JAPAN Accident Analyses for Application and Height on Head Restraints GTR

Rev.1 January '06

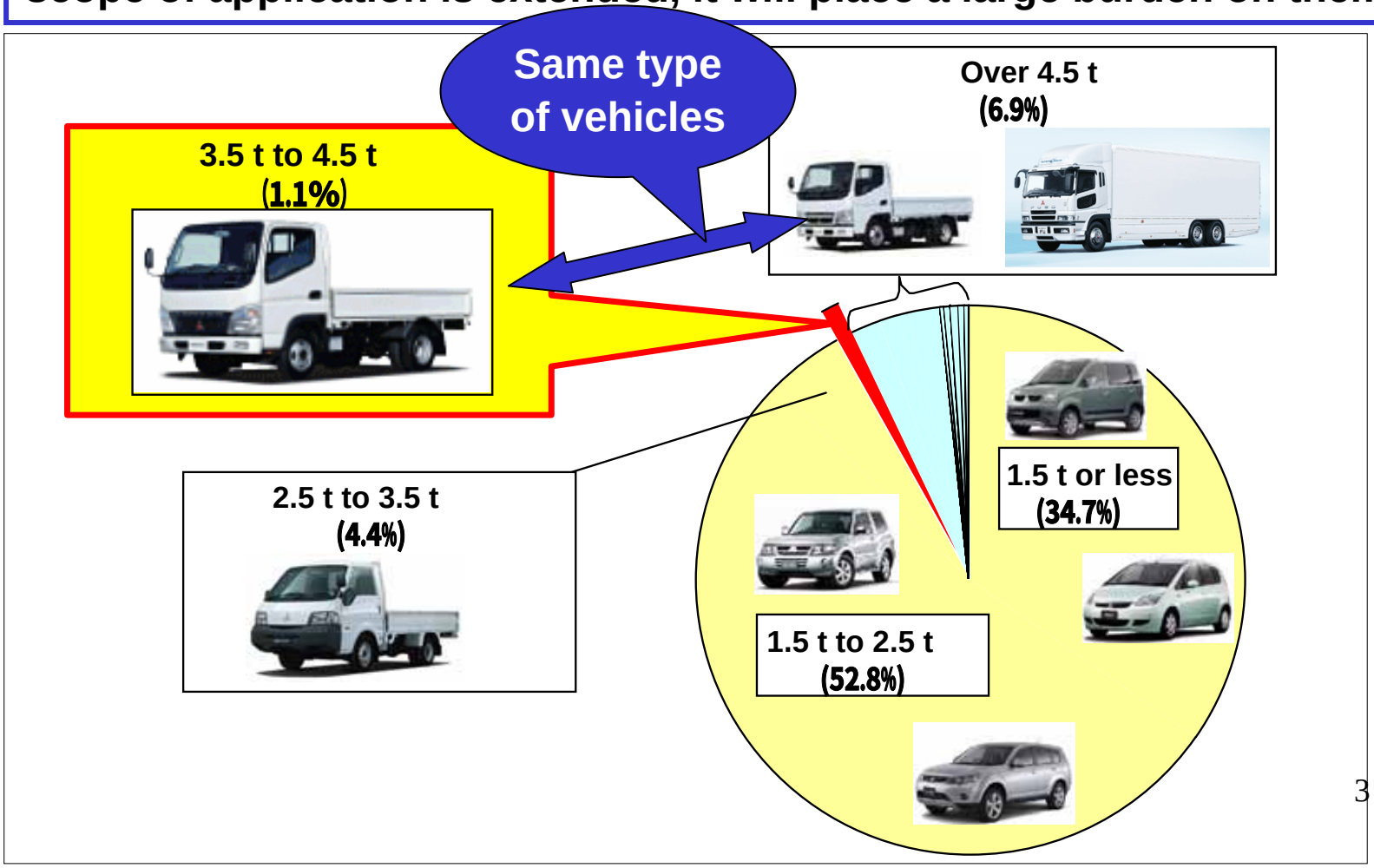
September '05

JAPAN MLIT

Part 1
Study of Application

Fleet composition in Japan at March 2005 Rev.1

- Vehicles of 3.5 t or less account for 92% of the whole fleet.
- Vehicles of 3.5 to 4.5 t account for only 1.1 % of the fleet, but many vehicles of the same type are found among larger vehicles. When the scope of application is extended, it will place a large burden on them.



