INJURY FREQUENCY AND INJURY PANORAMA AMONG DRIVERS

A COMPARISON BETWEEN SMALL AND BIG CARS AND THE INFLUENCE OF YEAR MODEL AND PRODUCTION START

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INTRODUCTION

Since the first automobile was made in the middle of the nineteenth century it has been subject to a continuous development. In the middle of the twenties, cars became more comfortable and efforts were made to make the exterior more pleasing to the eye. Besides, new constructions were made from technical and functional aspects. During the last two decades, car production has been focused round safety problems and economic aspects. (4)

Safety regulations

In September 1966 the National Traffic and Motor Vehicle Safety Act was signed into law in the U.S.A. The act specifies that the secretary of Transportation shall establish appropriate federal motor vehicle safety standards to reduce the number of fatalities and injuries resulting from traffic accidents.

Over the past twelve years, the National Highway Traffic Safety Administration (NHTSA) has issued over fifty motor vehicle safety standards. (8)

Car size

Due to rising fuel costs, there is a world-wide tendency to down-size cars. Small cars have less structure, substance, and size to absorb crash energy. As a result, car occupants are exposed to more violence and thereby to a higher injury risk. (2, 5, 6, 7)

The aim of this study has been to evaluate the influence of car size, year model, and production start on injury frequency and injury panorama.

MATERIAL AND METHOD

The material consists of cases of damage with claims for compensation on the compulsory third party liability insurance. During the studied period (1976-07-01 -- 1977-06-30) 80,891 accidents occurred that were reported to Folksam under tariff 01 (private cars for personal use only).

The distribution of the accidents can be seen from table 1. The number of private cars insured with Folksam during the studied period can be seen from table 2. The distribution of the injured is reported in figure 1.

Numbers between brackets refer to references listed at the end of the paper.

TABLE 1 The total number of private cars involved in accidents broken down by type of accident.

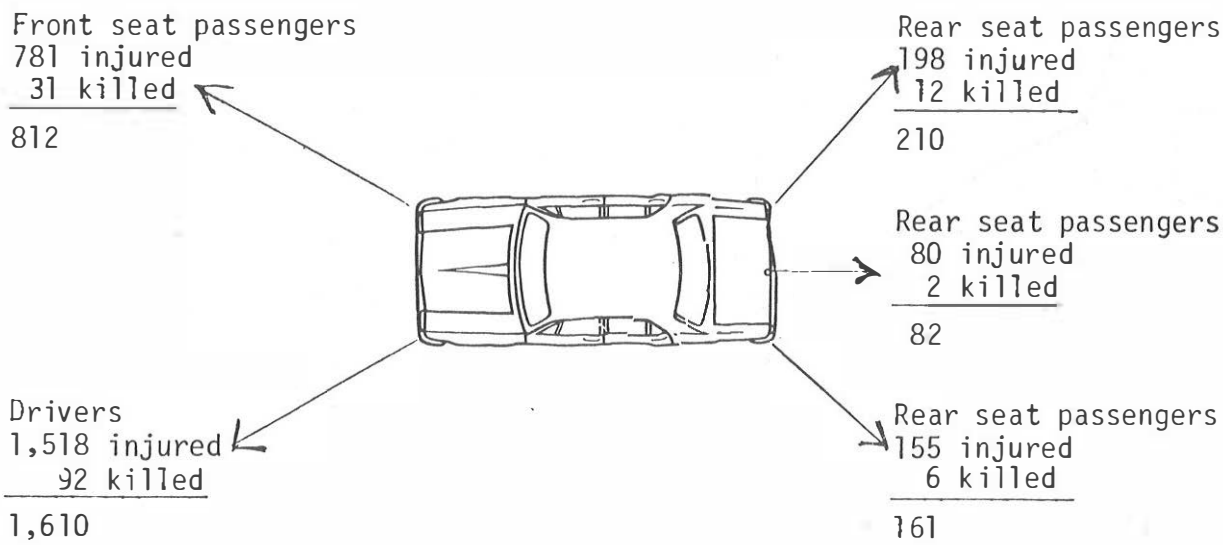
Collision with more than 1 vehicle involved	77,268
Other types of accidents	3,623

TABLE 2 Number of private cars insured with Folksam during the studied period (1976-07-01 -- 1977-06-30).

