Pedestrian Deaths in Oslo Traffic Accidents

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The large towns and cities of the world are endemic foci of pedestrian deaths caused by traffic accidents (Norman, 1962). In Oslo, the capital of Norway (450,000 inhabitants), 25 to 30 persons die from injuries received in traffic injuries every year. This total represents about a twelfth of the yearly toll of traffic victims in the whole country. (Norway has a population of 3,800,000.) In Oslo most of these deaths come to necropsy —usually requested by the Police Department—at Oslo City Hospital and the Rikshospitalet, University of Oslo. From 1952 to 1961 the figure was 88%.

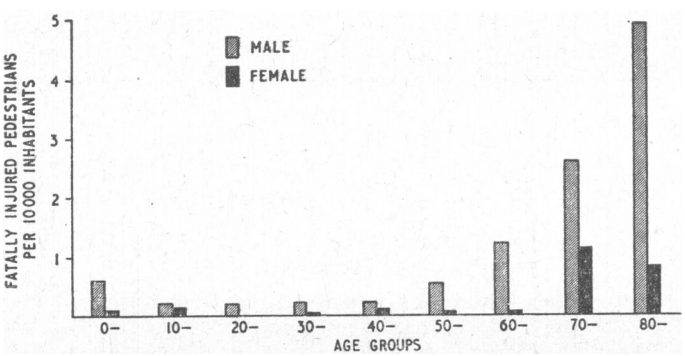
My series of 168 fatally injured pedestrians covers this 10-year period. These deaths account for about 65% of the total number occurring from traffic accidents during the same period in Oslo. In the two five-year periods, 1952–6 and 1957–61, the number of pedestrian deaths decreased from 73% to 58.4% of all deaths from traffic in Oslo, although the total number due to this cause increased by 36%. The increase is explained by the fact that while there was relatively little increase in the size of the population of the city there was a very great increase in the number of cars and motor-cycles. In consequence more deaths from traffic accidents occurred among motorists—in cars and on motor-cycles—in the second five-year period. It must be remembered that the sale of cars in Norway was rigorously restricted during the last war and indeed right up to 1957. In that year their sale again became free.

Age and Sex Distribution

Observations.—Of the total number of pedestrians in the series, 55% were 60 years of age or older and 12% under 9. Only a quarter were women (Table I). The absolute numbers show an age distribution which becomes more pronounced when mortality is related to the number of inhabitants in Oslo. The Chart shows the typical J-shaped curve.

TABLE I.—*Age and Sex Distribution of 168 Fatally Injured Pedestrians in Oslo 1952–61*

Age Groups	Males	Females	Total
0–9	17	3	20
10–19	6	4	10
20–29	6	—	6
30–39	8	1	9
40–49	8	4	12
50–59	16	2	18
60–69	24	15	39
70–79	23	14	37
80–	13	4	17
Total ..	121	47	168



Mortality rate of pedestrians killed in traffic accidents in Oslo, 1952–61.

Comments.—The high mortality among the older pedestrians is due partly to the age-associated risk of involvement in traffic accidents, and partly to the age-associated risk of a fatal outcome once injured (Haddon *et al.*, 1961). In assessing the relatively high mortality in the elderly pedestrians it has also to be remembered that the majority of old people are not exposed to traffic, keeping indoors at home or in institutions most of the time and moving outside only to a small extent.

Alcohol Intoxication

Observations.—Of the 138 fatally injured pedestrians aged 20 years or more, 27 (20%) were intoxicated by alcohol at the moment of the accident—that is, they were found to have a blood-alcohol concentration exceeding 0.05%. (This figure was chosen because in Norway it is forbidden by law to drive a motor vehicle when the alcohol concentration in the blood is above it.) One intoxicated pedestrian in the series was under 20 years of age. Another—one of the 27 referred to—was struck down by an intoxicated driver. Of the other 111 pedestrians, four were fatally injured by drivers who were intoxicated. It should be noted that in Oslo a blood test for alcohol is performed when there is the slightest suspicion of alcoholic intoxication in persons involved in traffic accidents, especially in serious or fatal accidents.

Comments.—Attention has rightly been focused on the intoxicated motorist and his responsibility in causing accidents. There is, however, very good reason to focus attention on the intoxicated pedestrian as well. As has already been noted, a fifth of the pedestrians in this series aged 20 years or over were intoxicated by alcohol—and this is a minimum figure. Of course, it can tell us little so long as we know nothing about the group of pedestrians as a whole.

In New York City Haddon *et al.* (1961), finding a high proportion of intoxicated pedestrians among those fatally injured, provided a control group consisting of four pedestrians for each fatality. Members of the research team visited the scene of the accident on the same day and at the same time of day at which the accident had occurred and stopped the first four pedestrians they met of the same sex as the person who had been killed. These they interviewed. They also obtained breath tests for alcohol. This controlled study suggested that the pedestrians fatally injured, in contrast to members of the control group, consisted of two discrete groups—a group of the elderly who had been drinking a little or not at all, and a group of the middle-aged who had been drinking heavily. In another series from New York McCarroll *et al.* (1962) found that out of 200 pedestrians fatally injured in traffic accidents 43% were intoxicated. Eckert *et al.* (1959) found 52% intoxicated among 121 pedestrians killed—the same figure as that of Freimuth (1958) and Gerber (1957).