Order of accident analyses

Number of Road Accidents in Japan in 2004

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Number of Rear Impacts in 2004

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Number of Injuries and Deaths in Rear Impacts

↓

Number of Vehicles and Occupants Sustaining Neck Injuries by Vehicle Class

Number and Proportion of Occupants Sustaining Neck Injuries by Gender and Age

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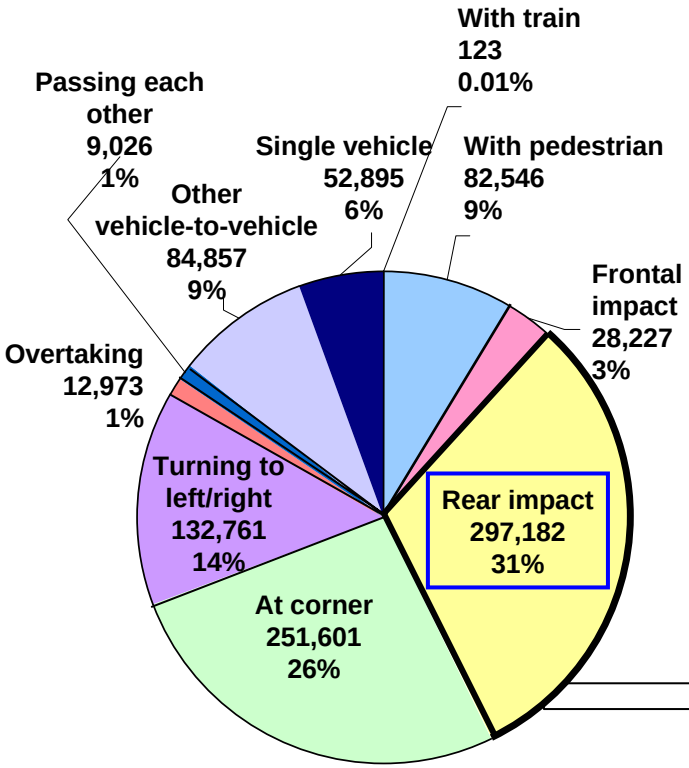
Conclusion

Number of Road Accidents and Rear Impacts in Japan in 2004

In Japan, rear impacts account for 30% of accidents resulting in bodily injury. Among them, 90% of the injuries of impacted vehicle occupants are minor neck injuries.

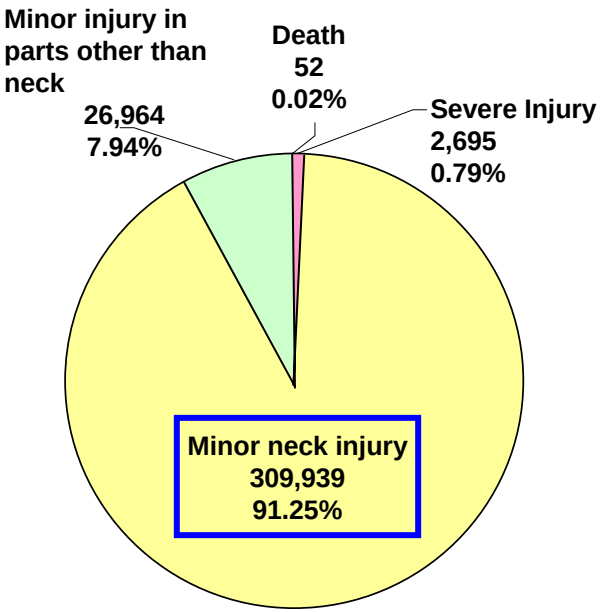


(Motorcycles and bicycles are included in vehicles)

Type of Accidents	Number of Accidents
With pedestrian	82,546
Frontal impact	28,227
Rear impact	297,182
At corner	251,601
Turning to left/right	132,761
Overtaking	12,973
Passing each other	9,026
Other vehicle-to-vehicle accidents	84,857
Single vehicle	52,895
With train	123
Total	952,191

Number of rear impacts of four-wheeled vehicles: 278,832

Number of deaths and injuries of impacted vehicle occupants in rear impacts of four-wheeled vehicles



Proportion by Vehicle Class

Proportion by Gender and Age

Proportion of Rear-Impacting and -Impacted Vehicles by Vehicle Weight

90% of accidents occur between cars with GVW up to 3.5 t.

