed or injured			Fatality rate (%)		
	12 & under	18-49	65 & over	12 & under	18-49	65 & over
N/P road	13,408	25,894	27,640	1.0	2.0	11.0
Municipal road	40,184	41,261	33,247	0.4	0.5	3.9
Ratio of municipal to N/P	3.0	1.6	1.2			
N/P road means national or prefecture roads						

Tab. 3: Pedestrian casualties and fatality rate by type of road 2001-2003

Type of Road and Estimated Vehicle Speed

Estimated vehicle speed just before crash is investigated by the police and incorporated into the national database. This variable denotes travelling speed just before the driver recognises the hazard, and is often based on testimony. Despite arguments about its preciseness, it is

1 Children 12 years old and under include all pre-school and primary school pupils in Japan. After this age group, travel mode changes as well as accident involvement as pedestrian. Age group of 18-49 is to represent relatively younger adults.

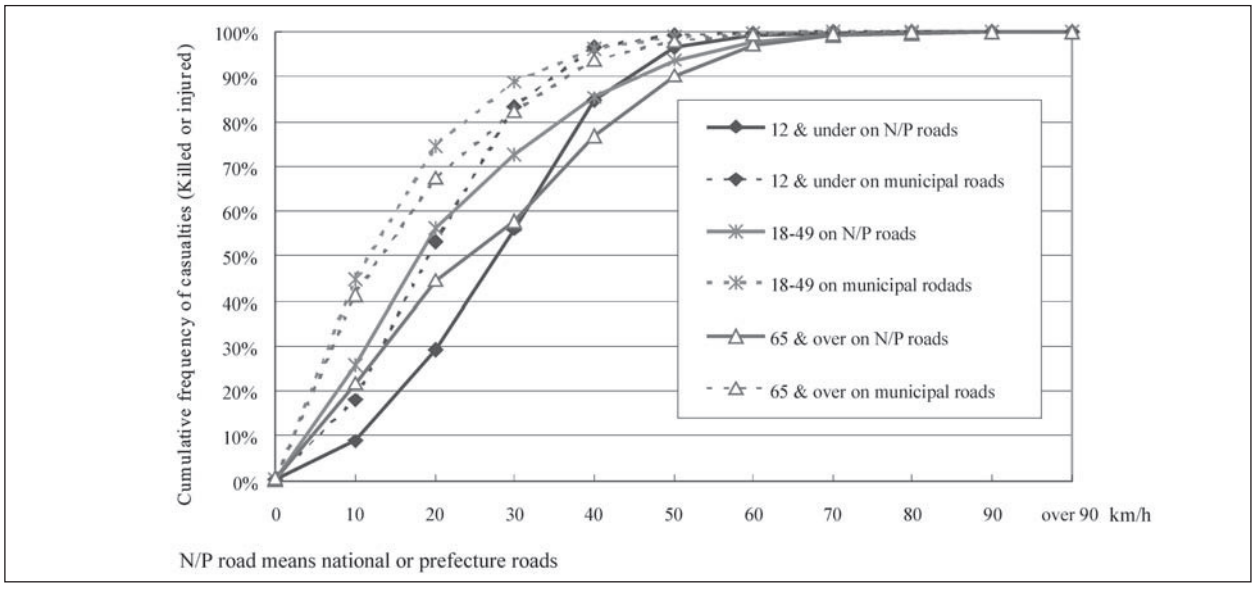

Fig. 1: Estimated vehicle speed just before crash when pedestrians were killed or injured by age group and type of road 2001-2003

useful to compare overall speed distribution. figure 1 shows estimated vehicle speed by type of road where pedestrians were killed or injured. For all three age groups, vehicles tended to travel slower on municipal roads compared with N/P roads. Adults were involved in accidents at slightly lower speed compared with older people on both N/P and municipal roads, whilst children were involved in accidents at higher speed than adults or older people (with the exception of 30km/h and above). At 50th%-tile level, children were involved in accident at about 8km/h faster speed on municipal roads, and about 10km/h faster on N/P roads compared with adults.

Vehicle speed just before crash was lower in accidents which occurred on municipal roads than on N/P roads. Lower fatality rate of child pedestrians may be relevant with children's over-representation in municipal road accidents. Adults tended to be involved in accidents at lower speed compared with older people below 30km/h. This probably is explained by a lower fatality rate of adults than that of older people. Older people's over-representation in N/P road accident and faster vehicle speed may contribute to elevated fatality rates among this age group.

Crossing Accident or not

About 60% of pedestrian accidents occur while pedestrians are crossing the road. Table 4 details crossing and no crossing accidents by age group.

For all age groups, 'intersection accidents' and 'no intersection accidents' account for 50% and 43% respectively. Of 'intersection accidents', 78% were crossing accidents. Of 'no intersection accidents', just 45% were crossing accidents. Of 'crossing accidents at/near intersections', about 70% occurred at crossings, and about 70% of them occurred at light-controlled intersections. Of 'crossing accidents not at intersection', 86% occurred where there were no pedestrian crossings.

There is a marked difference between age groups. Children were over-represented in crossing accidents outside pedestrian crossings and intersection (29.3% of this age group), whereas a higher percentage of adult pedestrians was involved in 'no crossing accidents' not at intersections (28.1%). Older pedestrians were more likely to be involved in crossing accidents outside crossings compared with adults (14.1% at/near intersection, 15.9% not at intersection). Both adults and older pedestrian accidents are similar in that higher percentages of them were involved in accidents while crossing within crossings at/near light-controlled intersections, representing 23.3% and 20.7% of each group.

