DESCRIPTION OF 3225 VICTIMS OF ROAD-TRAFFIC-ACCIDENT TRAUMA ACCORDING TO TYPE OF ACCIDENT, SEVERITY OF INJURY, AND NATURE OF LESIONS SUSTAINED

by

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The objectives of the present study were as follows:

1. To establish the frequency of road-traffic - accident trauma in a defined area surrounding the municipality of Odense, Denmark in 1978;

2. To determine the distribution of injured traffic-accident victims by type of accident responsible for their trauma;

3. To characterize the severity of the injuries sustained;

4. To summarize the nature of the injuries sustained in terms of body regions affected and region-specific lesions.

All data were collected by the Accident Analysis Group which maintains a trauma registry operating out of the emergency room at the Odense University Hospital.

Description of the trauma registry

Since February 1972 information on all road-traffic-accident victims presenting to the emergency room has been collected on a special registry form. This form includes personal information on the injured party, medical information about the injuries sustained, and a description of the circumstances surrounding the accident. From year to year parts of this form have been modified to focus on specific research issues. In 1978 AIS coding was incorporated for the first time. The registry catchment area includes a population of approximately 230,000 persons living in the mixed urban and rural area surrounding the municipality of Odense, Denmark. The only official emergency medical facility within the catchment area is at the Odense University Hospital where accident registration takes place.

The trauma registry records the type of accident in which victims are involved according to the victim's mode of transport (e.g., bicycle, automobile, walking, etc.) and the type of object with which the victim impacted. The severity of the injuries sustained by victims is characterized in the registry using both AIS coding and a designation as to the type of medical management required by the victim subsequent to treatment in the emergency room (e.g., follow-up treatment by family practitioner, admission to hospital, etc.). Also included is a notation as to whether the victim died of his injuries within 30 days of the accident.

For purposes of the present study the body was divided into the following nine regions: brain, head (excluding brain), neck, spine, chest, abdomen, pelvis, arms, and legs. The lesions to each region of the victim's body were characterized as being either to "soft tissue" or to "bone or joint" for regions other than the brain. Brain lesions were characterized as either suspected concussion, concussion or contusion.

Results

In 1978 3,225 road-traffic trauma victims were registered in and around the municipality of Odense. A distribution of these victims by type of accident is presented in Table 1. Six major categories of accidents are shown as well as fifteen subcategories which include reference to the nature of the object impacted by the victim. Moving objects with which the accident victims impacted are grouped according to their mass and speed potential relative to the victim's mode of transport.

For each type of accident the severity of injuries sustained is represented in two ways. First, a distribution of victims is given by the highest AIS code which was assigned to their injuries; second, victims are distributed according to the extent of

Table 1. Distribution of road-traffic-accident trauma victims by type of accident, severity of injury and extent of medical management required.