Breakdown of Impacting and Impacted Vehicles in Rear Impacts in 2003
(Based on the number of accidents, except multi-collisions, resulting in bodily injury of impacting or impacted vehicle occupant(s).)

Rear-Impacted Vehicle \ Rear-Impacting Vehicle		GVW up to 3.5 t				GVW over 3.5 t		Others	Total
		Passenger Car	Mini-car	Truck (up to 3.5 t)	Mini-sized Truck	Truck (Over 3.5 t)	Bus	Special Purpose	
GVW up to 3.5 t	Passenger Car	88,464	20,424	10,027	8,792	8,052	341	2,196	138,476
	Mini-car	24,368	8,119	2,509	3,133	1,932	80	510	40,651
	Truck (up to 3.5 t)	6,772	1,390	1,221	837	1,061	28	264	11,573
	Mini-sized Truck	9,827	2,815	1,388	1,524	1,146	40	318	17,058
GVW over 3.5 t	Truck (Over 3.5 t)	2,120	446	490	283	1,433	34	275	5,081
	Bus	198	52	35	18	61	12	18	394
Others	Special Purpose	504	103	107	68	309	7	159	1,257
Total		132,253	33,349	15,777	14,835	13,994	542	3,740	214,490

Number of rear impacts between vehicles with GVW up to 3.5 t, resulting in bodily injury: 191,790 (89.4%)

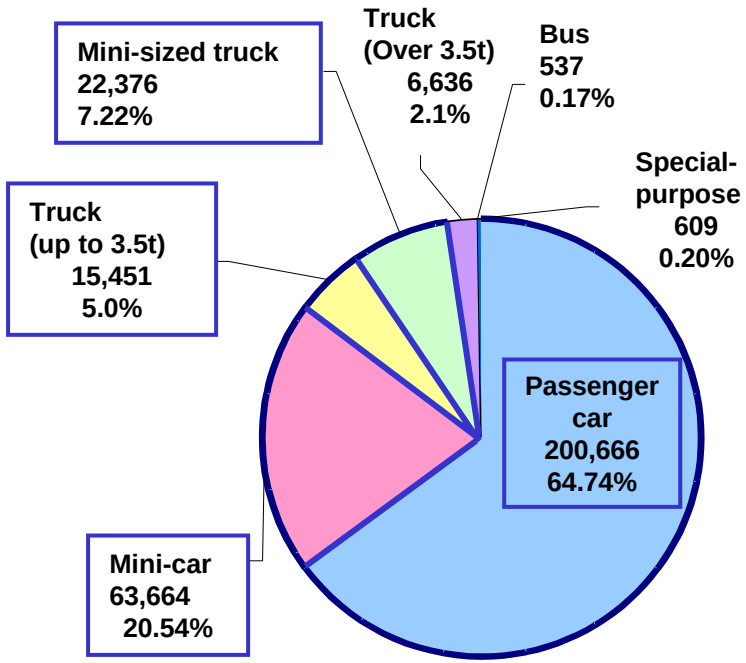
Number of rear impacts between vehicles with GVW over 3.5 t, resulting in bodily injury: 1,540 (0.7%)

Number of Occupants Sustaining Neck Injuries in Rear-Impacted Vehicles by Vehicle Class (2004)

Vehicles with GVW up to 3.5t account for 97.5% of rear-impacted vehicles which occupant(s) sustained neck injury.

Rear-impacted Vehicles

GVW	Vehicle Class	Number of Occupants	Subtotal by GVW
Up to 3.5 t	Passenger car	200,666	302,157 (97.5%)
	Mini-car	63,664	
	Truck (up to 3.5 t)	15,451	
	Mini-sized truck	22,376	
Over 3.5 t	Truck (Over 3.5 t)	6,636	7,173 (2.3%)
	Bus	537	
Others	Special-purpose	609	609(0.2%)



Number of occupants sustaining minor neck injury in rear-impacted vehicles: 309,939