Number of insurances under annual risk	Number of accidents with personal injuries (tariff 01)
711,989*	2,271

*Annual risk means that the duration of each insurance is counted as part of a calendar year. E.g. and insurance accepted on September 1st and in force for the rest of the year will get an annual risk of 1/3 = 0.333.

FIGURE 1 The study contains in all, 2,271 accidents with private cars (excl. taxis). At these accidents 3,353 persons were injured and 217 were killed.



The figure shows where the injured persons were sitting in the car at the time of the accident.

Totally 2,875 persons were injured or killed inside the car. For 109 persons (106 injured and 3 killed) the position in the car is unknown.

515 unprotected road users (cyclists, pedestrians, etc.) were injured and 71 were killed. In this study only injured and killed persons inside the car are reported.

RESULT

Car weight

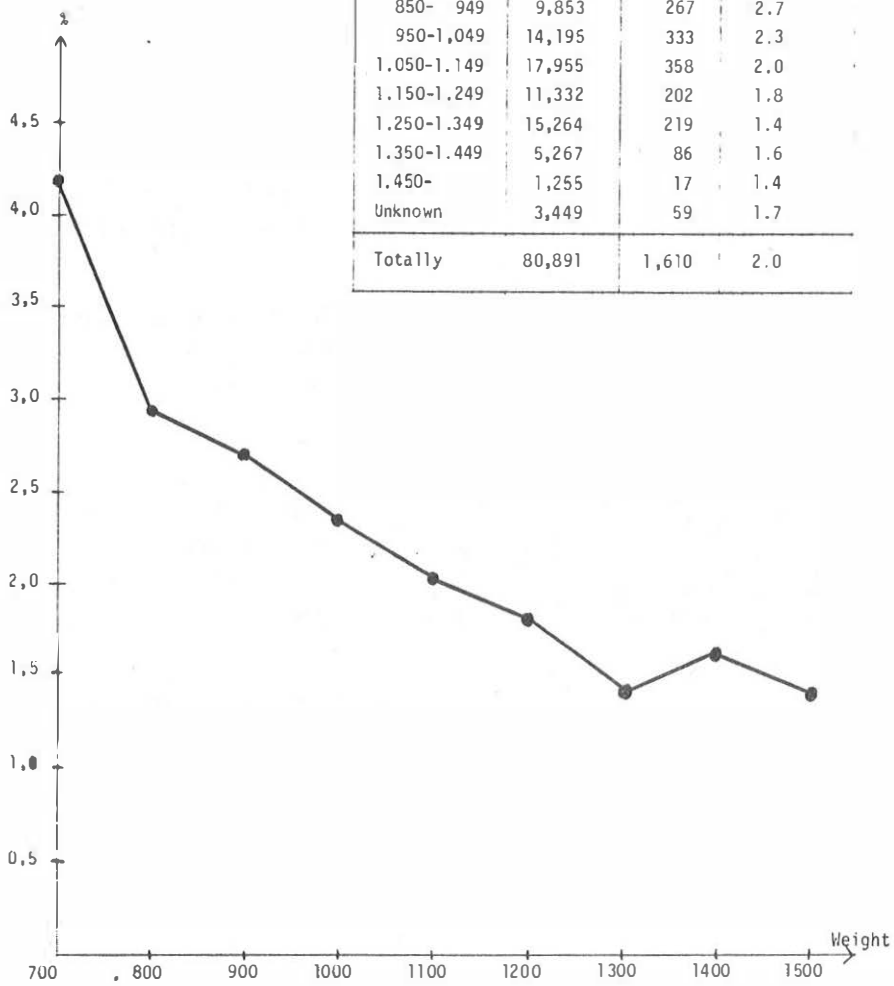
The injury frequency among drivers is twice as high in a car with a weight of 800 kg. compared to a car weighing 1,400 kg. (table 3 and figure 2).