			All ages (n = 254,058)	12 & under (n = 56,513)	18-49 (n = 74,547)	65 over (n = 65,801)
At/near intersection	Crossing within crossing	Light-controlled	19.4	10.2	23.3	20.7
		No traffic light	7.7	8.9	6.1	8.5
	Crossing outside crossing	Light-controlled	1.4	1.1	1.4	1.6
		No traffic light	10.7	13.8	7.6	12.5
	No crossing accident	Light-controlled	2.5	1.1	3.5	2.1
		No traffic light	8.4	8.6	9.2	7.7
No intersection	Crossing within crossing	Light-controlled	0.4	0.5	0.3	0.4
		No traffic light	2.4	3.9	1.5	2.5
	Crossing outside crossing	Light-controlled	0.1	0.1	0.1	0.1
		No traffic light	16.6	29.3	10.2	15.8
	No crossing accident	Light-controlled	0.1	0.1	0.2	0.1
		No traffic light	8.4	8.6	9.2	7.7
Other (railway level crossing/parking etc.)			6.5	4.4	8.3	6.3

Column percent.
Near intersection means within 30 metres from intersection.
Rows surrounded by broken line are crossing accidents.

Tab. 4: Accident classification in percentage by pedestrian age group, 2001-2003

Vehicle-Pedestrian Behaviour Prior to Accident

Manoeuvre of Vehicle

Sixty-five percent of vehicles that hit pedestrians were passenger cars, followed by goods vehicles (19%), two-wheeled motor vehicles (9%) and bicycle (2%). Table 5 outlines manoeuvre of vehicle that hit pedestrians. About 90% of two-wheeled motor vehicle were going straight when they hit pedestrian irrespective of pedestrian age group. When focused on passenger car and goods vehicle, most child pedestrians were hit when the vehicles was going straight, whereas lower percentages – just 43-50% of adult/older pedestrians were hit by a vehicle going straight. In adult/older pedestrian accidents, right-turning or reversing manoeuvre is distinctively more frequent. The higher percentage of vehicle going straight in child pedestrian accidents is well explained by their typical crossing accidents where there is no intersection. The higher percentage of right-turning vehicle in adult/older pedestrians is well in line with the higher incidence of crossing accidents at/near intersections.

Violation of the Law

As already described, the typical pattern of child pedestrian accidents is, "children are crossing outside intersection and crossing, and are hit by a vehicle going straight" (pattern I). Accidents of adults and older pedestrians are a little more varied, but if focused on crossing accidents, can be represented by two scenarios: pedestrians are crossing at/near intersection and hit by a vehicle going straight (pattern II), and pedestrians are crossing at/near intersection and hit by a right-turning vehicle (pattern III).

Police data have a variable 'violation of the law' for each party, as what they identified to be the major violation leading to accident causation. figure 2 shows the combination of major violations by both driver and child pedestrian in accident pattern I. Figure 3 shows major violations by both adults and older pedestrians and vehicle that hit them in accident pattern II. Figure 4 shows pattern III of both adults and older pedestrian accidents.

Figure 2 indicates that a significant number of children darted out, and drivers failed to carry out 'general duties of safe driving' (such as applying appropriate speed, to be alert to possible hazard and making proper judgement). Figure 3a shows that frequent violations by adult pedestrians are red-light running, improper crossing, or crossing while being masked by vehicle. Violations by drivers who hit adult pedestrians are mostly related to 'general safe driving duties'. Figure 3b shows that there were fewer red-light running by older pedestrian, whilst there were more 'not giving way to pedestrian' or 'red-light running' violations by drivers. Figure 4a and figure 4b show very similar patterns: very few pedestrians were found to have violations, but many drivers did not give way to pedestrians or failed to carry out general safe driving duties when turning right at intersection.

These results are summarised as follows. In crossing accidents of children that occurred outside intersections, children darted out and drivers did not fulfil general duties necessary to avoid an accident. In at/near intersections crossing accidents with the vehicle going straight, red-light running and improper crossing were typically found in adult/older pedestrians, but fewer older pedestrians ignored the light. Drivers failed to either carry out general safe driving duties or give way to pedestrians. In intersection crossing accidents with right-turning vehicle, most pedestrians did not violate the laws but ended up in an accident because drivers did not give way to pedestrians or failed to carry out general safe

	12 & under			18-49			65 & over		
	Passenger car (n = 37.551)	Goods vehicle (n = 11.230)	Two-wheeled motor vehicle (n = 4.337)	Passenger car (n = 47.654)	Goods vehicle (n =11.862)	Two-wheeled motor vehicle (n = 7.047)	Passenger car (n = 40.562)	Goods vehicle (n = 14.003)	Two-wheeled motor vehicle (n = 6.103)
Starting	3.9	3.7	1.6	11.4	10.5	3.8	7.2	8.3	2.8
Going straight	86.6	86.0	94.9	44.9	44.6	88.8	49.2	42.7	93.1
Turning left	2.6	3.7	1.9	6.8	7.4	3.4	4.5	5.9	1.9
Turning right	4.0	4.5	1.6	25.9	26.5	3.9	24.0	30.3	2.0
Reversing	2.9	2.0	0.0	11.0	11.0	0.1	15.0	12.9	0.1
In Japan, traffic keeps to the left and most vehicles are right-hand driven.									