Conclusion

1. Application

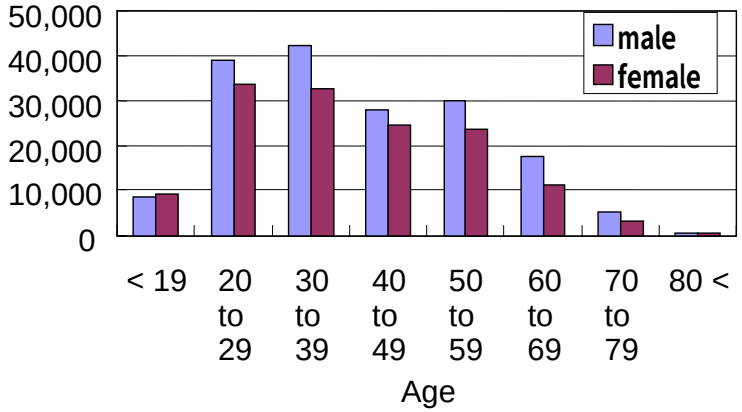
In Japan, there is no need for expanding the application beyond Category 1-1 and 2 with GVW up to 3.5t, because the number of neck injuries in the rear-impacted vehicles with GVW over 3.5t is quite small.

Part 2
Study of Height

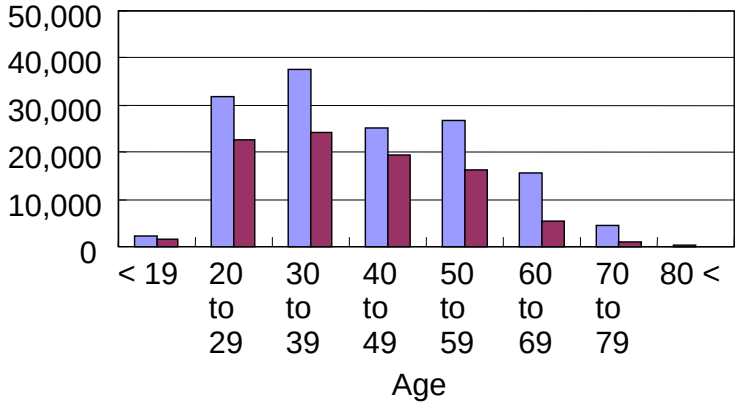
Number of Occupants Sustaining Neck Injuries in Rear-Impacted Vehicles by Gender, Age, and Seating Position (2004)

Drivers in their 30s make up the majority of the occupants sustaining neck injuries.

