

# A CASE HISTORY STUDY OF FATAL ACCIDENTS

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## FOREWORD AND SYNOPSIS

This is a condensed report of a cooperative project of the Public Roads Administration, the Highway Research Board, and the American Automobile Association.

In 1936 and 1937 pursuant to an act of Congress the Highway Research Board cooperated with the then U. S. Bureau of Public Roads in an investigation of Motor-Vehicle Traffic Conditions in the United States. As a part of this work the case histories of 1715 fatal traffic accidents were collected under the direction of Professor C. J. Tilden of Yale University. These accidents were studied and a report made thereon as Part 5 of the report to Congress published in six parts as House Document No. 462.

Feeling that this mine of valuable material had not been exhaustively explored the Public Roads Administration, and the Highway Research Board in 1939 arranged a cooperative project with the American Automobile Association whereby Mr. Earl Allgaier of the Association was assigned to make an independent study of the 1715 fatal traffic accidents occurring during 1936 and reported by eight States and eight cities.

The information was coded and sorting machines were used to obtain a large number of interrelationships of the various factors involved. The results consist of a large number of facts which will be useful in accident prevention programs but which cannot be summarized effectively in a few broad generalizations.

While the case histories studied were more complete than the usual accident report they indicated the lack of information concerning the circumstances which led up to the accident. This indicates the need for a shift in emphasis in accident reporting from a description of the collision and its effects to a more comprehensive analysis of the underlying circumstances that led up to the accident. A few of the more interesting points brought out by the study are as follows:

The median age of the pedestrians killed varied from a high of 65 from 5 to 6 a.m. to a low of 7 during the afternoon. When an index of the pedestrian death rate is computed on a population basis the age group 15 to 19 has the best record with an index of 0.19 while the group 75 to 79 has the worst record with 6.10. The index for older persons was found to be lower or higher but the number of cases was limited. Compared to all causes of death, traffic is most serious for pedestrians of 5 to 9 with an index of 11.76. It is less serious than the average for persons under 5 years of age and for those 60 or over.

Where data were available 54.3 per cent of the vehicles were 4 years old or less. Only 55.1 per cent of all vehicles were driven by the owner. Friends of the owner drove 18.0 per cent and employees of the owner 18.3 per cent of the cars. The median age of all drivers was 30. The median age of the driver when an owner was 36.5, when an employee 30.0 and when a friend of the owner 26.6 years. One-tenth of the drivers were 50 or over.

When an index of the estimated mileage driven per fatal accident for each age group is computed it indicates that those 19 and under had the poorest record with an index of 0.29 while those 50 to 59 had the best record with an index of 1.67. The probability of a driver being killed increases materially with age. Only 10.7 per cent of those under 20 were killed while 38.1 per cent of those 70 and over died as a result of the crash.

Drinking was reported for 11.6 per cent of the operators of passenger cars and 4.1 per cent of the operators of commercial vehicles.

An analysis of the case histories of 1715 fatal traffic accidents which occurred in 1936 was made to study the relative importance of the various factors involved and their relationship to each other. Each accident report not only had

more information than appears in the tabulations usually made of motor vehicle accidents but in addition the number of accidents was sufficiently large to be analyzed by quantitative methods. A total of 1455 case histories was obtained from the official records of the states of Connecticut, Massachusetts, New York, Rhode Island, New Jersey, Pennsylvania, Indiana and Michigan. The cities furnishing 260 additional case histories were Chicago, Ill.; Cleveland, Ohio; Detroit, Mich.; Evanston, Ill.; Louisville, Ky.; Milwaukee, Wisc.; and South Bend, Ind.

While it is true that the accidents were selected from states with the most complete records, it is not believed that the nature of the accidents will differ materially from those of the country as a whole. While the nature of the accidents is probably typical, the action that the state takes is probably not typical of the entire country. States with more complete accident reporting systems, driver examinations and licenses are more likely to take an active part once the accident has occurred.

The analysis of any motor vehicle accident is necessarily complex, not only because of the many factors involved but because of the many which are only partially known if known at all. The relationship of any one factor to any other is difficult to detect when there are many varying factors involved. In many cases differences have been obtained which are statistically significant but not large enough to have much practical use. In other cases differences have been indicated but only through the accumulation of parallel data will it be possible to state, with a fair degree of certainty, that the differences are significant.

The analyses of the various factors involved are necessarily based on the best judgment of the writer in interpreting, from the description of each accident, the relative importance of these various factors. So much is not known about these accidents, even though the information

was carefully gathered that any statement relative to the cause or causes of an accident must be subject to rather large probable errors. While in many cases the physical conditions surrounding an accident such as type of highway, condition of roadway or lighting can be quantitatively measured with a fair degree of accuracy, many other factors, probably more important, cannot be so measured. These include such items as the condition of the driver, the attention of the driver to driving, the speed of the vehicle, the exact location of the pedestrian and many of the conditions which more indirectly led up to the accident. It is apparent that most reports describe the nature of the accident but fail to give completely the circumstances which led up to the situation. This is probably due mainly to the fact that those involved in the accident usually do not know just what those circumstances were. If the circumstances had been known, the accident could probably have been avoided. The very nature of an accident makes a clear-cut description of it practically impossible.