Tab. 5: Vehicle manoeuvres that hit pedestrians by pedestrian age group and type of vehicle, 2001-2003

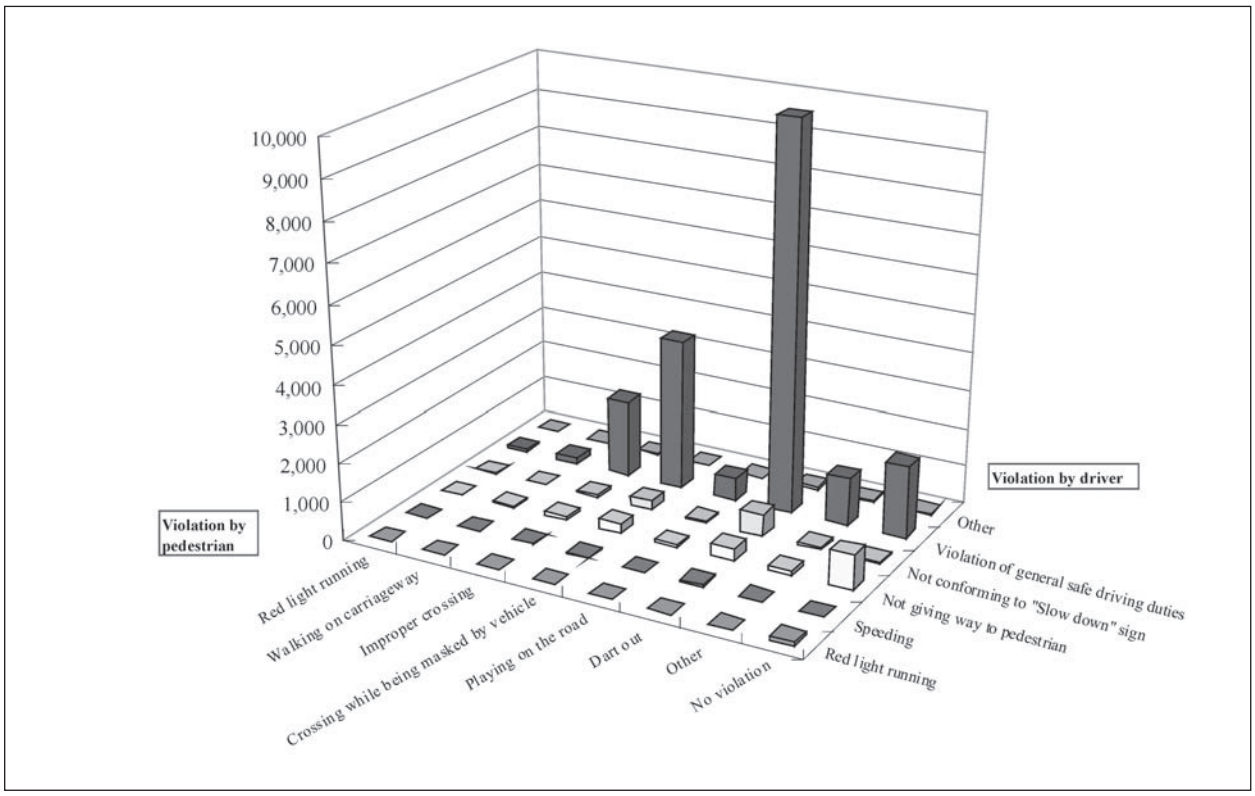

Fig. 2: Combination of major violations by child pedestrians and drivers going straight not at intersection: accident pattern I. 2001-2003
Violation by driver fewer than 100 and by pedestrian fewer than 10 are omitted for the sake of clarity.