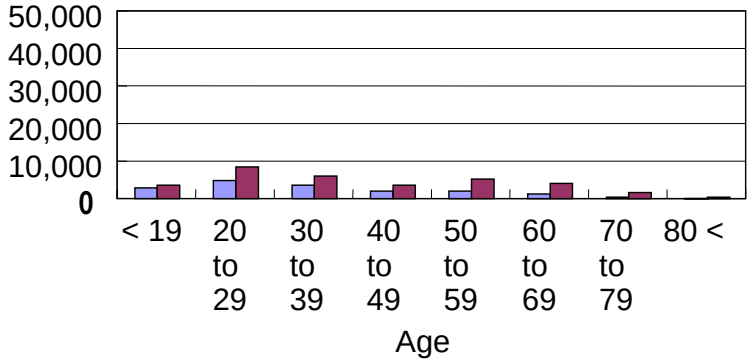
Occupant (Driver + Passenger) 309,939



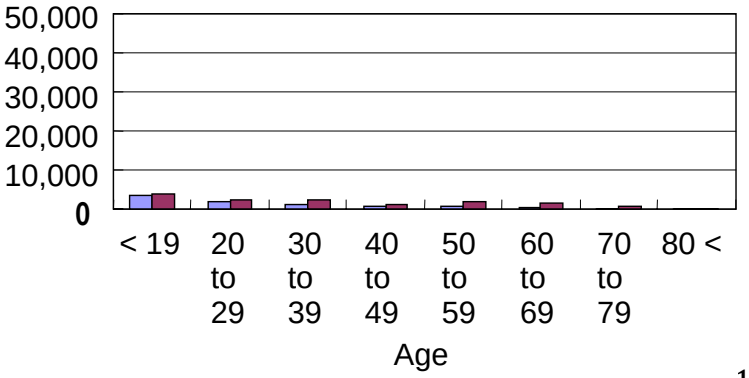
Driver 234,354



Front Seat Passenger 49,536

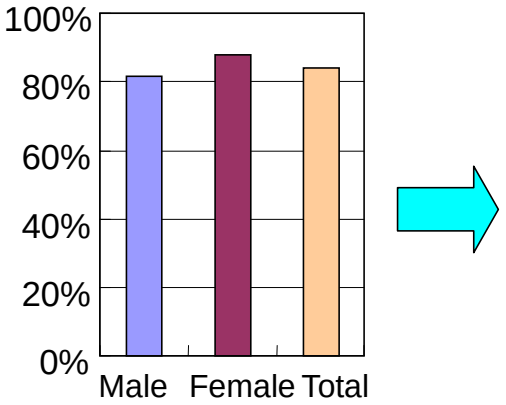


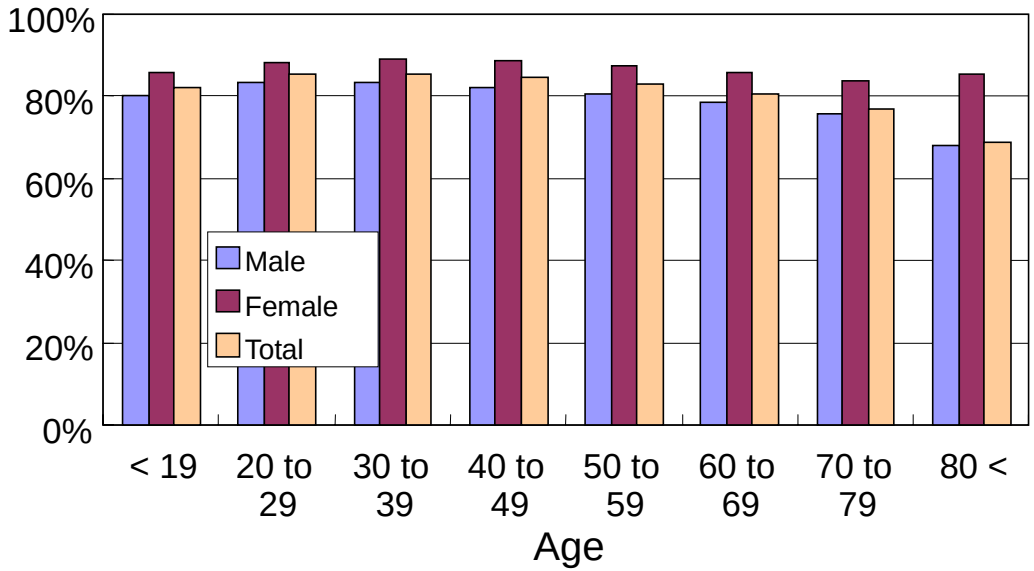
Rear Seat Passenger 26,049



Number of Occupants Sustaining Neck Injuries in Rear-Impacted Vehicles by Gender and Age

Among rear-impacts resulting in bodily injury, 81.7% of male and 88% of female drivers of the impacted vehicles sustained minor neck injuries.





Male	81.7%
Female	88.0%
Total	84.0%

Minor Neck Injury Ratio =
Minor Neck Injuries / (Deaths + Serious injuries + Minor Injuries + Not injured)

Subject: Rear impact resulting in bodily injury

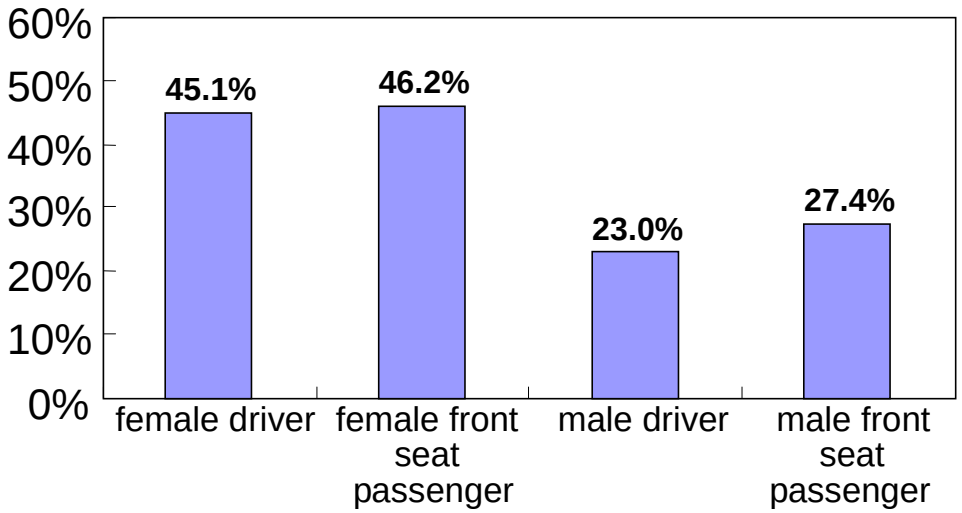
“Not injured” means the number of drivers who were not injured in the accident in which any passenger of rear-impacted vehicle was injured