For the most worthwhile interpretation of the data obtained, a great deal more information is needed regarding exposure. It appears that many of the differences and trends obtained might be explained to a rather large extent by exposure. For instance, much is known concerning the number of drivers of various age groups involved in accidents. However, the true significance of this cannot be stated until the annual mileage of each age group is known. Similarly, any comparison of the number of pedestrians killed at rural and at urban intersections has little meaning until the relative amount of pedestrians and vehicular traffic is taken into consideration for the two places. The number of pedestrians killed in each age group will have much more meaning when the amount of walking on the streets is known for each group.

## MOST SIGNIFICANT FINDINGS

While the study yielded a good deal of new information some of the findings were of especial significance. The more important of these are:

1. The median age of drivers involved in nighttime accidents was 4 years less than that of those involved in daytime accidents.
2. The percentage of drivers reported to be drinking was  $3\frac{1}{2}$  times as great for accidents at night as it was for accidents occurring during the day.
3. The greatest concentration of accidents was from 4 to 10 p.m., during which hours three-eighths of all fatal accidents occurred.
4. The median age of pedestrians killed varied from a high of 65 between 5 and 6 a.m. to a low of 7 for the hours from 1 to 2 and 3 to 4 in the afternoon.
5. While only one-tenth of the drivers were over 50, half of the pedestrians killed fell in this age group.
6. Only 55.1 per cent of the vehicles were driven by the owner at the time of the crash. Friends of the owner, not including relatives, drove 19.7 per cent of the passenger cars.
7. Based on estimates of mileage driven by various age groups, the group from 50 to 60 drove more miles per fatal accident than any other group, while the record was worst for the drivers under 20.
8. Older drivers involved in fatal accidents were more often killed than younger drivers. One driver out of ten in the age group under 20 was killed while four drivers out of ten in the age group above 70 were killed.

9. Drivers who had been drinking had a worse previous accident record than those who had not been drinking at the time of the accident.

10. Compared to all causes of death, traffic was more serious for pedestrians 5 to 9 than for any other age group.

## SUMMARY OF FACTUAL DATA

The data do not lend themselves to many sweeping generalizations about the accident situation as a whole. Instead, this study substantiates a number of facts previously suspected and brings to light a number of others. Accident prevention programs can be much more effective if they are developed on the basis of adequate information and are designed to attack known causes. With this thought in mind a rather complete summary is here given. While many of the points appear to be of minor importance they deserve consideration in any serious attempts to reduce the total number of accidents.

*Classification of Fatalities:* In 92.8 per cent of the accidents there was only one death per accident. The remaining 7.2 per cent of the accidents accounted for 15.5 per cent of the total number of fatalities. The persons killed were classified as follows:

	Per cent
Pedestrians .....	53.5
Passengers .....	27.2
Drivers of motor vehicles.....	16.5
Riders of bicycles.....	2.6
Drivers of horse-drawn vehicles.....	0.2

This sample of fatal accidents had a larger percentage (53.5 per cent) of pedestrians killed than the 40 per cent estimated by the National Safety Council for the entire country in 1936.<sup>1</sup>

## TIME ACCIDENT OCCURRED

*Seasonal:* The monthly distribution of fatal accidents shows that February had

<sup>1</sup> Accident Facts, 1937, p. 33.

the least (5.7 per cent) and October (10.5 per cent) the most. The three months having the largest number of fatal accidents were August, September and October.

Of all the accidents studied 15.2 per cent came from city records. This percentage remained very constant for the various months of the year. This indicates that, in general, weather conditions and other factors which change with the seasons affect city traffic about as much as they do rural traffic in so far as the number of fatal accidents are concerned.

Practically three-fourths (75.2 per cent) of the fatal accidents studied occurred under clear atmospheric conditions. The most frequent adverse condition was that of rain, present in one-eighth (12.1 per cent) of all accidents.

There is some indication that pedestrians killed during clear weather (median age of 47) tend to be younger than pedestrians killed during rains, snow storms or cloudy weather (median ages of 57, 58 and 59, respectively).

There is some indication that women drivers become involved in relatively fewer fatal accidents in the winter time than during the summer. While 7.2 per cent of the drivers involved in fatal accidents from April to September, inclusive, were women, only 4.3 per cent of the drivers for the remaining months were women.

The ages of pedestrians killed varied from month to month during the year. The median age for all pedestrians killed was over 50 for October, November and December. For the remainder of the months it was between 40 and 50. In February, May, June, August and September over 20 per cent of the pedestrians killed were under 10 years of age, as compared with 16.6 per cent for the entire year. Here again it is quite probably that exposure for all age groups is not the same for the various months. During the summer when school is not in

session a good many of the children are more likely to be on the streets.

Most of these fatal accidents occurred on Saturday (19.8 per cent) and on Sunday (18.0 per cent). Fewest accidents were reported for Tuesday (11.0 per cent). Both in percentage and in actual numbers there were fewer commercial vehicles involved on Saturday and Sunday than on any other day of the week despite large totals of fatal accidents for these two days. Apparently the large number of fatal accidents on Saturday and Sunday cannot be charged to commercial vehicles.

