AN ANALYSIS OF FATAL CAR CRASHES IN WHICH THE VICTIM WAS WEARING A SEAT BELT.

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Introduction:

This paper sets out to examine a group of seat belt wearers killed in road traffic crashes. Some demographic similarities and differences between the seat belt wearers killed and the population from which they have been selected are examined.

The number and type of all significant injuries of the deceased seat belt wearers have been recorded and these are compared with a sample of deceased crash victims killed in the same number of crashes of the same type but not wearing seat belts.

The material used has been collected from crashes in the Australian State, Victoria, which in 1971 had a population of 3.5 million. There were 1,427,104 motor vehicles registered in that year and 620 drivers and passengers were killed in road traffic crashes.

On December 22, 1970 the State Government proclaimed a bill that "a person shall not be seated in a motor car that is in motion, in a seat for which a seat belt is provided unless he is wearing the safety belt and it is properly adjusted and securely fastened".

Method

In Victoria all deaths resulting from road crashes are referred to the Coroner to determine the cause of death and where responsibility lies. An inquest is conducted at which evidence is heard from survivors of the crash, witnesses, police, doctors and any other experts who may be called. The Coroner has requested that blood alcohol levels be measured in all adults who die following crashes.

Depositions received by the Coroner in 1971/1972 relating to 476 road traffic crashes causing death were examined. General characteristics of this population - age, sex, seating position and seat belt usage were noted. Characteristics of the crashes e.g. day, time, light and crash type and the resulting major injuries, survival time and cause of death were also noted.

Out of this population of 476 crashes there was good evidence that seat belts were being worn by 67 victims who died in 60 crashes. All significant injuries of these fatally injured seat belt wearers were

noted. A sample of 60 crashes, stratified to insure equal numbers of single and multi-vehicle crashes to those in the seat belted group, was randomly selected from the remaining population. All injuries for this second group were compared to those recorded for the seat belt wearers.

Results and discussion:

There were 582 people killed in the 476 crashes examined and of these 67 were wearing seat belts* i.e. for each 8.7 victims there was one seat belt wearer.

Drivers made up 316 of the whole population and 36 of the seat belted population i.e. one in every 8.8 drivers killed was wearing a seat belt.

Passengers made up 266 of the whole population and 31 of the seat belted population i.e. one in every 8.6 passengers killed was wearing a seat belt. There is no material variation in the proportion of drivers and passengers killed while wearing seat belts.

Females make up one out of every 3 seat belted fatalities but only one out of every 3.6 non belted fatalities.

Day of Week:

There are minor differences in these figures from day to day (see Table 1) to what might be expected if wearing rates were the same on each day of the week. The variations appear to be random and with the exception of Thursday and Friday (in which the variation is in opposite directions) one more fatality in the seat belted population would bring the figures close to the expected proportions.

Crash times:

The pattern of time of crash for seat belted victims (see Table 2) is fairly similar to that for the whole population of occupant fatalities showing a general rise from midday which is maintained until 2.00 a.m. This pattern would seem to be a reflection of traffic density.

Age of deceased:

It was surprising to find that there is a sharp change in wearing rates for victims above the age of 35. If people wore seat belts in the same proportion throughout each age group and excluding the under 11 year olds, there would have been one belted occupant killed for each 8.4 victims.

*Belts were of lap sash type in all but four cases - three being sash and one a lap belt.

In those up to 36 years of age the average is one belted occupant killed for each 11 victims. For those 36 years of age and older the average is one seat belted occupant killed for each 5.3 victims! The breakdown of ages and seat belt wearers is shown in Table 3.

A number of hypothesis can be put forward to explain this variation. The first possibility is that seat belts are worn considerably more in the above 35 age group than by those 35 years old or less.

Evidence from an independent survey carried out by the Road Safety and Traffic Authority (1) towards the end of 1971 suggests that this is not the case.

They found that there was a slight variation with a tendency towards lower wearing rates in the very young drivers and higher rates in the oldest groups (see Table 4).

Another possibility which needs to be considered is that seat belts are saving the lives of the younger age group but not of the older age group.

This could be because the younger vehicle occupants are more resilient. The young may also be more conscientious about how they wear their belts and thus get greater protection by virtue of more effective use of seat belts.

The RoSTA survey referred to above examined this aspect of belt wearing and found that the 25-29 year old drivers were found to be wearing belts correctly adjusted in 21.6% of cases observed, whereas the overall average was 13.5%.