Example of Consideration in Europe

A DETAILED ANALYSIS OF THE CHARACTERISTICS OF EUROPEAN REAR IMPACTS

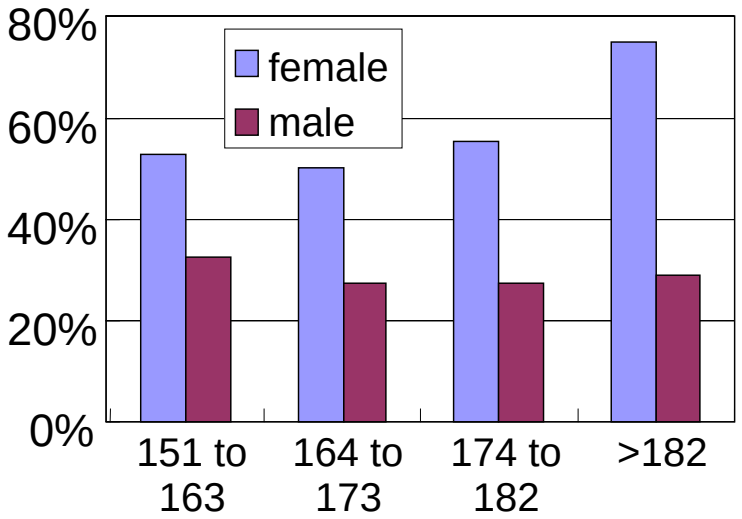
Volker Eis, Raimondo Sferco, Paul Fay/Ford Motor Company, Germany and UK #19ESV 05-0385

Female front seat occupants are at higher risk of receiving an STNI (Soft tissue neck injuries).



STNI risk of front seat occupants in single rear impacts by **gender and seating position**

The taller the women are, the higher is their risk of receiving a soft tissue neck injury.



STNI risk of front seat occupants in single rear impacts by **gender and body height**

Comparison of Seated Height of Japanese, Netherlanders, and Americans

Since the seated heights of Japanese females and males are shorter than those of Americans in all age groups, head restraints with a height of 800 mm will cover all occupants.

<Netherlands>		<Japan>			<USA>	
female (age:20-60) n = 635			female (age:18-29) n = 203	female (age:60-88) n = 50		female 2000CY
%ile	Sitting hight	%ile	Sitting hight	Sitting hight	%ile	Sitting hight
5	827	5	824.1	737.8	5	810
10	840	10	833.0	758.8	10	---
25	864	25	850.5	771.3	25	---
50	890	50	864.0	796.5	50	865
75	915	75	885.0	822.5	75	---
90	936	90	902.8	840.2	90	---
95	947	95	918.9	852.8	95	925
male (age:20-60) n = 495			male (age:18-29) n = 217	male (age:61-81) n = 47		male 2000CY
%ile	Sitting hight	%ile	Sitting hight	Sitting hight	%ile	Sitting hight
5	882	5	873.0	812.6	5	862
10	896	10	887.0	829.2	10	---
25	916	25	903.0	841.0	25	---
50	949	50	926.0	867.0	50	928
75	976	75	945.0	880.0	75	---
90	1001	90	969.4	887.6	90	---
95	1016	95	985.2	896.5	95	994

Source : (Netherlands) NL Calculation of needed head restraint height (informal group 3rd meeting)
(Japan) *Human Body Dimensions Data for Designs* (1994) by Life Engineering and Industrial Technology Research Institute, Agency of Industrial Science and Technology