This is a most important point. It means that the pedestrian must be educated in road safety as well as the motorist. More-

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over, diagnostic and therapeutic difficulties are greatly increased when the traffic victim is under the influence of alcohol.

Vehicles Involved

Observations.—From Table II it will be seen that the private car was the vehicle most frequently involved in traffic accidents in which pedestrians were fatally injured. Next in order came trucks, one-quarter being small ones. Further—and this again is a most important point—where responsibility could be assessed 66% of the pedestrians themselves had initiated the chain of events which led to the accident—by walking suddenly into the street, crossing at intersections against the signal light, and so on.

TABLE II.—*Vehicle Involved and Distribution of Responsibility*

Vehicle	Pedestrian at Fault	Motorist at Fault	Both at Fault	Neither at Fault	Unknown	Total
Private car ..	27	15	2	2	6	52
Lorry and truck	22	17	1	3	4	47
Bus	12	1	—	1	—	14
Taxi-cab ..	4	3	—	—	—	7
Train-subway-tram ..	23	—	—	1	1	25
Motor-cycle ..	4	2	—	—	—	6
Other vehicle or unknown ..	8	2	—	—	7	17
Total ..	100	40	3	7	18	168

Comments.—It might be difficult to decide who is at fault in traffic accidents. For this series the police reports were consulted. In Oslo the traffic police (a special police department) drive as soon as possible to the scene of an accident and make a thorough investigation in all those involving seriously injured persons. The percentage of pedestrians at fault was lower than that recorded by McCarroll *et al.* (1962) in New York, where more than 80% were responsible for the accident. It was higher, however, than the figure (50%) reported from Birmingham by Gissane and Bull (1961). The difference, of course, may depend, among other things, on different interpretations of what constitutes negligence. In Norway, the speed limit is 40 km. per hour in towns and urban districts.

Period of Survival

Observations.—Of the pedestrians in the series, just over 50% were dead on admission to hospital or died there within four hours; a further 14% died in the next 20 hours; 35% survived more than 24 hours (Table III).

TABLE III.—*Period of Survival*

Period of Survival	No.	%
Dead on arrival	69	41·1
Dead within 4 hours of admission	17	10·1
„ 4–24 hours after admission	24	14·3
„ more than 24 hours after admission	58	34·5
Total	168	100·0

Comments.—The frequency of "dead-on-arrival" victims in this series is in accordance with a usual finding (Eckert *et al.*, 1959; Kulowski, 1960; Haddon *et al.*, 1961). In nearly half, then, of the cases involving fatally injured pedestrians the hospital surgeons found no possibility of initiating treatment. Further, most of the patients had suffered such severe injuries that they could not have been saved even if treatment had been started as soon as the accident had occurred. In this series there was only one case where the fatal outcome could have been ascribed to delay in transport: a 17-year-old girl was knocked down by a bus at the periphery of the town and it took 50 minutes to get her to the hospital. Shortly before arrival she died—bleeding to death from a ruptured liver. It does not follow that immediate treatment—transfusion, secure open airway, etc.—would not have been of value in patients who died after admission. Theoretically it should be possible to reduce the mortality rate if specially trained doctors or other personnel accompanied the ambulance, as is routine in some places.

Aspiration

Observations.—In 24 of the 86 patients who were dead on arrival or who died during the first four hours, blood or gastric contents had been aspirated into the tracheo-bronchial tree—in 14 in considerable amounts. This is a minimum figure, as in 19 cases necropsy was not carried out.

Comments.—Many investigators, especially anaesthetists, have reported that aspiration into the airways is relatively common in injured patients, particularly in unconscious ones (Andreassen *et al.*, 1958; Dam *et al.*, 1958; Lind, 1962). Aspiration in itself could be fatal. Even small amounts aspirated could critically worsen the condition of patients with head injuries and of those suffering from shock, because of the supervening hypoxia. Moreover, aspiration increases significantly the risk of pulmonary complications. Injured patients who are unconscious should therefore be transported in the so-called NATO-position. If necessary, active measures should be taken to clear the airways of blood, etc. Of course these precautions have also to be followed in the hospital.

Nature of Injury

Observations.—The patients in this series very often had serious multiple injuries. Table IV shows the frequency of serious injury according to body area. On average, each patient had 2.4 body areas seriously injured. Head injury was most frequent, but the relatively high frequency of other serious injuries should be noted, especially thoraco-abdominal injuries and fractures of the lower limbs and the pelvis. Multiple injuries had a most significant influence on the survival time, as is apparent from Table V.

