

Evaluation Test Methods for Gtr 7

Accident Analysis **(Validation of Neck Injury Criteria)**

JASIC / JAPAN



Outline of Presentation

1. Overview Survey of Rear-end Collisions

(1) Trend of Rear-end Collision

(2) Type of Injuries due to Rear-end Collisions

(3) Relationship between type of Injuries and impact severity
(Traveling speed just before driver's notice)

(4) Relationship between permanent disabilities and impact severity
(Traveling speed just before driver's notice)

2. Validation of Neck Injury Criteria



1. Overview Survey of Rear-end Collisions

(1) Trend of Rear-end Collision

(2) Type of Injuries due to Rear-end Collisions

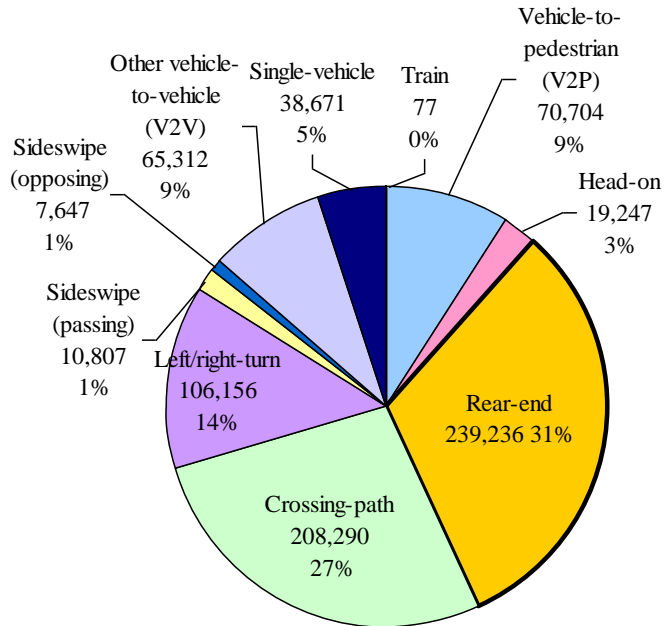
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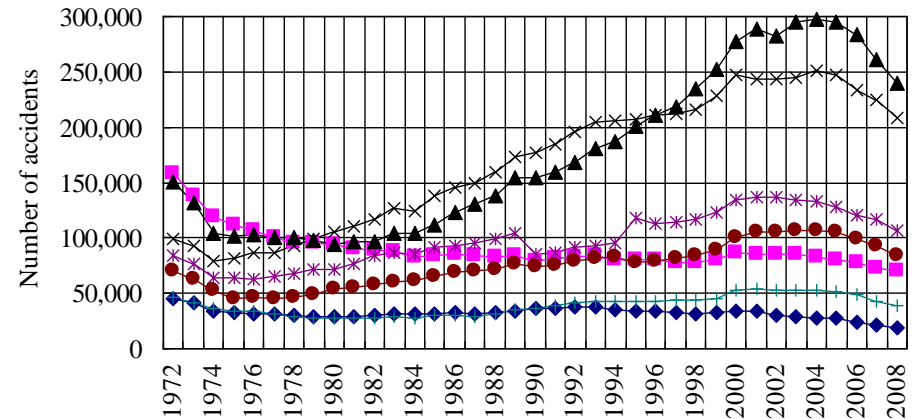
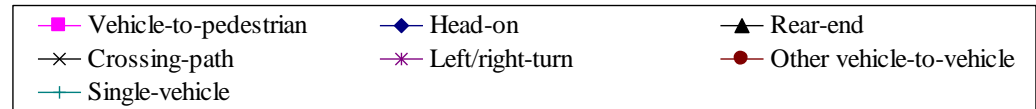
2. Validation of Neck Injury Criteria



Breakdown of traffic accidents (2008 traffic accidents statistics)