Effects of Straightening and Ramping-up on the Height of the Head Restraints

Rev.1

Straightening and Ramping-up of the test subject in the past

<Points of Examination >

1) Straightening

Amount of change due to the straightening of the vertebrae

→ **Amount of change in distance between T1-IC**

2) Ramping-up

Amount of elevation of the trunk

→ **Displacement of IC along the seat back**

Standard seat: 22.5 °

The above points were examined until just before the trunk rebounds from the seat back

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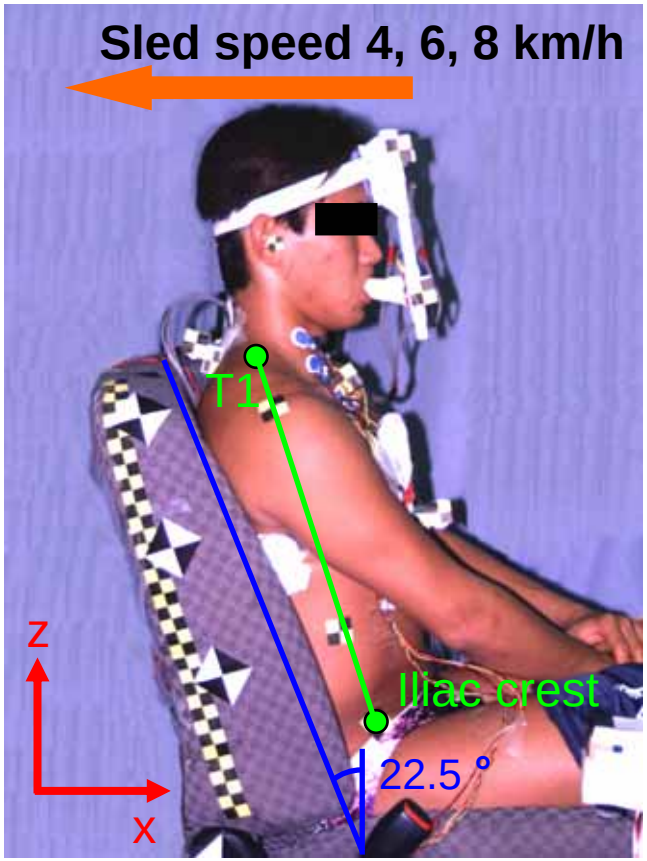
Check them at the moment T1 is closest to the seat back



Seat used: Standard seat

Test subjects: 4 to 5 males

Effects of Straightening and Ramping-up on the Height of the Head Restraints

Rev.1

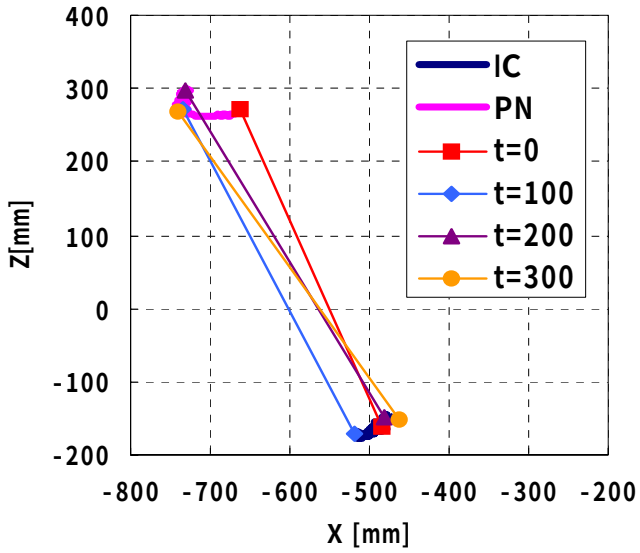
Straightening and Ramping-up at the moment T1 is closest to the seat back

Straightening : About 38 mm in average(up to 6km/h)

Ramping-up : About 10 mm in average (8 km/h)