The ages of cars involved in accidents were not the same for the various days of the week. Of the cars involved in accidents on Wednesday 24.7 per cent were 6 years old or older while on Saturday 45.6 per cent were in this age group.

The percentage of the pedestrians involved who had been drinking or were intoxicated was highest for Saturday and Sunday.

On Sunday not quite one-tenth of the persons killed as pedestrians were under 10 years of age while on Wednesday one-fourth of the pedestrians were in this age group. There is no significant variation in the sex of the pedestrian from day to day. About one-fourth of all those killed were females.

*Hourly Variation:* The hour from 6 to 7 p.m. had the greatest number of accidents (8.7 per cent) while the least number occurred between 5 and 6 a.m. (0.9 per cent). Three-eighths of the accidents (37.6 per cent) occurred from 4 to 10 p.m.

On the average 15.9 per cent of the vehicles involved were commercial vehicles. A very significant departure from this was for the period from 6 to 9 a.m. when two out of five of the vehicles involved in fatal accidents were in the commercial group. No doubt the relative amount of commercial vehicle traffic during various hours was an important fac-

tor. It is also possible that at this period of the day the effects of fatigue may become more serious, especially in the cases of operators who have been driving for most of the night previous. Only 7.0 per cent of all vehicles between the hours of midnight and 3 a.m. were commercial vehicles.

From 3 to 6 a.m. the proportion of drivers who were 40 or over was less than for any other three hour period. It is probable that relatively less driving is done by the older persons at night and if

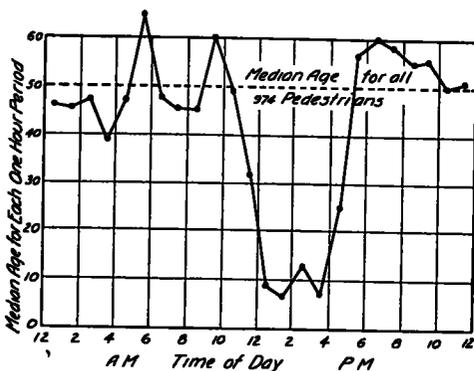


Figure 1. Age of pedestrian and hour accident occurred

the older people do drive, they compensate for their deficiencies. The period from 3 to 6 p.m. contains a higher percentage of drivers 40 or over than any other period.

The percentage of drivers with 5 years or less of experience involved in accidents from 9 to 12 p.m. was greater (26.4 per cent), and from 3 to 6 a.m. was less (12.7 per cent) than would be expected from the average throughout the day. The relative number of these younger drivers on the road is likely to account for a part of this difference.

**Day and Night Accidents:** Approximately one-third (34.0 per cent) of the accidents took place during clear daylight while an additional 7.0 per cent took place during cloudy daylight. Practically three out of five fatal accidents

(59.0 per cent) took place during darkness or dusk. This agrees quite closely with the estimate made by the National Safety Council<sup>1</sup> that 60 per cent of the traffic fatalities for the country as a whole during 1936 occurred at night.

Drivers of 50 and over constituted a smaller proportion of those involved in nighttime accidents than of the drivers involved in daytime accidents. Two possible explanations of this are: (1) older drivers operate more cautiously at night and (2) older drivers do less driving at night. Many elderly persons say that they do not drive at night because they are bothered by glare or it is difficult for them to see.

While women constituted 9.0 per cent of the drivers involved in accidents in the daytime, they formed only 2.7 per cent of the drivers in fatal accidents at night. It is probably that women do a relatively greater proportion of their driving during the day. Though most of the fatal accidents occurred at night, three-fifths of the women drivers in them were involved between 6 a.m. and 6 p.m.

The data indicated that drivers involved in accidents at night had less experience than those involved in daytime accidents. While about one-fourth (25.6 per cent) of the drivers involved in daytime accidents had five years or less of experience, about one-third (32.5 per cent) of those involved in night accidents could be so classified.

**Pedestrians Killed at Night:** There was a decided variation in the age of the pedestrians killed for the various hours of the day. (See Fig. 1.) During the four hours from noon to 4 p.m. the median ages of the pedestrians killed were 9, 7, 13, and 7 respectively, as compared with the highest median of 65 for the hour from 5 to 6 a.m. Children are of course kept off streets during night hours to a large extent. The hours from noon to 5 p.m. appear to be most dangerous for child pedestrians under 10 years of age.

During each of these hours from three-eighths to five-eighths of the pedestrians killed were in this age group while for the whole day only one-sixth of the pedestrians were under ten years of age.

Of all the pedestrian deaths, 62.8 per cent occurred at night. While the median age of the pedestrians killed during the night was 55, of those killed during the day it was only 9. Apart from differences in exposure the fact that older persons have greater difficulty in seeing at night so that traffic hazards become relatively more serious to them may be an important factor.<sup>2</sup> An A.A.A. research report gives the average glare resistance score for persons 25 years of age as 18.6 and for those 65 years of age as 5.4. Not only are these persons slower in perceiving hazards but they are slower to react once they see the danger. This indicates the need for emphasizing to adults the dangers of walking at night and to children the hazards of traffic in the daytime.