TYPE OF ACCIDENT	Number of victims	Percentage of total victims	Distribution of victims by highest assigned AIS code							Distribution of victims by type of medical management required subsequent to treatment in casualty room				
			0	1	2	3	4	5	6	None	Family physician	Hospital outpatient dept.	Hospital admission	Patient died
BICYCLE														
vs. pedestrian or bicycle	56		1	39	15	1	0	0	0	31	11	9	5	0
vs. moped, motorcycle/scooter, car or truck	227		6	152	51	8	4	1	5	115	28	24	54	6
vs. other moving or stationary object incl. road surface	990		14	752	203	16	5	0	0	479	210	144	156	1
all bicycle accidents	1273	39.5	21	943	269	25	9	1	5	625	249	177	215	7
MOTORCYCLE/SCOOTER														
vs. pedestrian, bicycle, moped or motorcycle/scooter	8		0	7	0	0	0	1	0	4	1	2	0	1
vs. car or truck	53		1	34	10	6	0	2	0	28	6	2	16	1
vs. other moving or stationary object incl. road surface	96		3	53	34	4	2	0	0	40	14	14	28	0
all motorcycle/scooter accidents	157	4.9	4	94	44	10	2	3	0	72	21	18	44	2
MOPED														
vs. pedestrian, bicycle or moped	45		1	32	9	3	0	0	0	20	6	10	9	0
vs. motorcycle/scooter, car or truck	209		4	130	56	14	2	2	1	93	29	24	60	3
vs. other moving or stationary object incl. road surface	433		10	305	110	6	2	0	0	217	65	81	70	0
all moped accidents	687	21.3	15	467	175	23	4	2	1	330	100	115	139	3
CAR														
vs. pedestrian, bicycle, moped or motorcycle/scooter	13		0	11	1	0	0	0	1	7	3	1	1	1
vs. car or truck	466		28	312	88	25	4	8	1	254	56	41	107	8
vs. other moving or stationary object incl. road surface	339		12	209	88	15	5	6	4	145	60	24	102	8
all car accidents	818	25.4	40	532	177	40	9	14	6	406	119	66	210	17
PEDESTRIAN														
vs. bicycle or moped	41		3	30	6	2	0	0	0	26	4	2	9	0
vs. motorcycle/scooter, car or truck	171		3	76	61	16	5	4	6	60	12	11	79	9
vs. other moving vehicle	9		0	5	2	1	0	1	0	5	0	2	1	1
all pedestrian accidents	221	6.9	6	111	69	19	5	5	6	91	16	15	89	10
all other traffic accidents	69	2.1	1	51	13	1	2	1	0	41	8	8	12	0
ALL TRAFFIC ACCIDENTS	3225	100.0	87	2198	747	118	31	26	18	1565	513	399	709	39

the medical management that they required subsequent to their treatment in the emergency room.

Several useful facts can be discerned in Table 1. First, it is clear that two-wheel vehicles account for the majority (65.6 percent) of injured accident victims in Odense. Bicycle accidents in particular contribute heavily to the total. For each type of two-wheeler, bicycle, moped and motorcycle/scooter, the majority of injured victims results from single-party collisions, i.e., collisions with stationary objects or falls from the vehicle. (Single-party collisions are designated as collisions with "other moving or stationary object including road surface" in Table 1.) Single-party collisions also account for a large number of victims injured in automobile accidents, although most such victims result from multi-party collisions. The vast majority of pedestrian victims (77.4 percent) results from accidents involving heavy moving vehicles.

If attention is turned from the total number of victims resulting from each type of accident to the number of severely injured victims, the relative contribution of the accident types changes somewhat. Of the 75 persons registered whose most severe injury was assigned an AIS code of 4, 5 or 6, slightly more (29) were victims of automobile accidents than were victims of two-wheeler accidents (27). A higher proportion of automobile victims (3.5 percent) was assigned AIS codes of 4 or higher than was the case for riders of motorcycles/scooters (3.2 percent), bicycles (1.2 percent), or mopeds (1.0 percent). As compared to automobile victims, the proportions for the latter two groups are significantly smaller at the .01 level. These findings probably result from differing characteristics of both the accident circumstances (impact velocities, etc.) and the people involved (age of victims, etc.).

In terms of the use of hospital inpatient facilities for accident trauma victims, two-wheelers again contribute the greatest part. Among victims who did not die as a result of their injuries, riders of two-wheel vehicles accounted for fully 56.1 percent of those for whom hospital admission was necessary. The picture changes however when considering the type of accident which leads to the majority of fatalities registered. Of the 39 victims who died within 30 days of experiencing severe accident trauma, 17 (43.6 percent) had been involved in automobile accidents. Fewer, 12 (30.8 percent), were victims of two-wheeler accidents.

Tables 2 through 6 present, for five major types of traffic accidents, the number of victims experiencing injury to each of nine body regions. For each region, percentage distributions of victims are shown by type of the severest lesion sustained and highest AIS score assigned to the region. For the brain, lesions were classified as suspected concussion, concussion, and contusion. For all other body regions, lesions were classified as soft tissue, bone or joint, other or unknown. The latter two

Table 2. Nature and severity of injuries to specified body regions among bicycle riders. Odense, 1978.