Percentage shares of injured drivers distributed on car weight.

Table 9.

Weight in kg.	No. of involved vehicles	No. of injured drivers	% share of injured drivers
- 749	189	8	4.2
750- 849	2,132	61	2.9
850- 949	9,853	267	2.7
950-1,049	14,195	333	2.3
1.050-1.149	17,955	358	2.0
1.150-1.249	11,332	202	1.8
1.250-1.349	15,264	219	1.4
1.350-1.449	5,267	86	1.6
1.450-	1,255	17	1.4
Unknown	3,449	59	1.7
Totally	80,891	1,610	2.0

Figure 2



Year model and production start

Car models have different production starts. A model can be made for many years, i.e. several year models are practically identical. This means that a row of year models with the same production start has the same safety level apart from minor modifications. The influence of the year model (the age of the car) and the production start (the safety level of the car) can be seen from figure 3 and tables 4 and 5.

FIGURE 3 Injury frequency among drivers for different year models and production starts.

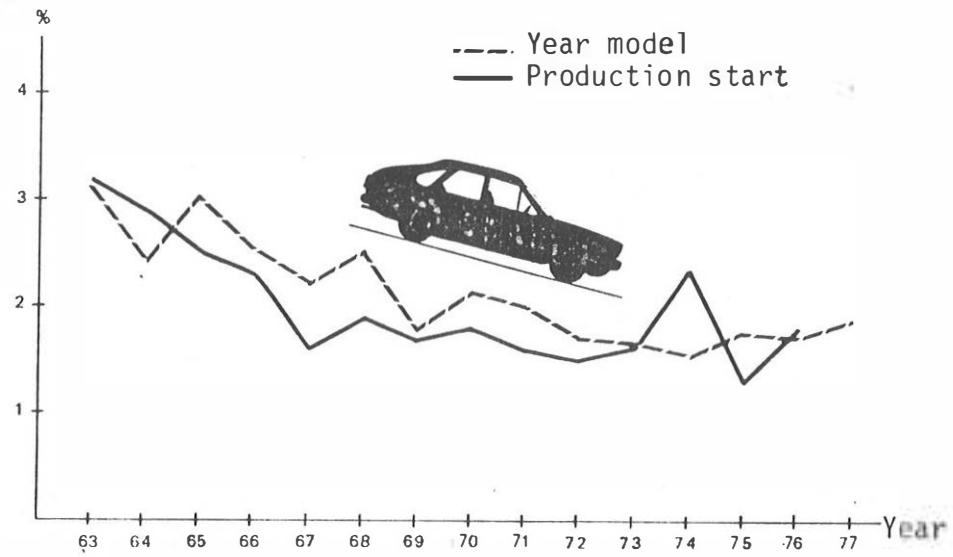


TABLE 4 Injury frequency among drivers correlated to year model.

Year model	No. of vehicles involved	No. of injured drivers	Injury frequency
1963	3,637	112	3.1
1964	2,392	58	2.4
1965	3,718	112	3.0
1966	4,009	102	2.5
1967	3,630	80	2.2
1968	4,569	115	2.5
1969	6,431	115	1.8
1970	6,205	132	2.1
1971	6,031	121	2.0
1972	6,741	114	1.7
1973	7,582	125	1.6
1974	7,228	112	1.5
1975	10,252	179	1.7
1976	5,379	91	1.7
1977	2,176	41	1.9
Unknown	911	1	
Totally	80,891	1,610	1.99

TABLE 5 Injury frequency among drivers correlated to production start.