LOCATION OF THE ACCIDENT

All except 4.2 per cent of the fatal accidents occurred in the four major locations—rural and urban, intersections and non-intersections. The percentages of accidents occurring at various locations were as follows:

	Per cent
Rural non-intersection .....	37.2
Rural intersection .....	5.6
Urban non-intersection .....	28.5
Urban intersection .....	24.5
Off the highway.....	0.3
Railroad crossing .....	1.3
Bridge .....	1.4
Underpass or overpass.....	0.6
Private driveway or alley.....	0.6

Drivers 50 and over seemed to have a disproportionate share of their fatal accidents at rural intersections. While about one-tenth of the drivers involved in fatal

<sup>2</sup> Research Report No. 6 Safety and Traffic Engineering Department, American Automobile Association.

accidents were 50 or over, one-fifth of those involved in fatal accidents at rural intersections were in this age group.

Child pedestrians under 10 years of age were more frequently killed at urban non-intersections and less frequently at rural non-intersections than would be expected from the total number of pedestrians killed at the various locations.

Women pedestrians were killed relatively more frequently than men at rural and urban intersections and less frequently than men on rural highways between intersections. It seems probable that women walk less on rural highways than men, especially at night, and this would account for a part of the difference noted.

*Traffic Control:* In seven accidents out of eight (87.5 per cent) there was apparently no traffic control functioning. Traffic signals were present in 6.7 per cent of the accidents, stop signs in 3.1 per cent and railroad warnings signs in 1.3 per cent. Other means of control were present in lesser numbers.

*Obstructions to Vision:* Aside from parked cars few obstructions to vision were mentioned. The most frequent were obstructed windshields, pillars in roadway and snow banks.

ROAD SURFACE AND CONTOUR OF HIGHWAY

*Surface Condition:* Nearly three-fourths (72.1 per cent) of the accidents occurred on dry and clean surfaces. An appreciable number (17.9 per cent) occurred on wet surfaces and an additional 6.3 per cent on icy surfaces. In only one accident out of 25 was a defect in the road reported that might have contributed to the accident.

*Grade and Alignment:* Practically nine-tenths (89.3 per cent) of the accidents occurred on the level while most of the remainder occurred on a grade and less than 1 per cent on a hillcrest. One-eighth occurred on curves while the remainder occurred on the straight-away.

MOTOR VEHICLES INVOLVED IN THE  
ACCIDENT

*Age and Condition of Vehicle:* The 1715 fatal accidents studied involved 1626 passenger cars, 3 passenger cars with trailers, 370 commercial vehicles, 43 commercial vehicles with trailers, 22 taxis, 27 passenger busses, 1 school bus, 6 emergency vehicles, 38 motorcycles, 24 trains, 52 bicycles and 4 animal-drawn vehicles.

The median age of all motor vehicles involved (including commercial vehicles and motorcycles) was 4 years with 54.3 per cent being 4 years old or less. One vehicle out of 8 was 8 years old or older. The commercial vehicles median age was 2 years and 72.6 per cent were 4 years old or less.

The prevalence of reported defects in vehicles was about the same for both commercial and passenger vehicles.

Since in only 7.4 per cent of the accidents was there mention of the condition of the vehicle any conclusion regarding the effect of certain defects on accidents must be highly tentative. Of the 117 cases of vehicles stated to be defective, brakes were mentioned in 66 cases, tires 13, windshield or wiper 13, steering 9 and in 16 other cases lights with one defect or another.

*Direction of Travel:* Eighty-nine per cent of the vehicles involved were going straight ahead or following a curve in the highway, while 3.4 per cent were overtaking another vehicle, 2.4 per cent were stopped in traffic or on the roadway, and 3.3 per cent were making right or left turns. In a few other cases the vehicle was parked, backing, pulling from the curb, slowing down or making a U turn. In this connection it is quite significant to note that while 10.3 per cent of the drivers of vehicles going straight ahead had been drinking or were intoxicated, only 1.9 per cent of the drivers making turns were so classified.

*Ownership:* A surprisingly large number of vehicles involved in fatal accidents were not operated by the owner at the time of the accident. In fact only 55.1 per cent of the vehicles were operated by the owner at the time of the crash. 18.3 per cent were operated by employees of the owner, 18.0 per cent by friends of the owner, and 7.4 per cent by relatives of the owner, including wives. Since the ownership was given in 90 per cent of the cases, the figures are probably fairly typical of fatal accidents in general.

While 58.5 per cent of the passenger cars were operated by the owner only 21.6 per cent of the commercial vehicles were so operated. Friends of the owner operated 19.7 per cent of the passenger cars but only 5.9 per cent of the commercial vehicles. 59.4 per cent of the commercial vehicles were operated by employees of the owner.

Relatively, women were more often driving a car belonging to another member of the family or a friend than were men but they were less often driving the car of their employer. Women though constituting 5.7 per cent of the drivers, were drivers of 15.3 per cent of the cars owned by a member of the family, 8.9 per cent of the cars owned by friends, 5.2 per cent of the cars driven by the owner but no women were involved in accidents while driving a vehicle belonging to an employer.