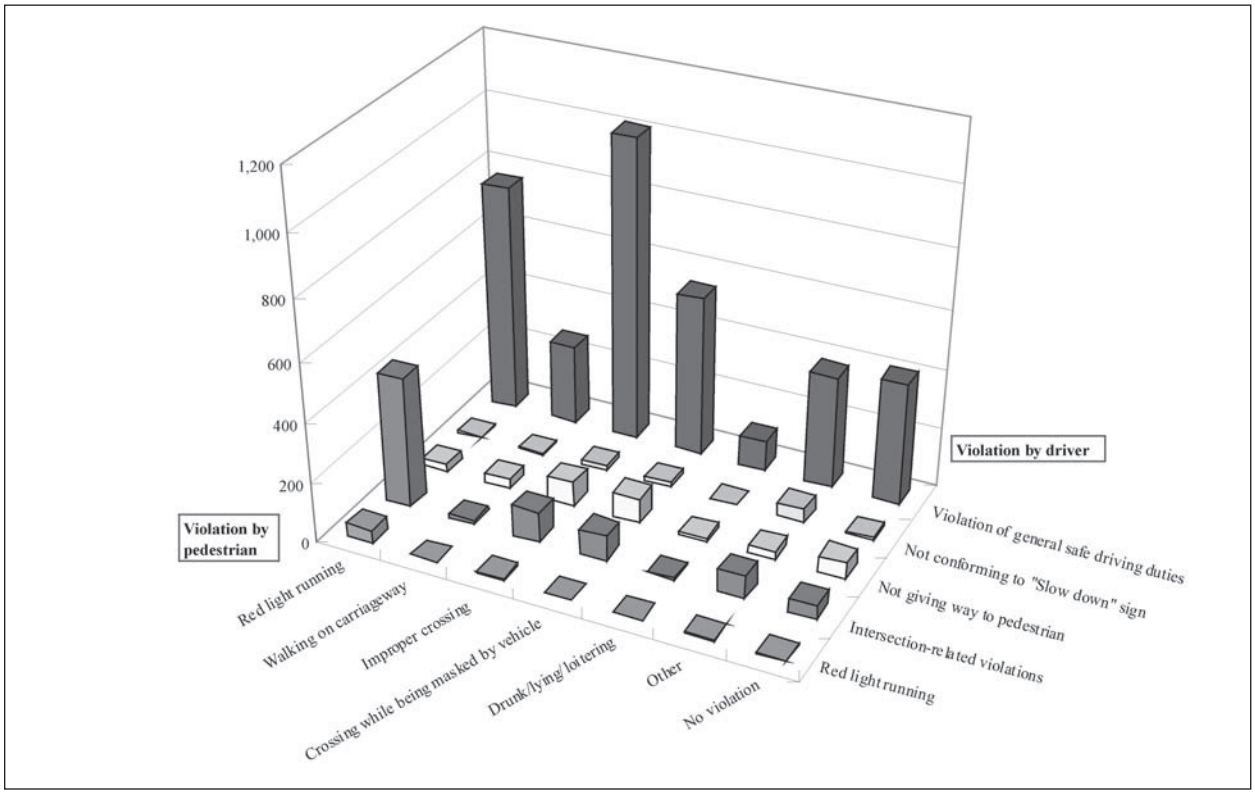

Fig. 3a: Combination of major violations by adult pedestrians (18-49 years old) and drivers going straight at/near intersection: accident pattern II. 2001-2003
Violation by driver fewer than 100 and by pedestrian fewer than 10 are omitted for the sake of clarity.

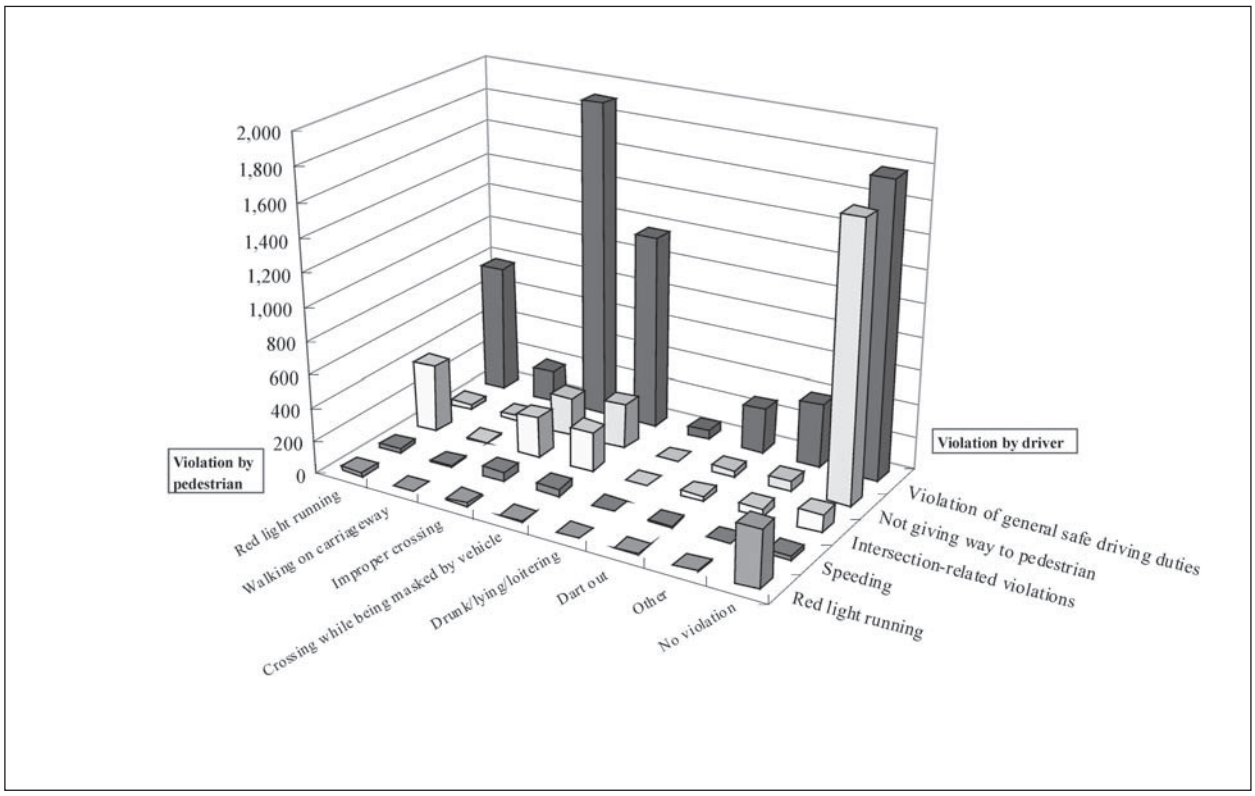

Fig. 3b: Combination of major violations by older pedestrians of 65 and over and drivers going straight at/near intersection: accident pattern II. 2001-2003
Violation by driver fewer than 100 and by pedestrian fewer than 10 are omitted for the sake of clarity.