REGION OF BODY	VICTIMS WITH INJURY TO REGION	PERCENTAGE DISTRIBUTION OF VICTIMS WITH INJURY TO REGION BY TYPE OF MOST SERIOUS LESION IN REGION				PERCENTAGE DISTRIBUTION OF VICTIMS WITH INJURY TO REGION BY HIGHEST AIS CODE ASSIGNED TO REGION						
	Number	(1) + Soft tissue	(2) + Bone or joint	(3) + Other	Unknown	0	1	2	3	4	5	6
BRAIN +	108	26.9	63.9	8.3	0.9	0.0	28.7	63.0	4.6	0.9	0.9	1.9
HEAD (EXCL. BRAIN)	458	84.1	13.1	0.4	2.4	0.2	91.5	6.8	0.4	0.4	0.0	0.7
NECK	13	84.6	15.4	0.0	0.0	7.7	76.9	7.7	7.7	0.0	0.0	0.0
SPINE	13	69.2	30.8	0.0	0.0	7.7	53.8	15.4	23.1	0.0	0.0	0.0
CHEST	45	68.9	28.9	0.0	2.2	2.2	66.7	20.0	8.9	0.0	0.0	2.2
ABDOMEN	12	83.3	0.0	16.7	0.0	0.0	83.3	0.0	0.0	16.7	0.0	0.0
PELVIS	30	90.0	10.0	0.0	0.0	10.0	76.7	13.3	0.0	0.0	0.0	0.0
ARMS	468	66.2	31.6	0.9	1.3	3.0	71.4	23.9	1.5	0.2	0.0	0.0
LEGS	397	83.1	15.4	0.5	1.0	3.5	77.8	15.9	2.0	0.8	0.0	0.0
ALL REGIONS	1544	74.0	23.3	1.2	1.5	2.3	76.0	18.8	1.9	0.6	0.1	0.4

+ Types of brain lesions: (1) = suspected concussion, (2) = concussion, (3) = contusion

Table 3. Nature and severity of injuries to specified body regions among motorcycle/scooter riders. Odense, 1978.

REGION OF BODY	VICTIMS WITH INJURY TO REGION	PERCENTAGE DISTRIBUTION OF VICTIMS WITH INJURY TO REGION BY TYPE OF MOST SERIOUS LESION IN REGION				PERCENTAGE DISTRIBUTION OF VICTIMS WITH INJURY TO REGION BY HIGHEST AIS CODE ASSIGNED TO REGION						
	Number	(1) + Soft tissue	(2) + Bone or joint	(3) + Other	Unknown	0	1	2	3	4	5	6
BRAIN +	22	13.6	72.7	13.6	0.0	0.0	13.6	72.7	4.5	0.0	9.1	0.0
HEAD (EXCL. BRAIN)	22	68.2	27.3	4.5	0.0	4.5	68.2	27.3	0.0	0.0	0.0	0.0
NECK	2	100.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0	50.0	0.0
SPINE	2	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
CHEST	2	100.0	0.0	0.0	0.0	0.0	50.0	0.0	50.0	0.0	0.0	0.0
ABDOMEN	2	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
PELVIS	11	72.7	18.2	9.1	0.0	9.1	63.6	27.3	0.0	0.0	0.0	0.0
ARMS	60	70.0	30.0	0.0	0.0	1.7	66.7	25.0	6.7	0.0	0.0	0.0
LEGS	88	78.4	19.3	0.0	2.3	1.1	72.7	15.9	8.0	2.3	0.0	0.0
ALL REGIONS	211	68.7	28.0	2.4	0.9	1.9	64.0	25.6	6.2	0.9	1.4	0.0

+ Types of brain lesions: (1) = suspected concussion, (2) = concussion, (3) = contusion

Table 4. Nature and severity of injuries to specified body regions among moped riders. Odense, 1978.