Drivers involved in accidents while driving their own car had a median age of 36.5 years, those driving their employer's car 30.0 years and those driving cars belonging to friends 26.6 years. The experience of the driver followed somewhat these same trends. Of the drivers operating their own cars  $\frac{1}{3}$  had 15 or more years of experience while only 13.7 per cent of the operators of friend's cars had that much experience.

One-fifth of all the drivers were reported to have had previous accident or violation records. Compared with this,

26.9 per cent of the drivers operating their employer's vehicles had previous records. This difference may be accounted for in part by the fact that employees of the owner probably do more driving than other drivers and so expose themselves to more accident situations.

#### THE DRIVERS INVOLVED

*Age:* Since the driver is probably the most important factor in the accident, a number of analyses were made to determine the relationship of various characteristics of the driver to the accident.

The median age of all drivers involved in fatal accidents was 30 years. One-tenth were over 50 years of age. The distribution of the drivers of various age groups follows very closely the distribution of drivers involved in fatal accidents in Connecticut for 1932 to 1936.<sup>3</sup> Drivers 20 and under had the most fatal accidents for the number registered while the drivers 46 to 50 had the least. On this basis the latter group had three times as good a record as the former.

When estimates of the miles driven by various age groups<sup>4</sup> are combined with the number of registered drivers in each group and the number involved in fatal accidents, the differences in the age groups is accentuated. (See Fig. 2.) With the drivers involved in the 1715 fatal accidents grouped by ten year periods it appears that the age group 50 to 59 drives the most miles per fatality while the group under 20 drives the least number of miles. The former group apparently drives nearly 5.7 times as far per fatal accident as does the latter group. While the data for drivers over 60 are more limited, they indicate that the

miles driven per fatal accident decline consistently with age.

While 18.6 per cent of all drivers were operating commercial vehicles at the time of the accident only 8.7 per cent of the drivers 50 and over were in this group. It seems probable that organizations hiring drivers tend to discourage older persons from driving. On the other hand there is little pressure brought to bear on the individual who drives his own

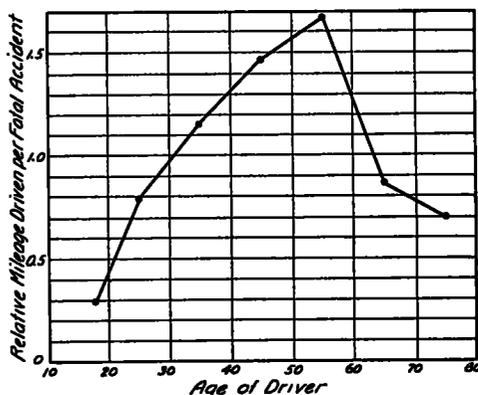


Figure 2. Miles driven per fatal accident. Mileage estimated from A.A.A. driver test records and number of drivers registered in Connecticut for 1932-36 for each age. Drivers involved in 1715 accidents in 1936.

car even though his abilities have fallen off somewhat with age.

As would be expected the older drivers involved in fatal accidents had more experience than the younger drivers. However, for drivers 40 and over the amount of experience did not appear to increase greatly with age. This indicates that the drivers in the higher age groups probably learned to drive at a much later age than the younger drivers.

The probability of the driver being killed in a fatal accident increases materially with age. (See Fig. 3.) Of all the drivers involved in fatal accidents 14.6 per cent died as a result of the crash. While 10.7 per cent of the drivers under

<sup>3</sup> "Motor Vehicle Traffic Conditions in the United States," Part 6, "The Accident Prone Driver," 75th Congress, Third Session, House Document 462, Part 6.

<sup>4</sup> "Drivers 20 to 40 Rate Highest on Tests," Earl Allgaier, *Psychological Bulletin*, Vol. 35, p. 651.

20 were killed the percentage of those over 70 who were killed was 38.1. Since there is no reason to assume that older drivers get into more violent accidents than do other drivers it is probable that the decreasing vigor which accompanies old age is an important factor. This points to the possibility that perhaps the high death rate among elderly pedestrians is due to their inability to recover from certain accidents that would not prove fatal to younger persons.

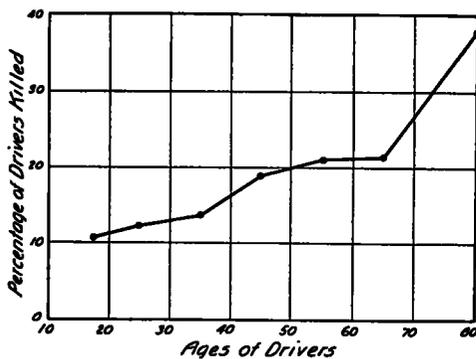


Figure 3. Likelihood of Drivers involved in fatal accidents being killed. 2044 Drivers involved. 299 killed.