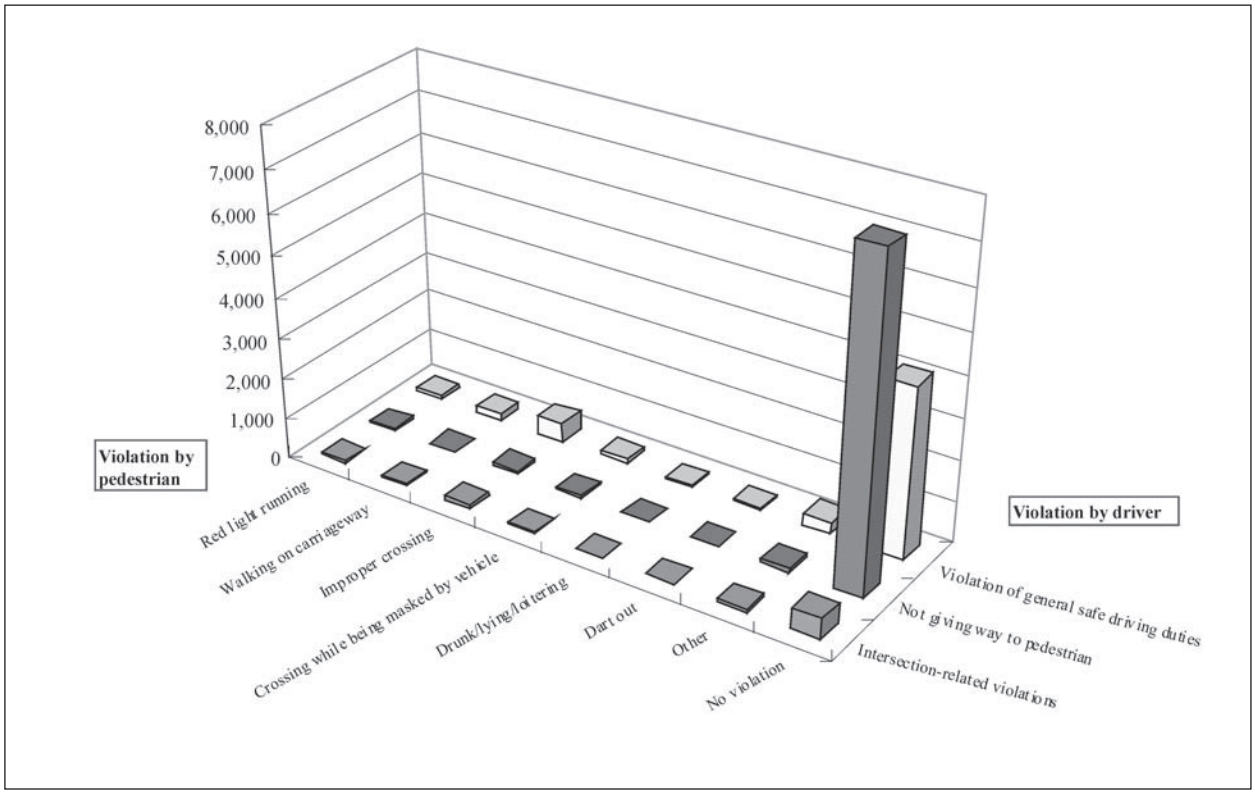

Fig. 4a: Combination of major violations by adult pedestrians (18-19 years old) and drivers turning right at/near intersection: accident pattern III. 2001-2003
Violation by driver fewer than 100 and by pedestrian fewer than 10 are omitted for the sake of clarity.

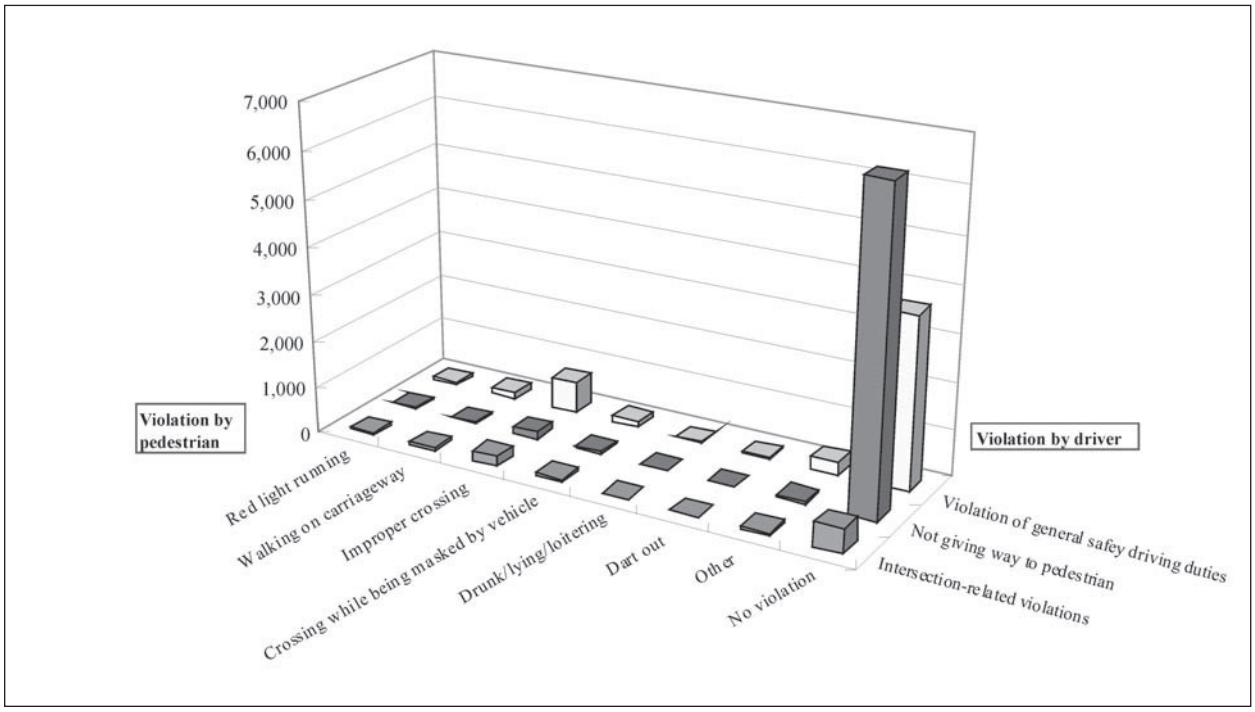

Fig. 4b: Combination of major violations by older pedestrians and drivers turning right at/near intersection: accident pattern III. 2001-2003
Violation by driver fewer than 100 and by pedestrian fewer than 10 are omitted for the sake of clarity.

driving duties. Interestingly, red-light running did not emerge as one of the most frequent violations in collision of right-turning vehicle vs. pedestrian. Both parties were proceeding according to the green light, and drivers failed to be ready to give way or to stop for pedestrians walking at crossing.

