SOME INTERNATIONAL DATA ON TRAFFIC ACCIDENT CONFIGURATIONS AND THEIR ASSOCIATED INJURIES

G.M. BARNWELL, J.R. CROMACK
A.F. MULLER, AND J.G. KUIPERBAK

ABSTRACT

The Committee on the Challenges of Modern Society, NATO, initiated a trial program to test the feasibility and value of obtaining standardized vehicle crash damage and injury information on an international basis. The goals of this program were to obtain better data on the degree of protection which a vehicle provides to its occupants in crashes, so that these data could aid automotive designers in producing safer vehicles and assist government engineers in assessing safety standard effectiveness.

International comparisons of traffic accident statistics have been addressed in only a relative few research papers, for example, Bull, Ref 1; Ryan and Mackay, Ref 2; and Hall, Ref 3. Many problems underlie such a comparison: lack of detailed data, missing data, uncertainty as to the biases surrounding the data collection procedures, etc.

A major program—the Road Safety Pilot Studies*— has provided the framework whereby an international accident data collection and analysis procedure has been established. The Accident Investigation Pilot Study is being conducted under the general supervision and guidance of the Netherlands, with participation from eight additional nations. Southwest Research Institute, under contract to the U.S. Department of Transportation, is providing consultation and technical assistance to chairman. Technical consultation is also provided by the United Kingdom, and procedural matters are handled by the Belgian representative.

Communications between the participating nations were effected by the establishment of a policy-setting coordinating panel, consisting of one high-level governmental representative from each nation. Because of their interest in vehicle safety, Sweden was also invited by the chairman to participate in the program.

The data on which this paper is based were collected by 33 different accident investigation teams in Belgium, Canada, France, Germany, Italy, the Netherlands, Sweden, the United Kingdom, and the United States. Each team collected the same information on each accident investigated and coded it according to a standard format agreed upon by all the participating countries. At least one member from each of the participating teams received orientation and training in the use of the standard collision analysis report form, vehicle damage index, and occupant injury scale. After the accident cases were coded by each team, they were sent to Southwest Research Institute, where they were processed, keypunched, and stored in a data file. There are now 520 cases

*The Road Safety Pilot Studies is a multiprogram effort to improve international road and vehicle safety. Individual nations have assumed leadership in each of the study areas. The basic program is being conducted under the auspices of the Committee on the Challenges of Modern Society, NATO. A final report of the Accident Investigation Pilot Study will be submitted to the Plenary Session in November 1973.

in the files. This paper and its companion paper, Cromack, et al., Ref 4, represent the first examination of these data. Each case in the data file consists of detailed information on the vehicle investigated and on each of its occupants, a total of 517 variables.

The computer-based data handling and analysis system permits a variety of statistical analysis techniques on the data, and any combination of variables concerning the accident configuration, vehicles, and occupants may be studied.

The statistical profiles presented herein are derived from a sample of 520 cases taken from the nine participating countries. Because of the relatively small initial sample size, any conclusions drawn from this preliminary analysis will have limited validity with respect to the actual international accident and injury frequencies of various types. The data to be presented should be regarded as a sample of the types of information available from such an international cooperative effort, and as examples of ways to utilize the information. This preliminary data analysis also constitutes a final test of the CCMS/NATO pilot study, and in our opinion, it does show that useful data can be obtained from a joint study of this type, at a much lower cost than obtainable by any single country.

In this paper we will present data on the frequency, nature, and extent of highway crash injuries, along with related data. We will first present some general characteristics of the accident population investigated. The sex and age distributions of the drivers in the sample are shown in Figures 1 and 2. From Figure 1, we see that approximately 4 out of every 5 drivers in this sample

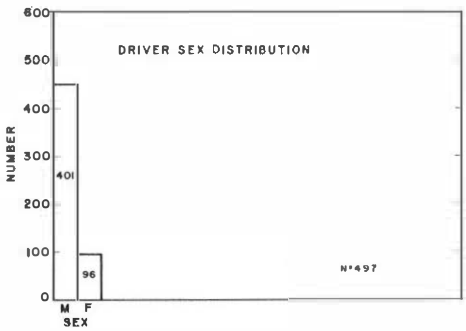

Figure 1

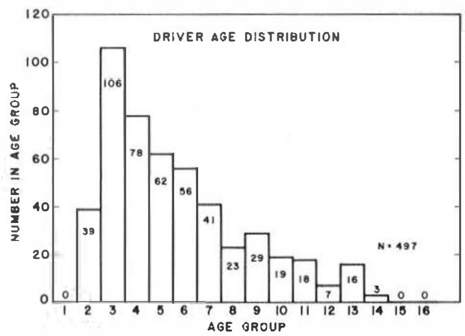

Figure 2

were male. Figure 2 shows that the age distribution covers an age range from 15 to 79 years. The highest frequency of driver ages is the 20-24 year group, with 106 drivers.