Fault in adjustment included -	twisted	25.9%
	loose	25%
	very loose	12.2%
	buckle not on hip	20.3%
	belt left partly around retractor	2.1%

Thus the wearing of belts incorrectly adjusted by the older group may have contributed in part to their higher fatality rate among belt wearers.

There is no doubt that with increasing age there is decreased ability to recover from injury. The time from crash until death (Table 5) when split into these two age groups, under 36 and 36 upwards, shows that most young occupants die in the first hour. Only about 25% died after that. With the 36 and over group, over 45% survived beyond the first hour only to die later. Secondary causes of death also appear more often in the older age group e.g. pneumonia, pancreatitis.

A fourth consideration is the possibility that young seat belt wearers are more careful drivers than young non belt wearers whereas all older drivers are generally more careful drivers.

If this were the case it might be supported by a finding of a larger number of severe injuries in the younger age group non seat belt wearers and also by evidence of more higher speed crashes.

While acknowledging that estimates of speed are not reliable it is worth noting that the reported speed at impact for all fatal crashes in the young group averaged almost exactly the same as for the older group - between 58 and 60 m.p.h. or about 95 km.per hour.

Examination of injuries sustained in the younger and older seat belt wearers killed show that except for head injuries where there is a slight predominance of younger occupants, the older group have far more of every type of significant injury. The sum total being 90 significant injuries for the 32 young occupants and 139 significant injuries for the 35 older occupants.

This tends to support the view that seat belts give less protection to the older age groups.

The younger fatalities in the non seat belt wearing population occurred in crashes at a higher speed than in the other groups - average speed being about 7 miles per hour or 10 km. per hour faster. It comes as a surprise then to find that there are slightly more injuries in the seat belted occupants killed than in the unbelted occupants killed.

Some explanation for this situation can be constructed by examining injuries in relation to type of crash. Here it is found that irrespective of whether a seat belt is worn or not there are more injuries suffered by victims of fatal multi-vehicle crashes, average 4 per person killed, than of fatal single vehicle crashes, average 3 per person killed.

According to my findings the younger group are more often involved in fatal single vehicle crashes than the older group - 22 to 12 in seat belt wearers and 28 to 16 in non belt wearers.

Thus the non seat belt wearers being younger and more often involved in single vehicle crashes manage to sustain less injuries than the seat belted victims.

There have been frequent suggestions that seat belts may be responsible for injuries. They have been reported as responsible for traumatic rupture of the uterus, rupture of the stomach, small and large bowel and omentum and more frequently rupture of upper abdominal viscera - liver spleen and kidney and a variety of spinal injuries.(2) A list of injuries sustained by belt wearers and non wearers was examined. See Table 6.

In tabulating injuries if an individual suffered a fractured base of skull, subarachnoid haemorrhage and contused brain the injury was recorded as fractured base of skull only.

Similarly ruptured aorta and haemathorax would be recorded simply as ruptured aorta. Intra or extraperioneal haemorrhage were only recorded where no site of the haemorrhage was specified.

Where two fractures occur to a single area in one person it was noted only once e.g. fractured mandible and fractured maxilla would appear as fracture of face, fracture of both femurs is recorded as two separate injuries. All rib fractures were multiple.

Because of the large number of variables involved it is not useful to draw conclusions from a table of this type, however it seems reasonable to presume that the large number of rib and lung injuries in the seat belt wearers came as a result of the seat belt restraint. The unrestrained occupant being more likely to sustain head injuries.

Table 6 tends to support the view that seat belts may play a significant part in ruptures of bowel and mesenteric tears.

The overall injury pattern suggests that at least in the fatally injured abdominal trauma is no greater in belt wearers than non wearers.

One is tempted to speculate on the considerably larger number of serious cervical fractures and dislocations in the seat belt wearers. There are not sufficient numbers for useful comparison but one must wonder whether the constraint imposed by the seat belt is of real significance.

Blood alcohol levels for seat belt wearers and non wearers were compared. It was found that 12 belt wearers had levels above .05 mgm % with an average of .145 mgm %.

There were 22 non belt wearers killed with blood alcohol levels above .05 mgm % and these had an average of .158 mgm %.

Two features stand out in this group: the crashes occurred at considerably higher speeds than those for the non intoxicated and the intoxicated seat belt wearer suffered far fewer injuries than the intoxicated unbelted victim.