*Women Drivers:* Only 5.7 per cent of the drivers involved in fatal accidents were women. While accurate figures on the mileage driven by men and women are not known, estimates can be made. In Connecticut, for example, about one-fifth of the registered drivers are women. Of the persons taking the AAA driver tests the men indicated about twice as much driving per year as the women. If these figures are approximately correct then one-tenth of the driving would be done by women and consequently we would expect them to have one-tenth of the total fatal accidents. It thus seems that exposure is not sufficient to account for the difference in the number of fatal accidents involving men and women drivers.

Drinking appears to be more prevalent among men drivers involved in fatal accidents than among women drivers. While 10.2 per cent of the men drivers were reported to have been drinking or were intoxicated, the figure for women was only 3.3 per cent.

Women appear more likely than men to get into collisions with fixed objects but less likely to hit pedestrians.

*Experience:* The median number of years of driving experience for drivers involved in fatal accidents was nine. Drivers having less than one year of experience constituted 4.9 per cent of the entire group; 11.8 per cent of the drivers had 20 years or more of experience. About the same percentage of drivers with little experience got into accidents on slippery surfaces as did drivers of considerable experience.

On the average the women involved in fatal accidents have had less experience than men. The median number of years of experience for women was seven while for men it was nine. Of all drivers with experience reported less than 5 per cent were women. Of the drivers with less than a year's experience 20.3 per cent were women. This indicates the necessity especially for women who are learning to drive to avoid the hazards of traffic as far as possible.

*Occupation of Driver:* In about half of the fatal accidents the occupation of the driver was given. Of these cases practically three drivers out of ten were chauffeurs or drove as their main business. An additional two out of ten were skilled or semi-skilled workers while common laborers constituted one out of ten involved in fatal accidents. Other occupational groups showed smaller percentages.

While 7.7 per cent of all the drivers had collisions with fixed objects this percentage was practically doubled for the following groups: (a) professional persons, (b) common laborers, (c) house-

wives and domestic workers, (d) youths, students and unemployed. On the opposite extreme are the drivers and chauffeurs. Only 2.1 per cent of them had collisions with fixed objects.

*Previous Record of Driver:* One driver out of five was reported to have had a previous accident or law violation. Half of these had more than one accident or violation. The records of 80 per cent of the drivers were not mentioned in the accident reports. It is likely that this latter group had a large number of drivers who had previous clear records. In cases where the coroner takes action he, either consciously or unconsciously, is more likely to hold a driver with a past record than a driver where no past record is reported. Of the drivers with recorded previous records 7.6 per cent were held while 4.6 per cent of the drivers with no past records were held. There was a record of the police arresting two drivers out of each five involved in fatal accidents. The past record of the driver did not seem to have any effect on the probability of being arrested or on the action of the court in punishing the driver. In contrast to this the motor vehicle departments were more apt to suspend the license of a driver with a past record than that of a driver with no past record. While 29.1 per cent of the drivers with no past records had their license suspended for 30 days or more, 43.8 per cent of the drivers with past records had their license so suspended.

There was a record of one out of ten of the drivers involved in fatal accidents having had some type of previous punishment such as fines, jail sentence or revocation of driver's license. Six-tenths of these drivers received fines only.

In most of the reports there was hardly information enough to weigh accurately the importance of the various factors which contributed to the accident. While it may generally be conceded that the driver is probably the most important

factor in most accidents just which actions of the driver are most serious is far from a settled question. As far as could be determined from the reports about 17 per cent of the drivers were apparently not at fault, that is, they were driving in a normal fashion and in general following the rules of good driving. A number of these, however, might possibly have been able to avoid the accident by taking extreme measures. An example might be driving off the highway into the ditch to avoid a head-on collision with someone driving on the wrong side.

*Speed Too Fast for Conditions:* While it is possible in most accidents to assign a number of main and contributing causes, in this study not more than two were assigned to any one driver or vehicle. An analysis of these causes indicated that speed too great for the proper control of the car was the major cause of most fatal accidents. Of 2126 important causes listed 39.2 per cent included speed too fast for vehicles, pedestrians or objects in the path of the vehicle. Included here are such cases as a driver hitting a pedestrian at night because he did not see the pedestrian soon enough or hitting some object in the roadway because of poor visibility due to atmospheric conditions. In other words, the stopping distance of the car was in excess of the clear highway visible ahead.

In another category are those classes of excessive speed where normally the road would be clear but where the driver under normal conditions should expect occasionally other drivers or pedestrians to come into the pathway of the vehicle. These include chiefly going too fast through intersections so that it would be impossible to yield to another driver should he come from the side, going too fast past pillars, parked cars, etc., where one might expect pedestrians. This group included 21.5 per cent of the causes.

Still another category of excessive speed included accidents where the driver

was not able to control the car because of the condition of the highway or the car. Driving too fast for a slippery road or road alignment are included in this group as well as speed that is excessive for proper control even with the highway and car in good condition. These causes account for an additional 15.9 per cent of the total.

While these percentages may appear to be rather high for speed as a factor, it is assumed that the good driver will adjust his driving to the conditions he finds. It appears that the factor of safety used in driving is relatively small under normal conditions and even this small factor of safety is lost by a great many drivers when driving under adverse conditions. This in turn results in accidents.