Figure 3 shows the general classification of accidents, with respect to type of loss (personal injury, property damage, or both personal injury and property damage). By far, the highest frequency was the accident involving both personal injury and property damage, with 465 cases fitting this category. One should not attempt to compare this finding to other statistics since, in this case, the sample is definitely biased. Most of the accident investigating teams investigated only accidents severe enough to require tow-away of the case vehicle or to produce injuries. Thus, the sample is biased toward more severe accidents, and most of these involved both injury and property damage.

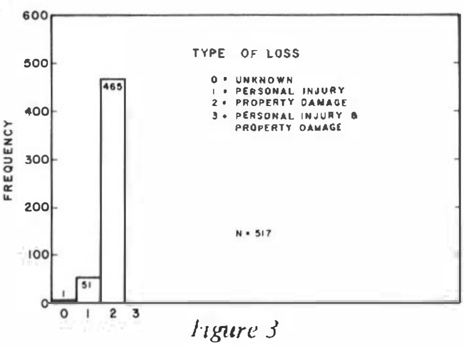

Figure 3

The vehicle age distribution is shown in Figure 4. The age in years is shown along the lower axis. The 0 denotes current year models. As the graph shows, most of the vehicles investigated were recent models, with only 23 of the vehicles being older than six years. Over half of the vehicles (295) were either current or previous year models.

There were a total of 916 occupants in the sample of accidents. It is a well-known fact that most people still do not wear restraint belts. Figure 5 shows the number of occupants who had lap belts available and the number who wore them, while Figure 6 shows the number of occupants who had upper torso restraints available and the number who wore them. Thus, from Figure 5, we derive that there were 555 occupants with lap belts available, 337 occupants without lap belts available, and 23 unknowns. Therefore, approximately 62 percent of the occupants could have worn lap belts. Of the 555 occupants having access to lap belts, only 129 actually wore them; i.e., about 23 percent of the people who could have worn seat belts bothered to do so.

Figure 6 shows that there were 435 occupants with upper torso restraints available, 462 without restraints available, and 18 unknowns; i.e., 48.4 percent of the occupants could have worn upper torso restraints. Of the 435 occupants, only 67 actually wore them, or only 15.4 percent of the occupants used upper torso restraints when they were available.

Information was also obtained on the condition of the various restraints. For example, restraint separation did occur in a very few cases. Restraint separation at the buckle occurred in one case; restraint separation of the webbing occurred four times; and restraint separation of the anchorage hardware occurred one time. Although we have not yet done so, it is possible to examine the data and narrative discussion from these six cases in more detail to attempt to determine why the restraint separations occurred.

In some instances, occupants were ejected. Figure 7 shows the degree of occupant ejection. A total of 16 occupants were partially ejected, while 38 occupants were completely ejected from the vehicle. Figure 8 shows the region through which ejection occurred. The greatest number of ejections occurred through the doors, with 16 on the left side and 14 on the right side. There were 11 occupants ejected through the tailgate or backlight and 2 through the rear windows. There were 7 through the left-side window, and 6 through the right-side window. We also plan to examine the data from these cases in more detail to see whether these occupants were wearing restraints, whether the doors opened due to latch or hinge failure, etc.

The nature and extent of vehicle damage in these accident cases was described by two scales. The exterior damage was described by the Vehicle Deformation Index (VDI)—a seven digit code which indicates the location, distribution, and degree of damage. The interior damage was described by the Vehicle Interior Deformation Index (VIDI)—a seven digit code which describes damage to interior regions in terms of degree of deformation along five different coordinates.

With respect to the VDI, Figure 9 shows the distribution of impact forces with respect to o'clock direction. Thus, the collisions were predominantly in frontal areas. Figure 10 shows the VDI damage ratings. The most frequent damage ratings were scores of 2 and 3. However, there were 74 vehicles with damage extents of 4, and 104 vehicles with damage extents of 5 or more. The mean VDI severity rating was 3.32.