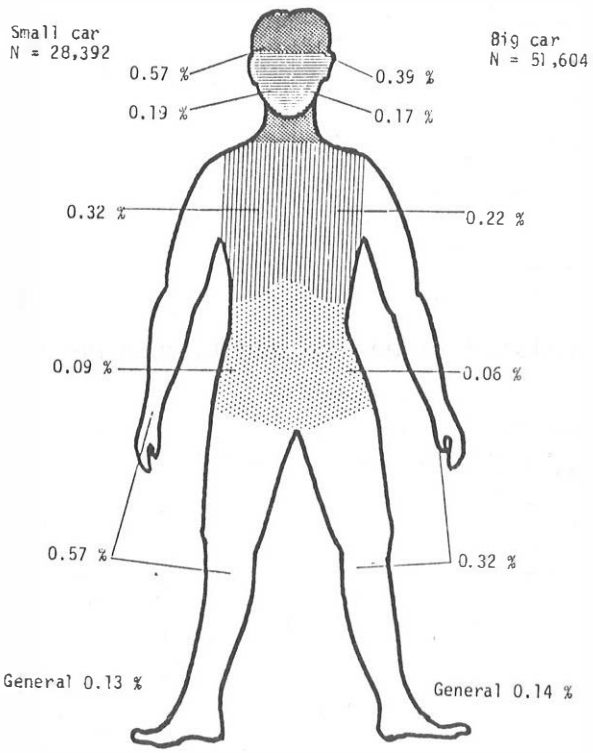
Production start	No. of vehicles involved	No. of injured drivers	Injury frequency
1960	13,257	348	2.6
1961	962	28	2.9
1962	2,545	63	2.5
1963	1,976	63	3.2
1964	279	8	2.9
1965	6,770	172	2.5
1966	2,620	59	2.3
1967	15,181	246	1.6
1968	3,768	72	1.9
1969	8,036	139	1.7
1970	1,844	33	1.8
1971	5,253	85	1.6
1972	4,562	69	1.5
1973	3,431	56	1.6
1974	1,182	31	2.6
1975	4,559	61	1.3
1976	874	16	1.8
1977	343	2	
Unknown	3,449	59	
Totally	80,891	1,610	1.99

There is a clear tendency showing that the injury frequency decreases the newer the car. The tendency is the same for the production start, but the figures are somewhat inhomogenous due to the fact that some years there are few car models with new production starts. However, a deep analysis has shown that the production start has a greater influence on the car safety than the year model.

Injury panorama

Injured drivers in small cars have more injuries in all body regions apart from the face. Injuries to the face are often caused by the steering wheel and in most cars the distance to the steering wheel is the same irrespective of the size of the car. (1, 3) Injuries to the rest of the body are due to the fact that the interior of the car is closer to the body in a small car, resulting in a violent contact with the body in case of an accident.

FIGURE 4 Injury panorama among drivers. A comparison between small and big cars.



The influence of engine mounting and type of drive

The cars in the study are divided into three groups according to engine mounting and type of drive. In tables 6 - 8 the injury frequency among drivers is shown for cars with front engine mounting and front or rear drive and with rear engine mounting and rear drive.

TABLE 6 Injury frequency among drivers related to engine mounting/drive and production start. Car weight below 1,100 kg.

Production start	Injury frequency among drivers		
	Front engine mounting/ rear drive	Front engine mounting/ front drive	Rear engine mounting/ rear drive
1960-1966	3.0 %	2.8 %	3.8 %
1967-1971	2.2 %	1.9 %	2.0 %
1972-	2.3 %	1.7 %	-

TABLE 7 Injury frequency among drivers related to engine mounting/drive and production start. Car weight 1,100 kg. and over.

Production start	Injury frequency among drivers		
	Front engine mounting/ rear drive	Front engine mounting/ front drive	Rear engine mounting/ rear drive
1960-1966	2.2 %	1.8 %	2.6 %
1967-1971	1.5 %	1.8 %	-
1972-	1.4 %	-	-

TABLE 8 Injury frequency among drivers related to engine mounting/drive and car weight.

Car weight	Injury frequency among drivers		
	Front engine mounting/ rear drive	Front engine mounting/ front drive	Rear engine mounting/ rear drive
- 849	3.5 %	2.6 %	4.8 %
850-1049	2.5 %	2.2 %	3.3 %
1050-1449	1.7 %	1.8 %	2.4 %
1450-	1.4 %	-	-

Among cars weighing less than 1,100 kg. the injury frequency among drivers is the lowest for cars with front engine mounting and front drive. For cars over 1,100 kg the cars with front engine mounting and rear drive have the lowest injury frequency.