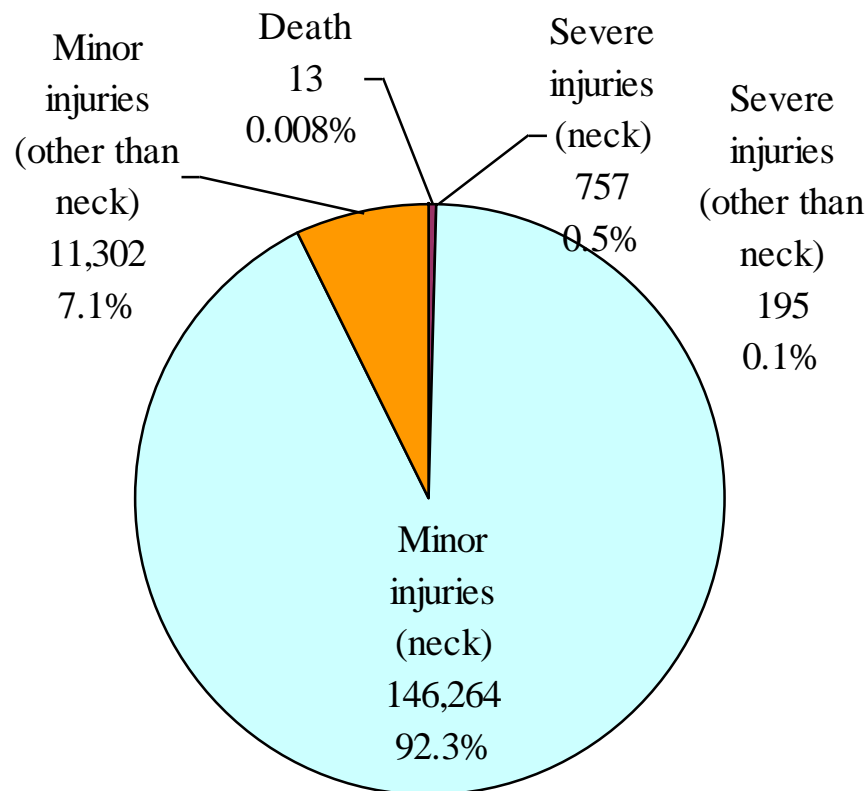


Annual number of traffic accidents by accident type (2008 traffic accidents statistics)



- Subject year : 2008
- Rear-end collisions are the most frequent type of traffic accident, accounting for 31%.
- The number of traffic accidents reached its peak in 2004. The number of rear-end collisions has decreased for four years in a row, and still remains at a high level.

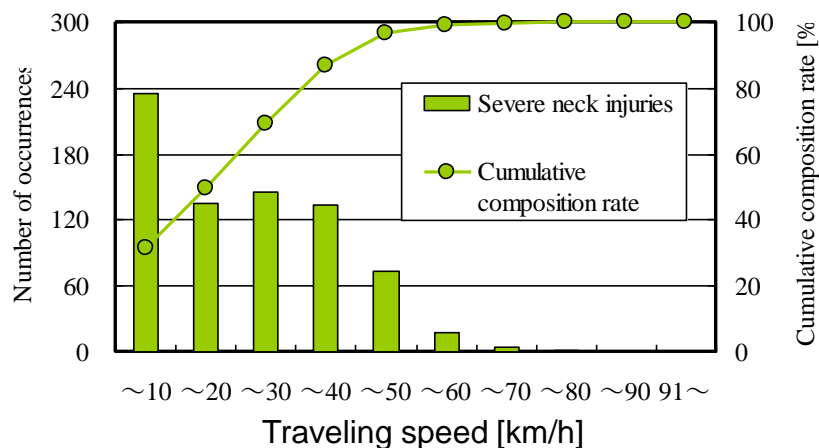
Type of Injuries due to Rear-end Collisions



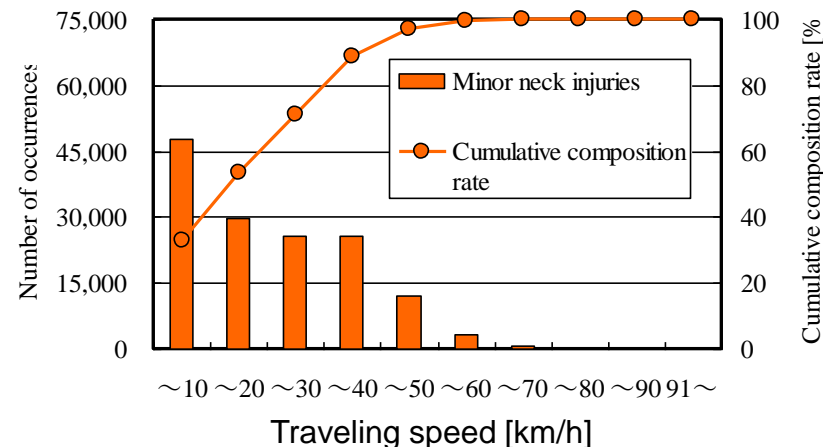
- Subject year : 2008 (excluding multiple accidents) . Drivers of Rear Impacted Vehicles, Rear Impacted Vehicles : all vehicles
- Minor neck injuries account for 90% of the injuries suffered by drivers from rear-end accidents.