Relative Culpability

In each accident the police decide which party assumes more responsibility than the other in causing accident. The party judged to be more culpable is recoded as 'the most responsible party'. When it is not possible to weight the culpability of the two parties, one who sustains less serious injury is recorded as 'the most responsible party'. Table 6 shows the proportion of pedestrians judged to be most responsible by age group and level of injury. Pedestrians were generally less likely to be judged more culpable than the other party, but there are substantial differences between age group and injury level. Children were more likely to be judged culpable than adults or older people, except when they were fatally injured. Conversely, adults and older pedestrians were more likely to be judged culpable when they were killed than when they were injured. High culpability of injured children is probably related to a higher incidence of darting-out accidents where it is difficult for drivers to expect child presence and to take appropriate manoeuvre in advance. High culpability of fatally injured adults/older pedestrians may partially relate to alcohol involvement and lying on the road or loitering (shown in figure 3 and figure 4).

	12 & under	18-49	65 & older
Fatally injured	6.1	17.6	9.7
Seriously injured	12.3	7.2	4.2
Slightly injured	11.5	3.5	3.0
Overall	11.6	4.0	3.7

Tab. 6: Proportion of the most responsible to most/second responsible party by age group and level of injury, 2001-2003

Type of Vehicle and Injury to Pedestrian

Type of Car and Severity of Injury

Larger vehicle mass, faster vehicle speeds, vehicle geometry (particularly front-end design) and stiffness are said to be the main factors to aggravate pedestrian injuries. Among registered vehicles in Japan, the percentage of conventional sedan has been decreasing while the proportion of mini-cars, minivan, wagon and SUV has been increasing. The Increase of heavy, larger cars such as minivan, SUV and wagon is of particular concern for pedestrian injury. In 2003, about 60%

of cars that hit pedestrians were sedan. The Combined proportion of minivan, wagon, SUV and Sports & Specialty that hit pedestrians adds up to 35%. Once these types of car hit pedestrians, the fatality rate is considerably high compared with sedans. Figure 5 illustrates this: fatality rates sustained by Sports & Specialty, SUV and minivan are markedly higher than that of sedans. Fatality rates rise sharply at middle-aged about 50-54 years old and above.

Previous research in Japan reported that aggressivity of SUV and minivan are explained by their frontal shape (higher hood-edge or shorter nose) and stiffness, and by faster speed of Sports & Specialty [1-3].

Vehicle Speed and Level of Injury

One of these recent studies [3] indicates that the vehicle geometry could have larger effects on pedestrian injury, as average estimated vehicle speed before crash is actually lower for minivan than that of sedan. Despite its lower speed minivans are more likely to sustain fatal injuries to pedestrians compared with sedan, and this is because front the shape of minivan aggravates injury to pedestrians. Figure 6 shows the estimated vehicle speed just before the driver recognised the hazard by selected type of car for fatal/non-fatal injury. For non-fatal injury curves of 4 types of car are clustered, but speed of minivan and SUV were