REGION OF BODY	VICTIMS WITH INJURY TO REGION	PERCENTAGE DISTRIBUTION OF VICTIMS WITH INJURY TO REGION BY TYPE OF MOST SERIOUS LESION IN REGION				PERCENTAGE DISTRIBUTION OF VICTIMS WITH INJURY TO REGION BY HIGHEST AIS CODE ASSIGNED TO REGION						
	Number	(1) + Soft tissue	(2) + Bone or joint	(3) + Other	Unknown	0	1	2	3	4	5	6
BRAIN +	80	22.5	70.0	7.5	0.0	0.0	23.8	70.0	0.0	1.3	3.8	1.3
HEAD (EXCL. BRAIN)	151	76.8	19.9	0.7	2.6	1.3	88.1	9.3	0.7	0.7	0.0	0.0
NECK	5	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
SPINE	15	80.0	20.0	0.0	0.0	6.7	73.3	13.3	6.7	0.0	0.0	0.0
CHEST	29	48.3	41.4	0.0	10.3	10.3	48.3	24.1	13.8	3.4	0.0	0.0
ABDOMEN	6	100.0	0.0	0.0	0.0	0.0	83.3	0.0	0.0	16.7	0.0	0.0
PELVIS	22	72.7	22.7	4.5	0.0	4.5	72.7	18.2	4.5	0.0	0.0	0.0
ARMS	298	71.1	26.2	0.3	2.3	2.0	71.8	24.2	1.7	0.3	0.0	0.0
LEGS	359	80.5	18.1	0.3	1.1	2.2	77.4	14.8	4.7	0.8	0.0	0.0
ALL REGIONS	965	71.3	25.8	1.0	1.9	2.2	72.0	21.6	3.0	0.8	0.3	0.1

+ Types of brain lesions: (1) = suspected concussion, (2) = concussion, (3) = contusion

Table 5. Nature and severity of injuries to specified body regions among people riding in cars. Odense, 1978.

REGION OF BODY	VICTIMS WITH INJURY TO REGION	PERCENTAGE DISTRIBUTION OF VICTIMS WITH INJURY TO REGION BY TYPE OF MOST SERIOUS LESION IN REGION				PERCENTAGE DISTRIBUTION OF VICTIMS WITH INJURY TO REGION BY HIGHEST AIS CODE ASSIGNED TO REGION						
		(1) +	(2) +	(3) +								
	Number	Soft tissue	Bone or joint	Other	Unknown	0	1	2	3	4	5	6
BRAIN +	150	26.0	64.0	8.7	1.3	0.0	26.0	65.3	0.7	2.0	5.3	0.7
HEAD (EXCL. BRAIN)	410	86.1	9.8	0.7	3.4	2.7	88.8	6.6	1.5	0.0	0.2	0.2
NECK	57	89.5	8.8	0.0	1.8	12.3	77.2	1.8	7.0	0.0	0.0	1.8
SPINE	29	72.4	27.6	0.0	0.0	3.4	69.0	13.8	13.8	0.0	0.0	0.0
CHEST	114	60.5	32.5	2.6	5.3	5.3	55.3	15.8	14.0	1.8	4.4	3.5
ABDOMEN	25	88.0	0.0	12.0	0.0	12.0	40.0	0.0	0.0	28.0	16.0	4.0
PELVIS	21	38.1	47.6	0.0	14.3	9.5	33.3	42.9	9.5	4.8	0.0	0.0
ARMS	212	66.5	29.7	1.4	2.4	6.6	65.6	24.5	2.4	0.9	0.0	0.0
LEGS	178	73.6	20.8	3.4	2.2	9.0	67.4	14.0	8.4	1.1	0.0	0.0
ALL REGIONS	1196	69.8	24.7	2.6	2.9	5.0	67.4	19.6	4.4	1.4	1.5	0.7

+ Types of brain lesions: (1) = suspected concussion, (2) = concussion, (3) = contusion

Table 6. Nature and severity of injuries to specified body regions among pedestrians. Odense, 1978.