Distribution of Injuries and Cumulative Composition Rate by Traveling Speeds

【Severe injuries : Neck】



【Minor injuries : Neck】



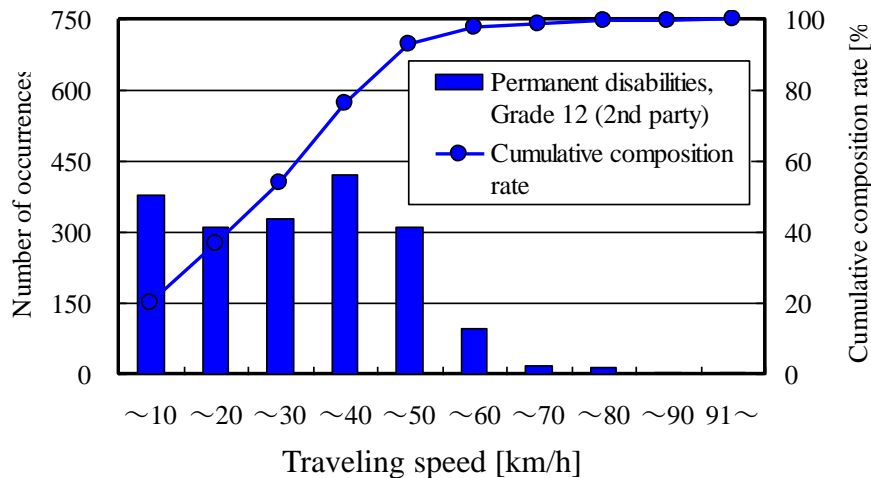
- Subject year : 2008 (excluding multiple accidents). Drivers of Rear Impacted Vehicles, Rear Impacted Vehicles : compact cars and small cars
- For both severe and minor injuries, many of the injured were running at a traveling speed of 10 km/h or less.
- The three speed ranges between 11 and 40 km/h each occurred for the same number of injured person.
- Traveling speed at a cumulative composition rate of 80% is 31 to 40 km/h for both severe and minor injuries (estimated ΔV 14.1 to 18.7 km/h)

Estimated ΔV is change in speed calculated from travel speed, expressed, based on past papers, by the following formula:

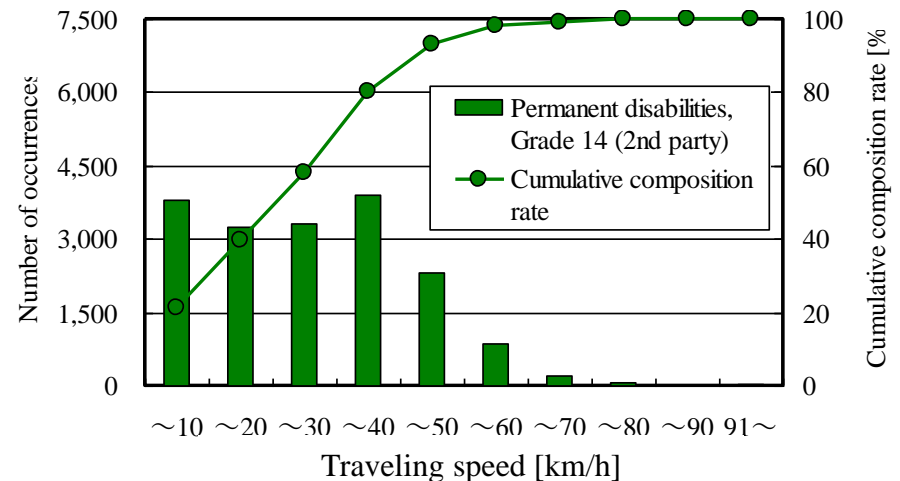
$$\text{Estimated } \Delta V = \frac{0.935 \times \text{Travel speed}}{2}$$

Where the rear-end accident is assumed to be an accident between vehicles of same type.