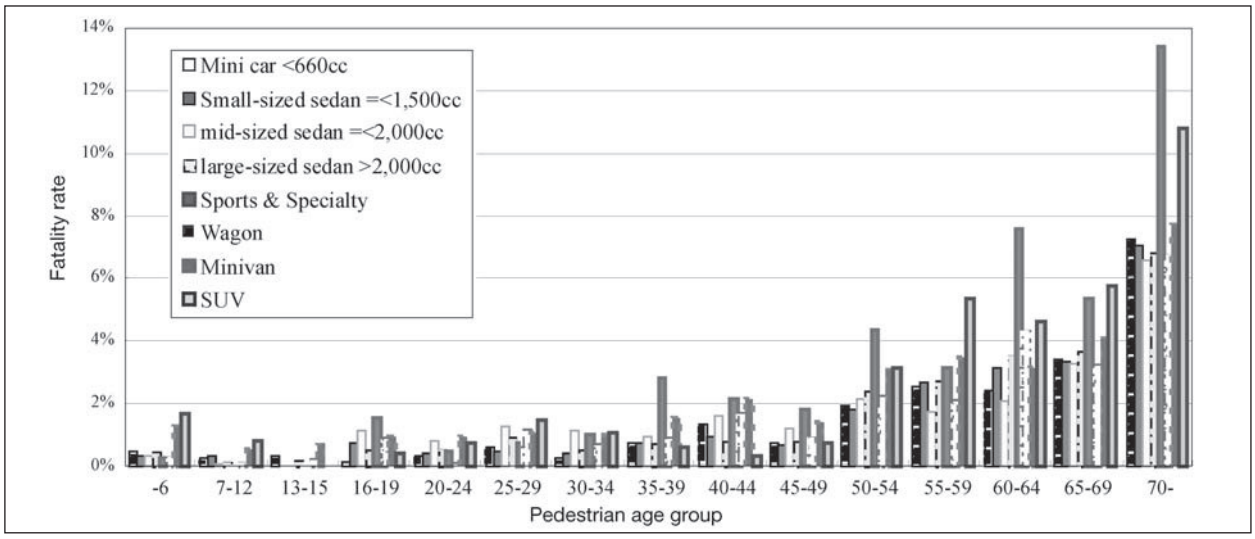

Fig. 5: Fatality rate of pedestrian by type of vehicle and age group, 2001-2003

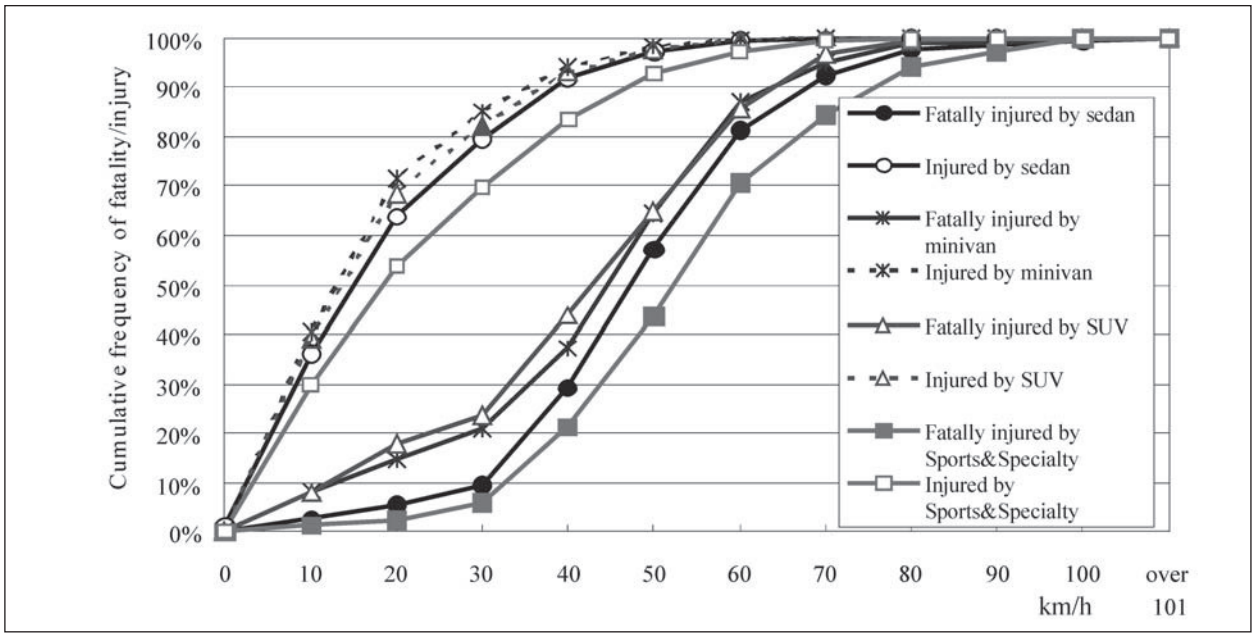

Fig. 6: Estimated vehicle speed by type of vehicle and level of injury, 2001-2003

slightly lower than sedan, whilst speed of Sports & Specialty was higher than sedan. The difference between types of car is more marked in fatal injuries. At 50th%-tile, the speed of SUV and minivan is approximately 2-5km/h lower than sedan, whereas the speed of Sports & Specialty is about 5km/h higher than sedan. These results generally support those shown in previous studies. Higher hood-edge of SUV and shorter distance from bumper to windshield of minivan are likely to affect adversely on the impact point and the trajectory of pedestrians and thus consequences of injury. On the other hand, the higher speed of Sports & Specialty is likely to be the major factor to increase the fatality rate of pedestrian.

The most frequent pedestrian injury is to leg, but it is to head in fatal injuries. Head injury is often caused by hitting the head against the road surface, windshield frame or A-pillars. Leg injury is often caused by hitting the lower limb against the bumper [1, 2]. Measures in relation to injury protection of head and leg are briefly reviewed in the following section.

Relevant Measures

Vehicle Safety

Test Procedures for Vehicle Structure

Japan has been actively involved in recent activities in developing test procedures of vehicle structure aiming at pedestrian protection in collaboration with Europe and the United States. Various organisations have proposed test procedures: the European Enhanced Vehicle-safety Committee (EEVC), International Standards Organisation (ISO) and International Harmonized Research Activity (IHRA) and United Nations' WP 29 (World Forum for Harmonization of Vehicle Regulations). Test procedures of pedestrian protection in view of head/leg injury have been incorporated into EuroNCAP since 1997. In Japan, test procedures of head protection were incorporated into Japan NCAP in 2003. After September 2005, all new cars (with a few exceptions) and goods vehicles of 2.5 tonnes and under will be required to satisfy designated criteria by having a structure or hood material to absorb impact. In recent studies in Japan, data of ITARDA has been utilised in providing real-world crash information and in estimating effects of test instruments or procedures.

Given that most pedestrian injury is to leg, test procedures of leg injury protection are indeed of importance. In Japan, research on test procedures of leg injury protection has been under way, and the test instrument 'Flex impactor' is considered to be of most validity in reconstructing fracture patterns below knees in addition to problems of knee joints [4]. It should be also noted that research on the development and evaluation of a pedestrian dummy prototype has been actively conducted in Japan [5].

Other Technological Developments

There have also been various attempts to apply new technology including the area of active safety. Advanced Safety Vehicle (ASV) project has been promoted since 1991 with a leadership of the Ministry of Land, Infrastructure and Transport. 'Infrared censor to detect pedestrians before crash' and 'pedestrian airbag' aiming to cover A-pillars to avoid direct contact with the pedestrian body, are examples to name a few. However, it is expected to take at least a couple of years before the technology is put into practical use [6].

Engineering and Education

Environmental Issues for Pedestrians

The most significant environmental problems concerning vulnerable road user safety in Japan is perhaps a lack of adequately dedicated space separated from carriageway due to mixed or undifferentiated road use. The most imminent problem for pedestrians is lack of pavement, which often leads to situations where they have to walk on narrow space only divided by a white line beside carriageway.