TABLE IV.—*Frequency of Injury According to Body Area*

Body Area	No.	%
Head	121	72·0
Thorax	90	53·6
Abdomen	41	24·4
Columna	27	16·1
Pelvis	43	25·6
Lower extremity	56	33·3
Upper „	32	19·0

TABLE V.—*Effect of Multiple Injury on Period of Survival*

No. of Body Areas Injured	Persons		Survival (Hours)		
	No.	%	0–4	4–24	Over 24
1	30	17·7	9	3	18
2	50	29·7	22	8	20
3	28	16·7	14	3	11
4	23	13·7	10	6	7
5	16	9·6	11	4	1
6	2	1·3	2	—	—
Unknown (no necropsy)	19	11·3	19	—	—
Total ..	168	100·0	87	24	57

Comments.—The injury pattern in pedestrians could be likened to that of persons injured when ejected from cars in traffic accidents. The pedestrian is injured by direct contact with the vehicle and is then thrown forcibly away from it to the ground. The multiplicity and seriousness of the injuries should be borne in mind by all who treat traffic victims. This is well known to those who carry out the necropsies on them (Aston and Perkins, 1954; Eckert *et al.*, 1959; Gissane and Bull, 1961).

Cause of Death

Observations.—The causes of death of pedestrians in the series are given in Table VI. Head injury led the list, but it should be stressed that serious thoraco-abdominal injuries together accounted for nearly 25%. Further, head injuries combined with thoraco-abdominal injuries were often found

TABLE VI.—*Cause of Death*

Cause of Death	No.	%
Head injury	79	47·0
„ +thoracic injury	10	6·0
„ +abdominal injury	3	1·7
Thoracic injury	24	14·3
„ +abdominal injury	11	6·5
Abdominal injury	6	3·5
Multiple fractures	2	1·2
Unknown	13	7·6
Complications:		
Fat embolism	6	3·5
Pulmonary embolism	4	2·5
Miscellaneous infections	9	5·6
Uraemia (shock-kidney)	1	0·6
Total	168	100·0

to be the cause of death. Various complications—for example, fat embolism, pulmonary embolism, and miscellaneous infections—accounted for about 12%. Retrospectively, the diagnosis was clinically missed or made too late in five patients with head injuries (three extradural and two subdural haematomata), in five patients with thoracic injuries (two flail-chest, one pneumothorax, one haemothorax, one rupture of the diaphragm), and in four patients with abdominal injuries (two rupture of liver, one rupture of mesenteric vessels, one intestinal rupture).

Discussion

A consideration of importance in traffic accidents involving pedestrians is that the injuries are due to blunt trauma. In recent years vehicles have become more streamlined and sharp external angles and projections have been eliminated. In fact, in Norway sharp projections on the front of cars are now forbidden by law. Nevertheless, at the moment of an accident a great deal of force is dissipated because of the sizable kinetic energy of the vehicle and the pedestrian's relatively small mass. Unfortunately, this combination of great force applied by an approximately smooth surface often causes severe internal injuries of which there may be little evidence on the body (McCarroll *et al.*, 1962). As a result, serious problems in the diagnosis and management of pedestrian injuries are created—and they are accentuated by the fact that a high proportion of the fatally injured are intoxicated. The clinician therefore should not be misled if he does not find surface signs of injuries. He must be prepared to carry out a most thorough search not only for one but for several serious injuries, as these are very common.

Another important factor in accidents involving pedestrians is the high frequency of aspiration of blood and gastric contents into the airways. This not only necessitates a revision of transportation facilities but also underlines the importance of maintaining a constant watch for this complication after patients have been admitted to hospital.

As a high proportion of the fatally injured were dead on arrival at the hospital, the question arises whether fewer would die if doctors and personnel specially trained in resuscitation accompanied the ambulance. So far as doctors are concerned this proposal, in Norway at least, is not practicable at present, for economic reasons.

Conclusion

In the prevention of traffic accidents to pedestrians we have to stress that the pedestrian himself is very often at fault, initiating the chain of events leading to the accident. To counteract the ever-increasing number of such accidents we should aim at making all categories of road-users, including pedestrians, more traffic-minded. In Norway a long-term programme has been started partly among pre-school children and partly in school, where special lessons are given and where the children themselves participate in traffic school patrols.

Summary

A 10-year series of 168 pedestrians fatally injured in traffic accidents is discussed. Only one-quarter were women. Necropsy was carried out in 88%. The mortality rate is shown by a typical J-shaped curve.

Multiple injuries were common. On average, each patient had 2.4 body areas seriously injured. Head injury was the principal cause of death, but thoraco-abdominal injuries were also frequent, and their importance is stressed.

Aspiration of blood or of gastric contents or of both into the airways was common. This complication has to be watched for. A thorough search must be made to exclude serious internal injuries.

Not only motorists but also pedestrians must be made more traffic-minded. In this series 20% of the pedestrians fatally injured were found to be intoxicated and 66% had themselves initiated the chain of events which led to the accident.

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