Conclusion:

This documentary study indicates that an in depth prospective study could be of value in examining the mechanism of injuries sustained by seat belt wearers. Fractures and dislocations of the cervical vertebrae call for special attention.

The fact that there is more than one serious head injury for each seat belt wearer killed suggests to me that belts are often worn incorrectly adjusted so that too often victims can still hit the windscreen with their heads. The large number of fractured ribs, lacerated lungs and haemothoraces may be the price to pay for seat belt protection. It is surprising to find more ruptured abdominal viscera in the non belt wearers but this may be the payoff for the smaller number of chest injuries.

References:

(1) ANDREASSEND, D. C. The Effect of Compulsory Seat Belt Wearing Legislation in Victoria. National Road Safety Symposium conducted by the Expert Group on Road Safety, Canberra 14-16 March, 1972.

(2) HODSON-WALKER, N. J. The Value of Safety Belts : A Review C.M.A. Journal Feb. 28 1970, Vol. 102 : 391.

Table 1:

Day	Seat Belted	Whole Population
Sunday	13	105
Monday	7	45
Tuesday	6	39
Wednesday	3	33
Thursday	8	50
Friday	7	84
Saturday	16	120

Table 2:

Time of Crash	Victim Belted	Victim Not Belted
0 - 2 a.m.	5	65
2 - 4	1	23
4 - 6	1	15
6 - 8	2	19
8 - 10	2	13
10 - 12	4	22
12 - 2 p.m.	7	35
2 - 4	6	35
4 - 6	11	66
6 - 8	5	45
8 - 10	8	63
10 - 12 midnight	8	66

3 Unknown

Table 3:

Age	Number wearing seat belt	Whole Population	Proportion
0 - 5	-	17	
6 - 10	1	5	
11 - 15	1	12	1/12
16 - 17	2	38	1/19
18 - 21	13	128	1/10
22 - 25	10	110	1/11
26 - 35	5	76	1/15.2
36 - 45	10	57	1/5.7
46 - 55	11	46	1/4.2
56 - 65	8	43	1/5.4
66+	6	38	1/6.3

Table 4:

Driver's Age	Under 20	20-24	25-29	30-39	40-49	50-59	60+
Number seen	29	135	105	158	146	91	37
% wearing seat belts	65.5	75.6	79	70.9	80.8	75.8	83.8

Table 5:

	Age to 36	36+
less than 1 hour	24	19
" " 8 hours	6	11
more than 8 hours	2	5

Table 6:

INJURY			NUMBER BELTED	NOT BELTED
Head				
Fractures - Vault			13	18
Base			29	25
Face			16	10
Unspecified			5	4
Severe brain damage without fracture			5	1
Severe intercranial haemorrhage without fracture			9	13
		TOTAL	77	71
Neck				
Cervical spine fractures or dislocation with fatal cord injury			9	3
Chest				
Fractures				
Ribs	Left		8	4
	Right		4	6
	Both		14	10
Lacerated Lung	Left		6	1
	Right		3	1
	Both		9	5
Haemothorax	Left		3	1
	Right		-	3
	Both		10	6
Tension Haemo-pneumothorax			1	-
Lacerated heart			1	5
Ruptured/torn aorta			5	7
Other mediastinal haemorrhage			2	4
Ruptured/torn diaphram			5	2
		TOTAL	71	55

Table 6 cont.

Table 6 (cont.)

				NUMBER BELTED	NUMBER NOT BELTED
Abdomen					
Ruptured/torn liver				11	15
" " spleen				7	10
" " kidney				2	5
Other severe injury e.g. ruptured intestine, torn mesentery or intraperitoneal haemorrhage				9	1
			TOTAL	29	31
Pelvis					
Fracture				6	2
Extra peritoneal haemorrhage				4	2
			TOTAL	10	4
Limbs					
Fractures	Humerus	L		6	-
		R		4	3
	Radius and ulna	L		1	-
		R		2	1
	Hip	L		-	-
		R		2	1
	Femur	L		4	4
		R		9	6
	Tibia and Fibula	L		3	6
		R		7	6
Other - dislocations and fractures				2	5
			TOTAL	40	32
Asphyxiated (primary cause of death) usually due to inhaled blood or vomitus.				5	5
Late causes precipitated by crash injuries				2	5