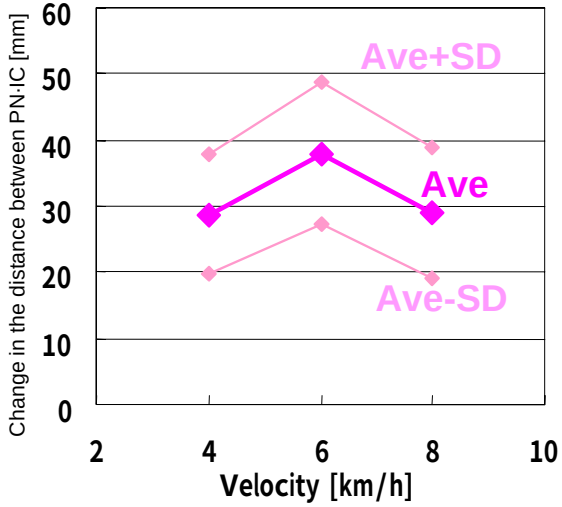
Orbit of T1· IC

Sled speed: 8 km/h



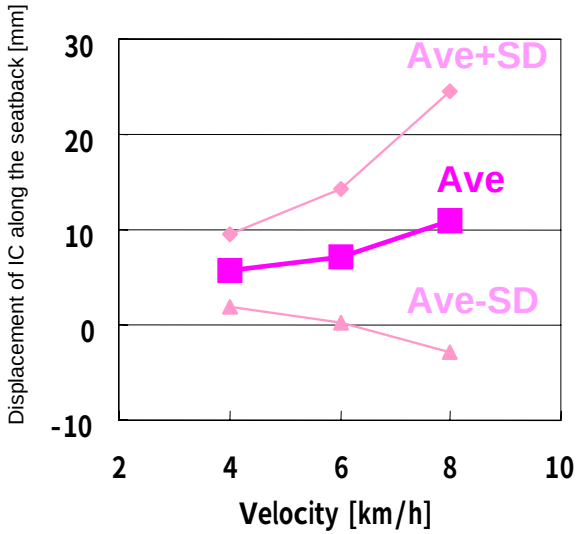
Straightening

Change in the distance between PN·IC



Ramping-up

Displacement of IC along the seatback



Effects of Straightening and Ramping-up on the Height of the Head Restraints

Rev.1

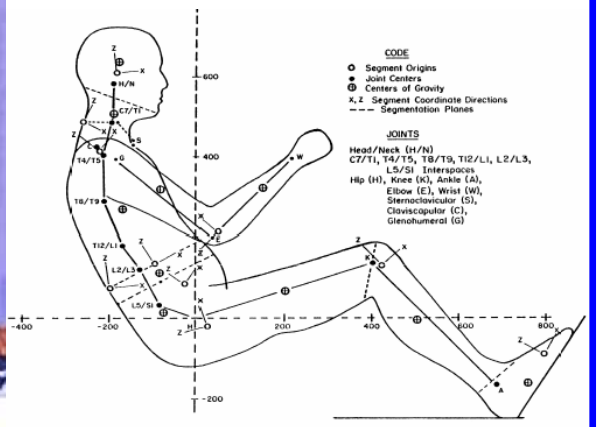
Measuring Seating Height and Seating Position
At CEASAR and in Japan, the seating height is measured with the subject sitting up straight and includes extension due to the straightening of the vertebrae that occurs at the moment the occupant sustains a rear impact.

CEASAR : Sitting Height

Same method used in Japan

Position of the subject's when her/his sitting height is measured

Mini sled test



UMTRI method

Example of the sitting position

Effects of Straightening and Ramping-up on the Height of the Head Restraints

Rev.1

Summary

- **Upward move during a mini-sled test simulating a rear impact**

  Ramping-up : About 10 mm (8 km/h)

  Straightening : About 38 mm (6 km/h)

- **Of the above amount, the “Straightening ” is included in the sitting height measured.**

⇒ **The factors we have to consider in determining the head restraint height are only**

“the straight sitting height + Ramping-up”.

Conclusion

2. Height

- It was found that females are more susceptible to neck injury than males in Japan. However, there is no data supporting the relationship between seated height and susceptibility.

- According to the research in Europe, females with high seated height are the most susceptible.

- Head restraints with a height of 800 mm can cover the body of Japanese occupants . Head restraints with a height of 850 mm may cause a concern about rear field of view. Therefore, Japan recommends 800 mm.

Reference : Japan comment at 3rd HR IWG meeting

2. Study of Possible Effects on Mini Cars

(1) On direct rearward and rearward oblique visibility

Affected by the head restraint width, but hardly affected by its increased height.

(2) On indirect rearward visibility

At the maximum head restraint height, visibility through the inner mirror greatly affected due to a limited vehicle width.

- **Height-adjustable head restraints are likely to be required.**