The frequency and severity of injuries to various regions of the body are summarized in Figures 11 through 14 and Table 1. The severity codes for these injuries are from 1 to 6 in order of increasing severity, with 6 denoting an injury to that body region severe enough to cause death,

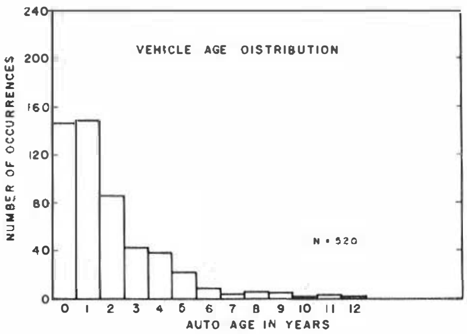

Figure 4

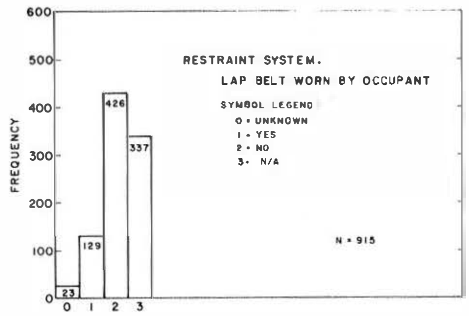

Figure 5

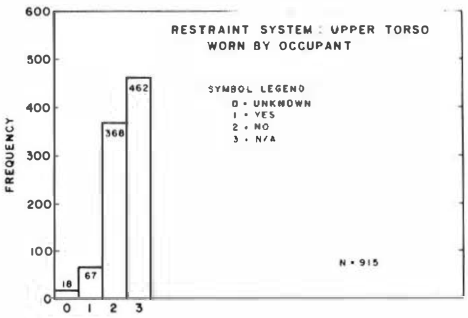

Figure 6

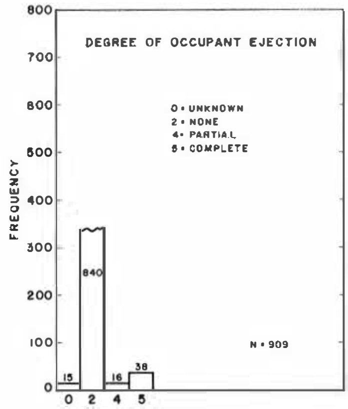

Figure 7

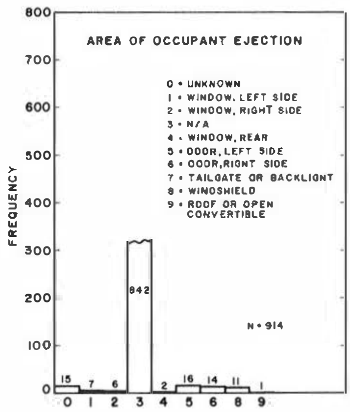

Figure 8

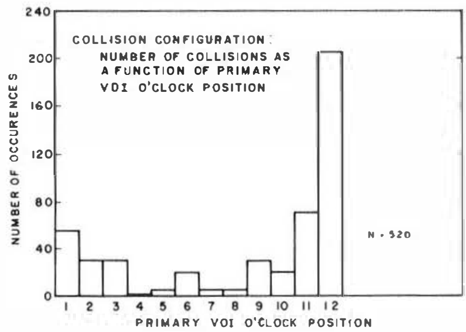

Figure 9

and 9 indicating injured, but details unknown.* Blanks are equivalent to no injury. There were 189 injuries to the scalp and vault of the skull.

Table 1 presents the frequencies of injury to limbs and gives comparisons of left and right sides for each region. The columns correspond to the injury severity codes. Table entries are numbers of injuries of a given severity to the particular body region. It is interesting to note that

*In these cases, the entry "9" does not denote AIS severity. The ratings in these Figures are discrete injury severity ratings, not overall severity ratings.