Accidents that caused permanent disabilities of grade 12 to the driver of the rear-end –impacted vehicle

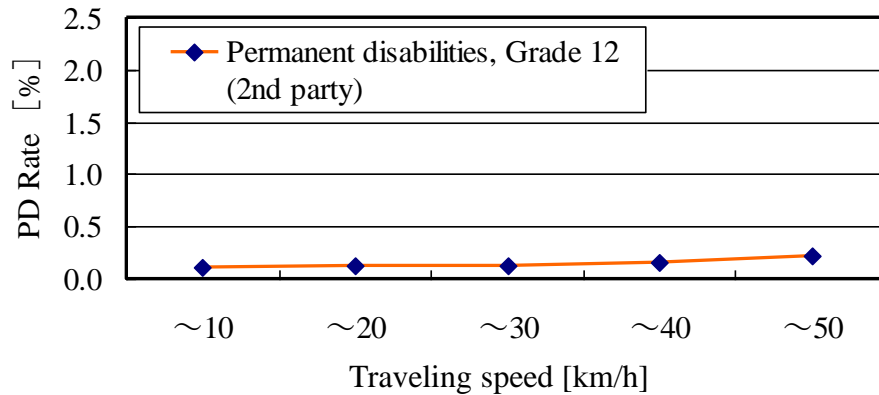


Accidents that caused permanent disabilities of grade 14 to the driver of the rear-end-impacted vehicle

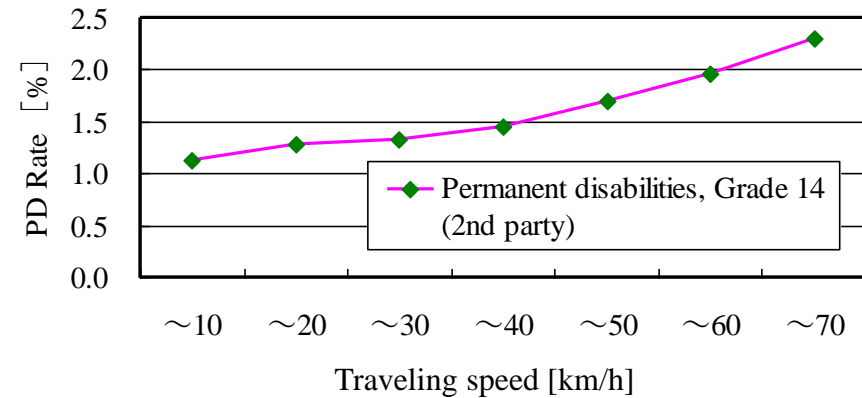


- Subject year : 1995-2004 (excluding multiple accidents). Drivers of Rear Impacted Vehicles, Rear Impacted Vehicles : compact cars and small cars.
- For both of the driver groups that suffered permanent disabilities of grade 12 and 14, they were most often traveling speed at 31 to 40 km/h.
- Accidents that caused permanent disabilities of grade 14 showed the smallest difference in travel speed : The cumulative composition rate not more than 40 km/h (estimated ΔV of 18.7 km/h) reaches 80%.

Permanent disabilities of grade 12



Permanent disabilities of grade 14



- Subject year : 1995-2004 (excluding multiple accidents). Drivers of Rear Impacted Vehicles, Rear Impacted Vehicles : compact cars and small cars
- The rate of permanent disabilities of grade 12 is almost unchanged.
- The rate of permanent disabilities of grade 14 showed an upward tendency until 40km/h (estimated $\Delta V 18.7\text{km/h}$) with the increase in traveling speed. But the strong upward tendency was shown from 41km/h (estimated $\Delta V 18.7\text{km/h}$).

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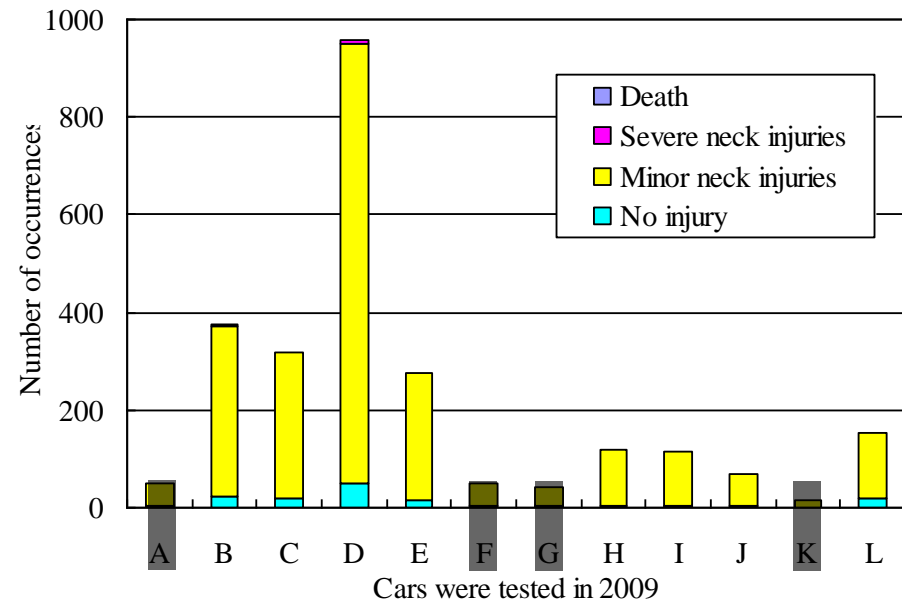
2. Validation of Neck Injury Criteria