REGION OF BODY	VICTIMS WITH INJURY TO REGION	PERCENTAGE DISTRIBUTION OF VICTIMS WITH INJURY TO REGION BY TYPE OF MOST SERIOUS LESION IN REGION				PERCENTAGE DISTRIBUTION OF VICTIMS WITH INJURY TO REGION BY HIGHEST AIS CODE ASSIGNED TO REGION						
		(1) +	(2) +	(3) +								
	Number	Soft tissue	Bone or joint	Other	Unknown	0	1	2	3	4	5	6
BRAIN +	66	12.1	68.6	24.2	0.0	0.0	13.6	63.6	4.5	3.0	9.1	6.1
HEAD (EXCL. BRAIN)	85	85.9	12.9	0.0	1.2	1.2	90.6	5.9	0.0	1.2	0.0	1.2
NECK	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPINE	7	28.6	71.4	0.0	0.0	0.0	28.6	14.3	42.9	0.0	14.3	0.0
CHEST	10	60.0	30.0	0.0	10.0	0.0	40.0	10.0	30.0	0.0	10.0	10.0
ABDOMEN	10	100.0	0.0	0.0	0.0	0.0	50.0	10.0	10.0	20.0	10.0	0.0
PELVIS	17	52.9	47.1	0.0	0.0	0.0	47.1	41.2	11.8	0.0	0.0	0.0
ARMS	59	66.1	32.2	0.0	1.7	3.4	61.0	30.5	5.1	0.0	0.0	0.0
LEGS	103	64.1	34.0	0.0	1.9	7.8	52.4	24.3	12.6	2.9	0.0	0.0
ALL REGIONS	357	59.7	34.5	4.5	1.4	3.1	54.6	28.0	7.8	2.2	2.5	1.7

+ Types of brain lesions: (1) = suspected concussion, (2) = concussion, (3) = contusion

categories were necessary for cases in which it was not meaningful to designate any particular region-specific lesion as "most severe".

The information in Tables 2 - 6 is useful in determining the areas of the body which are most in need of biomechanical prophylaxis for specific types of transportation situations. For all types of traffic accidents, injuries to the brain, head (excluding brain), arm and leg were most common. A significant number of chest injuries among victims of automobile accidents was also noted. As expected, brain and head injuries tend to represent the severest injuries sustained in terms of the threat to life. Chest and abdominal injuries among automobile-accident victims were also frequently life threatening. The majority of brain lesions were classified as concussions in all types of accidents. Most frequently, for all types of accidents and all body regions (other than the brain), the severest lesion sustained was a soft-tissue lesion.

Discussion

In setting priorities for the study and implementation of biomechanical methods to reduce the physical injury caused by impacts, a diverse set of interdependent criteria must be considered. The questions of what is important, what is necessary, and what is possible must all be considered simultaneously. The value of hospital-based data in suggesting the answers to some of the relevant questions has been demonstrated many times. Important clues as to which problems are most in need of immediate attention and which problems are not are often forthcoming from such data. Nevertheless, it is important to bear in mind the limitations of hospital-based data in general, including the data of the present study.

First, it must be emphasized that the results of the 1978 registration of traffic-accident trauma in Odense cannot be used directly to determine either the risk of having a given type of accident, or the risk of sustaining injury having had an accident of a particular type. Precise calculation of both types of risk would only be possible if all accident victims in the Odense area were registered regardless of whether injury was sustained or not. Experience has shown clearly however that many people involved in accidents do not seek emergency medical care and therefore are not registered. The probability that such care is sought is influenced by such diverse factors as the age of the person involved in the accident, the time and place of the accident, and the drama surrounding the accident as viewed by witnesses.

Despite the rather uncontrolled nature of the de facto sampling which is taking place, local experience has demonstrated clearly

that nearly all of the relatively severe traffic-accident injuries are recorded. As the first aim of accident prevention must be to reduce the occurrance of tragic trauma, i.e. fatal and permanently disabling or disfiguring injuries, the information collected by the registry would seem to be that of greatest inherent value.

The findings of the present study demonstrate, among other things, that a good deal more work needs to be done to improve restraint systems and steering column characteristics of automobiles. It is also clear from the data that bicyclists would profit considerably from use of some sort of head protection. In fact, the whole area of head protection for riders of two-wheel vehicles would seem to warrant further study.