*Vehicle Control:* Aside from speed the next most important factor appeared to be improper control of the vehicle. This covers a multitude of operations for which there is no apparent reason and in some respects is not a cause but a part of the accident. Here are included such items as running off the road without any apparent reason, or driving on the wrong side. Inattention may be a large factor but rather than try to guess what the basic cause may be it seems better simply to state the fact as objectively observed. A man may drive off the road because he goes to sleep, because he was distracted by a passenger, because he had heart failure or possibly because something went wrong with the steering mechanism but unless one of these other factors is established it seems best to merely state the fact that he drove off the road for no apparent reason. Of the total there were 104 cases of driving on the wrong side of the road and yet there was no evidence to indicate the cause such as excessive speed, slippery road surface, etc. Improper control of the vehicle as thus defined accounted for 12.9 per cent of the causes.

*Other Deficiencies:* Other factors

which seem to be clearly identified as causes of the accident are: inattention and distraction 3.2 per cent of the total causes listed, violation of traffic control 2.8 per cent, physical condition of the driver 2.2 per cent, known or suspected defects of the vehicle 1.9 per cent, and miscellaneous causes 0.4 per cent.

*Accident Prevention Education:* After the foregoing analysis of the causes of accidents as applied to the driver it appears that the greatest prospects for the reduction of accidents lie in the education of the driving public to proper speeds to be driven to maintain a proper margin of safety for all conditions of the highway, the car and other traffic including pedestrians. It appears for example that a great many accidents involving pedestrians after dark are due to the fact that the motorist does not see the pedestrian until it is too late to avoid a collision. The motorist fails to appreciate the limited distance he can see a pedestrian or else he is willing to take the chance that the roadway will be clear. In his particular instance education as to the difficulties in seeing at night and also of the possibilities of pedestrians being on the roadway should be effective in bringing speed down to a point where the stopping distance does not exceed the clear distance ahead. In case the driver still fails to drive with a reasonable factor of safety, regulation may be necessary. Structural changes in highways may make the relative danger apparent to the driver. This would call for a uniform use of danger or warning signs, scientific speed zoning, etc. It is not the danger itself that causes the trouble but the danger which the driver does not realize exists.

#### THE PEDESTRIAN

The importance of the pedestrian in the accident problem is indicated by the fact that over half (53.5 per cent) of the persons killed in the 1715 fatal accidents

were pedestrians. While the pedestrian does not have under his control a powerful machine capable of inflicting serious injury he nevertheless is expected to cooperate with the driver since both must use the same roadway at times and especially so since the pedestrian is the one from a personal point of view who is most likely to suffer in an accident.

*Ages of Pedestrians Killed:* It is quite evident that traffic deaths among older pedestrians is far in excess of what would be expected from the number living in each age group. (Fig. 4.) In the present

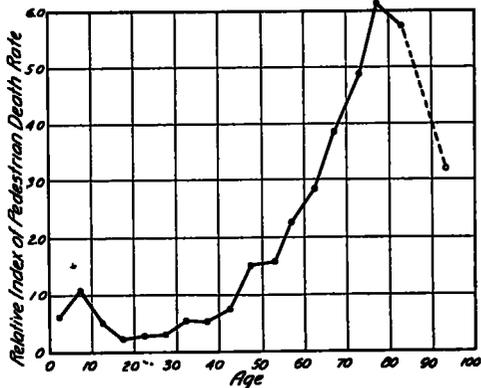


Figure 4. Pedestrian Death rate by Age groups. 983 pedestrians

study approximately half (50.4 per cent) of the pedestrians killed were 50 years or older. Compared with this only 17.1 per cent of the U. S. population is 50 or over. This confirms other studies that the death rate among elderly pedestrians is much higher than that among younger pedestrians. For the construction of a table of index figures for the death rate of pedestrians of various ages a value of unity has been assumed for the average of all age groups. On this basis the 5 year age group from 15 to 19 inclusive had the best rate of 0.19 while the group from 75 to 79 had the highest rate of 6.10. In other words, the chances of a person in the latter age group being killed as a

pedestrian are 31.4 times as great as that of a person in the younger age group. The age group 5 to 9 and all persons 45 and over had a higher death rate than the average.

If the pedestrian death rate followed the general death rate due to all causes, the two curves would follow each other. However, although 1 per cent of the persons dying from all causes are between 5 and 10 years of age nearly 11 per cent

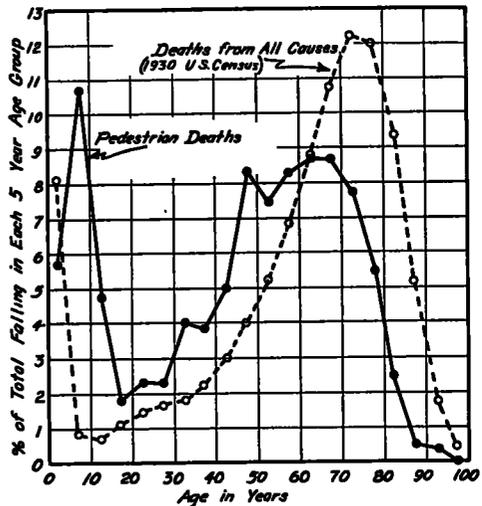


Figure 5. Pedestrian and all deaths by ages

of all pedestrians killed were in this particular age group, showing that relatively, traffic is a very important cause of death for children 5 to 10 years of age. This comparison is shown graphically for all ages in Figure 5. It is interesting to note from the graphs that it is the persons under 5 and over 60 who have a pedestrian death rate lower than would be expected from the general death rate, while those between 5 and 60 have a higher pedestrian death rate than would be expected.