Number of rear-end collisions and rate of neck injuries*

Car Type	Death (person)	Severe (person)	Minor (person)	No injury (person)	Total (person)	Neck injury (Death) (Severe) (Minor) [%]	No injury [%]
A	0	0	46	2	48	95.8	4.2
B	0	1	350	23	374	93.9	6.1
C	0	1	298	20	319	93.7	6.3
D	0	8	900	49	957	94.9	5.1
E	0	1	262	14	277	94.9	5.1
F	0	0	44	4	48	91.7	8.3
G	0	0	42	2	44	95.5	4.5
H	0	0	118	2	120	98.3	1.7
I	0	0	110	5	115	95.7	4.3
J	0	0	65	4	69	94.2	5.8
K	0	0	17	0	17	100.0	0.0
L	0	0	133	20	153	86.9	13.1
Total	0	11	2,385	145	2,541		

Number of rear-end collisions



Subject year : 2009 JNCAP test vehicles (12 vehicle types) : 2008 to 2010 (excluding multiple accidents and property damage accidents)

Drivers of rear-end vehicles (male and female)

Rear-end vehicles: compact cars and small cars

(Number of victims: deaths 0, severe injuries 11, minor injuries 2,385, no injury 145)

*Note: The car types shown in the shadowed parts of the table above didn't exceed 50 cases and hence excluded.

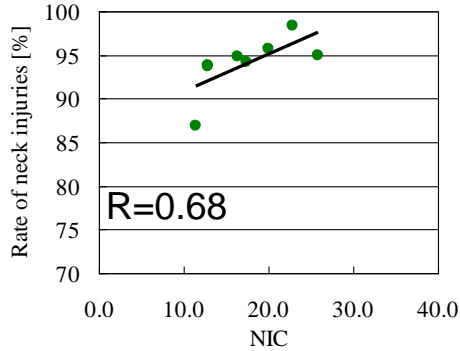
$$\text{Rate of neck injuries} = \frac{(\text{Deaths} + \text{Severe Injuries} + \text{Minor Injuries})}{(\text{Deaths} + \text{Severe Injuries} + \text{Minor Injuries} + \text{No injury})}$$

(The term "No injury" in accidents involving physical injuries refers to accidents where the occupant in the passenger's seat was injured but the driver was not.)