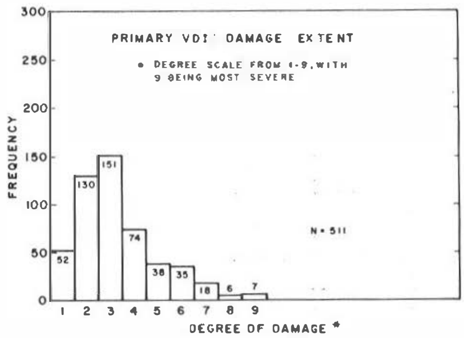

Figure 10

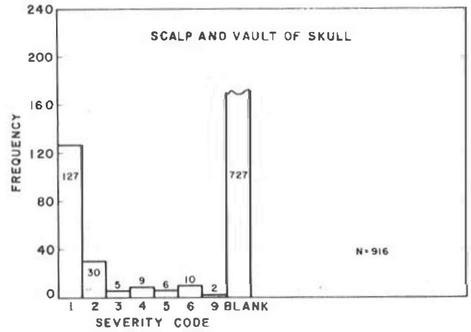

Figure 11

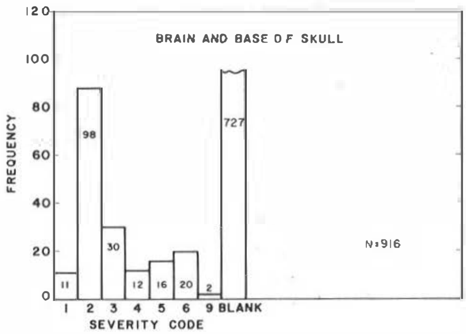

Figure 12

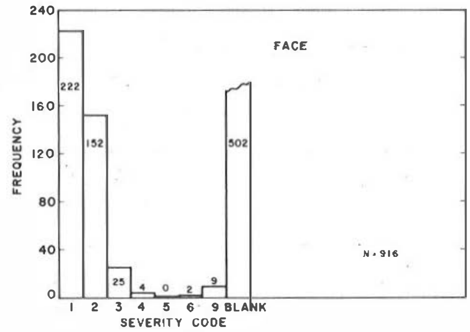

Figure 13

with respect to lower extremities, the frequency of injuries to left and right sides is approximately equal, while considerable disparities occur in the frequency of injuries to the upper extremities. For example, hip and thigh, knee, leg, and ankle-foot injury frequencies are about even for left and right sides for each severity code, while injuries to the left shoulder and arm are far more frequent than injuries to the right. Injuries to the wrist and hand also occurred far more frequently on the left side. In contrast, elbow and forearm injuries were all on the right side. The reasons for these disparities cannot be discerned without further analysis, particularly with respect to collision configuration. However, the capability to retrieve and present the data in this manner suggests further research.

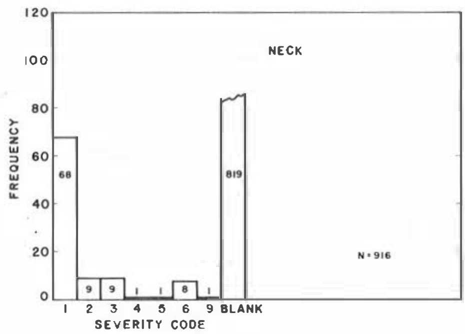

Figure 14

While it is recognized that the data presented raise certain inevitable questions, these types of questions cannot be answered accurately with a data sample of only 520 accidents. We have nevertheless shown that it is feasible to collect accident data on an international basis according to a standardized protocol. This paper (and the previous one, Ref 4; which correlates injury with injury causative factors) is intended primarily to prove the program and to illustrate its potential returns. We strongly urge interested nations to adopt an international traffic accident data collection protocol. such as the one being developed in the NATO/CCMS program. Use of such a protocol would permit assessment of the body of data by a singular agency established for that purpose. It would also permit nations, who did not desire to participate in the overall program, to

TABLE 1. OVERALL INJURY SEVERITY TO EXTREMITIES

		1	2	3	4	5	6	9	Blank
Shoulder & Arm	L	34							882
	R	3							913
Elbow	L								916
	R	17							899
Forearm	L								916
	R	22	1						893
Wrist Hand	L	58	9	2	1				846
	R	4							912
Hip & Thigh	L	44	7	8	6			3	848
	R	45	8	10	7			4	842
Knee	L	127	16	4	2				767
	R	115	23	7	3			1	767
Leg	L	85	12	4	2		1	2	810
	R	90	10	4	6			2	804
Ankle-Foot	L	21	13	6	4				872
	R	18	12	3	5			2	876

exchange and compare results of selected studies on a common basis. Both uses have merit, since, in the long term, reductions in death, injury, and expense must result.

REFERENCES

1. Bull, J.P., "International Comparisons of Road Accident Statistics." *Accident Analysis and Prevention,* 1, 293-300 (1969).

2. Ryan, G.A., and G.M. Mackay, "Comparisons of Car Crashes in Three Countries." In: **Proceedings of Thirteenth Stapp Car Crash Conference.** Society of Automotive Engineers: New York, 1969, pp. 336-352.

3. Hall, P.A., "International Comparisons of Traffic Accidents." *Traffic Engineering.* 20-24, Nov. (1970).

4. Cromack, J.R., G.M. Barnwell, E.E. Flamboe, and H. Perring. "Injury Patterns According to Crash Configuration." Paper presented at International Conference on the Biokinetics of Impacts, Amsterdam, June 26-27, 1973.