Injury severity correlated to car weight, year model, and production start

Big new cars have the lowest injury risk for all severity grades ($\geq$ 1,100 kg., year model $\geq$ 72, production start $\geq$ 72 and $\geq$ 67 respectively). Small old cars have the highest injury risk for all severity grades ($<$ 1,100 kg., year model $<$ 72 and $<$ 67 respectively). The injury risk for small new cars almost reach the safety level of big old cars.

TABLE 9 Risk figures

Small old car $<$ 1,100 kg. year model $<$ 1972
Small new car $<$ 1,100 kg. year model $\geq$ 1972
Big old car $\geq$ 1,100 kg. year model $<$ 1972
Big new car $\geq$ 1,100 kg. year model $\geq$ 1972

	I S S			
	1 - 3	4 - 10	11 -	Killed
Big new cars	100	100	100	100
Big old cars	127	128	150	143
Small new cars	122	123	150	185
Small old cars	180	288	212	285

TABLE 10 Risk figures

Small old car < 1,100 kg. production start < 1972
Small new car < 1,100 kg. production start ≥ 1972
Big old car ≥ 1,100 kg. production start < 1972
Big new car ≥ 1,100 kg. production start ≥ 1972

	I S S			
	1 - 3	4 - 10	11 -	Killed
Big new cars	100	100	100	100
Big old cars	121	131	105	180
Small new cars	121	121	126	220
Small old cars	181	223	178	380

TABLE 11 Risk figures

Small old car < 1,100 kg. production start < 1967
Small new car < 1,100 kg. production start ≥ 1967
Big old car ≥ 1,100 kg. production start < 1967
Big new car ≥ 1,100 kg. production start ≥ 1967

	I S S			
	1 - 3	4 - 10	11 -	Killed
Big new cars	100	100	100	100
Big old cars	135	137	200	112
Small new cars	131	119	180	125
Small old cars	185	237	240	275

The influence of speed

Big cars are in this study more often involved in accidents on roads with a speed limit exceeding 50 km/h. Higher speed means increased violence to the body in case of an accident. Thus big cars in this study have been exposed to higher retardation compared to small cars but nevertheless both injury frequency and injury severity are lower in big cars.

The influence of seat belt usage

Many studies have shown the positive effect of seat belt usage. In Sweden the usage rate is 80 - 85 % among front seat occupants. One group with a low belt usage rate is young people (18 - 24 years old) who also used big old cars to a higher degree. If 18 - 24 year old drivers are excluded from the study, there will be the same tendency as to injury frequency and injury severity as described above.

DISCUSSION

Due to rising fuel prices, the production of small cars have increased all over the world. Small cars give more severe injuries than big cars. There is, however, an ambition among car manufacturers to make safer cars. (2, 5, 6, 7)

In March 1982, US Department of Transportation presented a report that showed significant safety benefits in terms of reduced fatalities and injuries due to the introduction of safety regulations in the U.S.A. During 1966 - 1981 a reduction of 83,000 fatalities was calculated for traffic victims. (8)

This study shows that small cars have a higher injury frequency than big cars, but the difference decreases when a small new car is compared to a big old one. As to year model and production start, it is evident that the latter has more influence on injury frequency. Production start means a fundamental change of the construction of a car and most changes are intended to increase the safety level. Different year models with the same production start have only minor changes. These changes have less influence on car safety than the fundamental ones for different production starts.

CONCLUSIONS

1. Small cars have a higher injury frequency than big cars.

2. Small cars have a higher injury severity compared to big cars.

3. Drivers in small cars have more injuries in all body regions except the face. Face injuries are often caused by the steering wheel. An improvement of the steering wheel construction is desirable.

4. The difference in injury severity and injury frequency is levelled out for new cars. The efforts to make the interior of the car safer have been successful.

5. Many different things influence the design of a car. In the last decade car weight has been a matter of concern due to rising fuel prices. It is

vital to follow up important changes in different car models in real traffic accidents. It is also important to study all traffic accidents both with and without bodily injuries to be able to judge the safety level of a car. An insurance material gives this opportunity.

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