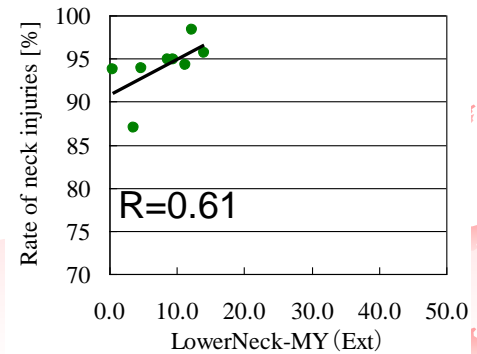
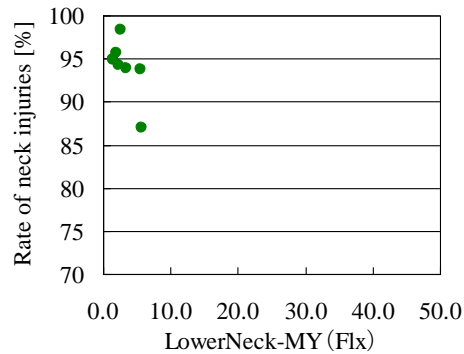
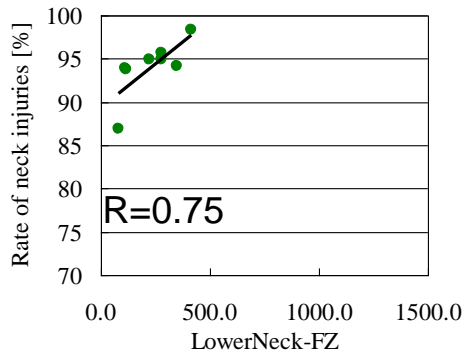
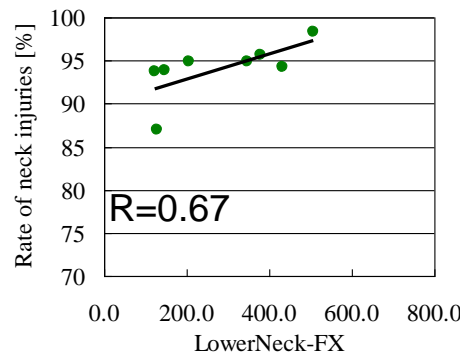
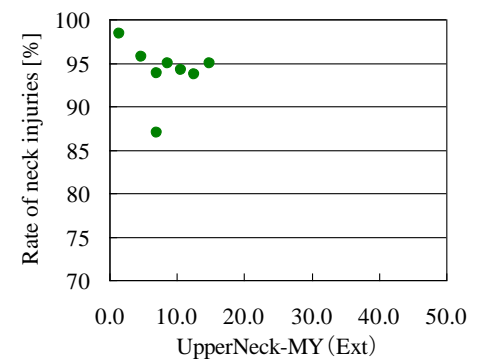
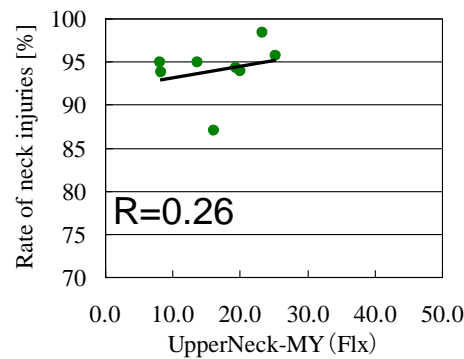
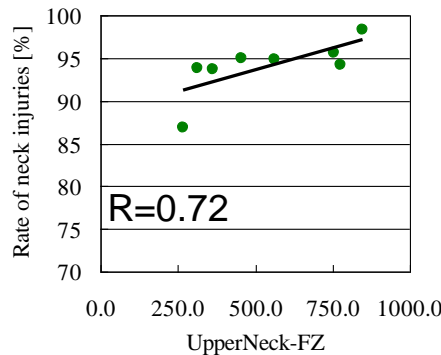
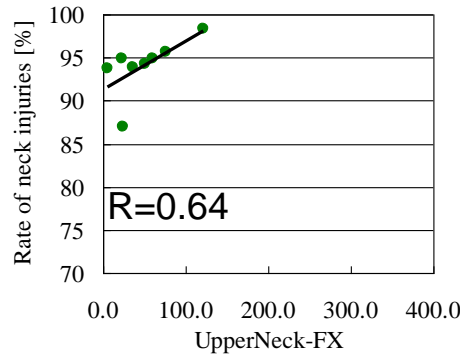
Neck Injury Criteria and Rate of Neck Injuries

(Excluding injuries whose number of occurrences is 50 or less)

The neck injury criteria proposed by Japan to UN/ECE/WP.29/GRSP/grt7 and the rate of neck injuries in Japan were as shown below:



- Although there are not a lot of data, the correlation coefficient to the rate of neck injury and injury value is 0.26-0.75.
- In each injury criteria, when an injury value rises, there was also a tendency for the rate of neck injury to go up. And these had correlation with real world accident and injury criteria.



An analysis of how rear-end accidents occurred was made based on traffic accident data in all of Japan. The results are as follows:

- The number of traffic accidents in 2008 was 766,147. Among them, rear-end accidents, were the most frequent type accounting for about 31%.
- As to the severity of injuries and the area most often injured in rear-end collisions in 2008, minor neck injuries accounted for about 90% of them.
- For both severe and minor injuries, many of the injured were running at a travel speed of 10 km/h or less. And, traveling speed at a cumulative composition rate of 80% is 31 to 40 km/h for both severe and minor injuries (estimated ΔV 14.1 to 18.7 km/h).
- The rate of permanent disabilities of grade 14 showed the upward tendency until 40km/h (estimated ΔV 18.7km/h) with the increase in traveling speed. But a strong upward tendency was shown from 41km/h (estimated ΔV 18.7km/h).
- In each injury criteria, the rate of neck injuries in rear-end collisions tends to increase with the injury value. It was found that there is a correlation between the neck injury criteria proposed by Japan to UN/ECE/WP.29/GRSP/gtr7 and the rate of neck injuries.