Pedestrian crossing facilities in Japan are mostly crossings with zebra markings, and they can be with or without traffic signal. Flyovers, most of which were constructed in the past days, are not widely used today. Central refuge is rare to be seen. The accident data shown in table 4 explained that about 30% of pedestrian accidents were 'crossing accidents occurred at crossing', and most of them occurred at light-controlled intersections. Most typically drivers did not recognise pedestrians or failed to give way at crossings while they were proceeding according to the green light. This suggests that serious problems between crossing pedestrian and driver lie in light-controlled intersections.

Area-wide Engineering Scheme to Protect Vulnerable Road User

In 2003, the Japanese government embarked on the 5-year project Safe Walk Zone. It started by designating about 800 residential/commercial areas with high accident frequency. It aims to improve road traffic environment by engineering treatment and to reduce accidents of vulnerable road users by 30%. Relevant measures include (a) improvement of physical environment (installation of pavement, street lighting and dedicated right-turning lane), and (b) introduction of improved traffic control (installation of traffic light – LED light in particular, introduction of complete pedestrian protect phase, and extended green phase for infirm people), and (c) other traffic calming schemes [7]. Other similar area-wide schemes aiming to improve walking environments for infirm road users, for example, have been introduced as well [8]. A complete pedestrian protect phase would be very effective in reducing accidents of crossing pedestrian vs. right-turning vehicle, as it is supposed to be human error proof unless drivers ignore the light since drivers will be freed from relying solely on their alertness to recognise pedestrians when approaching a crossing.

Education and Enforcement

Educational measures for pedestrians have been targeting children or older people mostly by giving occasional lectures. Lectures for children are usually given at kindergarten or schools by police officers or teachers. A gathering of older people is sometimes organised to give a lecture taking advantage of leisure activities through sports/hobby clubs. There are other positively sounding schemes such as community-based activities using accident mapping by residents and educational programmes involving three generations. Educational programmes targeting parents/grandparents for child safety are not widely implemented, but more could be done to raise awareness to protect children given their high risk of injury. Furthermore, older people may appreciate more practical information such as walking in relation to health issues or various transport service available to them besides traffic rules teaching.

Summary and Discussion

The analysis of traffic accident data showed:

(1) The population-based age and sex comparison shows that the risk of injury as pedestrian is highest for boys and older women, whilst the risk of fatal injury is extremely high for older men and women.

(2) Child pedestrians were over-represented in accidents on municipal roads, whereas older pedestrians were slightly over-represented in accidents on national/prefecture (N/P) roads that include most arterials except for motorway. The speed of vehicles that hit pedestrians was generally lower on municipal roads compared with N/P roads, and this could contribute to the lower fatality rate of child pedestrians and higher fatality rate of older pedestrians.

(3) Sixty percent of pedestrian accidents were ‘crossing accidents’, and most of them occurred at/near intersections. Crossing accidents of children, however, are different from accidents of adults or older pedestrians. Children were more likely to be hit when they were crossing the road outside crossings, whereas adult/older pedestrians were more likely to be hit when they were crossing within crossings at/near intersections.

(4) Children tended to dart out or cross the road improperly (in a way that it is nearly impossible for the driver to recognise them and avoid an accident) and collide with a vehicle proceeding straight. Possibly due to frequency of darting out violation, children were more likely to be judged to be culpable than adult or older pedestrians. High culpability of fatally injured adult/older pedestrians could be related to alcohol involvement.

(5) In case of crossing accidents colliding against vehicle going straight at intersection, many adult pedestrians were found to cross the road improperly or ignore the light. However, many older pedestrians were found not to violate the laws, and red-light running was less frequent compared with adults. Most drivers who hit pedestrians, on the other hand, were found not to carry out general safe driving duties, and red-light running was far fewer than this.

(6) In case of crossing accidents colliding against right-turning vehicle at intersection, most

pedestrians were found to be lawfully crossing the road, whilst most drivers failed to fulfil general safe driving duties or failed to give way to pedestrians. Red-light running by drivers did not emerge as one of the major violations.

(7) The particular type of vehicle is known to incur more serious injury to pedestrian once they hit them compared with sedan. Among all, minivan, SUV and Sports & Specialty are more lethal once they hit pedestrians. The fatality rate of pedestrian becomes markedly high and particularly so with increasing age of the pedestrians. The major factor is considered to be front-end geometry of minivan and SUV and high speed of Sports & Specialty.

Compared with other industrialised countries, the proportion of pedestrian fatalities in Japan is very high. There are many factors related to this, but poor road environment and subsequent ambiguity in right-of-way discipline in vehicle-pedestrian interaction seem to be the major characteristics that make pedestrian accidents in Japan peculiar. It is commonly observed that drivers do not give way to pedestrians at pedestrian crossings without light, and pedestrians do expect that drivers may not stop at such crossings. Accidents of right-turning vehicle colliding with pedestrian at crossings while green lights appear for both pedestrians and drivers may also be such examples to illustrate the ambiguity in the right-of-way discipline. Engineering treatment such as complete pedestrian protect phase is expected to help reducing such conflicting situations.

The evidence suggests that physical abilities of children have been declining owing to increasingly sedentary life style and perhaps fewer distances walked over the years. It may well be that safety and environmental improvement for pedestrians may not be given the priority with increasing dependency on car. This is a common issue for other vulnerable road users such as older or infirm people. Traffic calming measures were rather recently introduced in Japan, but if appropriately implemented, they are expected to play an important role in improving walking environment in general and in reducing vulnerable road users casualties.

Acknowledgments

We would like to thank Hiroyuki MIZUNO of Japan Automobile Standards Internationalization Center (JASIC) for his advice and sharing valuable information on vehicle safety.

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