Another interesting analysis is shown in Figure 6. On the basis of life expectancy tables the total number of years of expected life lost by pedestrians killed

in each age group was calculated. As shown in Figure 6 this is greatest for the group of 5 to 10. Nearly one-fourth of all the expected life lost comes from this group.

Female pedestrians killed constituted a larger proportion of the age group from 0 to 9 than of any other age group. This may indicate a tendency for boys of this age group to adapt themselves more readily to the hazards of traffic than girls. It would not be expected that in this group exposure is relatively greater for the girls.

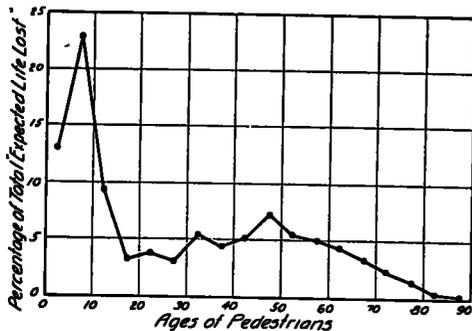


Figure 6. Years of expected life lost by pedestrian deaths at each age. 983 pedestrian deaths. Expected life from U. S. Census.

*Pedestrian Accident Factors Unknown:* In most fatal pedestrian accidents the story of the accident must come from the driver. Usually the driver, even if honest, does not have a clear picture of what happened or he might have avoided the accident. Because of this the important factors relative to the pedestrian are not known. Frequently only the point of contact is known instead of the more important questions as to where the pedestrian came from, where he was going, how fast he was traveling and how much of a chance an alert motorist would have had of seeing him. Careful interviews of pedestrians who have been hit but survived might yield clearer answers to these problems than are possible from study of fatal accidents only.

Nearly six-tenths (58.2 per cent) of the pedestrians were crossing the roadway when hit. The large majority of these were crossing a city street, with twice as many killed crossing between intersections as at intersections.

Of all pedestrians killed 30.2 per cent were walking in the roadway. The action of half of these was not known. Of those walking in traffic two were killed walking against traffic for each three killed walking with traffic. Other important actions involving pedestrians in the roadway included playing, working on a parked car and hitching rides.

#### INTOXICATION

Drinking appears to be more of a factor in night than in day accidents. While 4.1 per cent of the drivers involved in day accidents were alleged to have been drinking or were intoxicated, 14.5 per cent of those involved in night accidents were so reported. This may partially explain why, on a mileage basis, the accident rate is so high at night. The night rate may not be due entirely to darkness as such but to the factors that are associated with darkness—more drinking being one of them.

The prevalence of drinking as far as these fatal accidents were concerned reached a peak from 12 to 3 a.m. when one-fourth of the drivers were reported to have been drinking or were intoxicated. Drinking during the daytime seemed to be much less of a problem as only 4.3 per cent of the drivers involved in accidents from 6 a.m. to 6 p.m. were so reported. While no doubt many cases of drinking were not reported the general trend for the various hours of the day is probably substantially correct.

Drinking among pedestrians appeared to be most frequent from 9 p.m. to 6 a.m. when one-fourth of pedestrians killed were reported to have been drinking or were intoxicated, while between 6 a.m.

and 6 p.m. only 3.2 per cent of the pedestrians were so reported. These figures indicate the necessity of keeping drinking pedestrians off the street during certain hours of the night and also the probability that alcohol is an important factor in the production of night pedestrian accidents.

Drivers who were intoxicated or who had been drinking were in a disproportionate number of accidents on curves. While 8.3 per cent of the drivers involved in accidents on the straightaway were reported to have been drinking or were intoxicated, this group constituted 19.6 per cent of the drivers involved in accidents on curves. It seems that the difficulty drinking drivers have in controlling a car on the straightaway is materially increased on curves.

While nearly one-tenth of all drivers were reported to have been drinking or to be intoxicated, only 2.8 per cent of the drivers of cars belonging to an employer fell into this group.

Drinking among pedestrians between 20 and 59 is much more prevalent than among those older or younger; 23.6 per cent of this group had been drinking or were intoxicated while only 8.6 per cent of those 60 or above could be so classified. There was no record of any pedestrians under 20 having been drinking.

While the condition of the pedestrian was given in one-fifth of the cases it is quite apparent that drinking was the most common condition that might have contributed to the accident. Inattention, confusion and physical defects such as hearing and vision, were mentioned in a number of cases.

#### BICYCLE ACCIDENTS

Of the 52 bicycle accidents studied, 71 per cent took place during the 5 months from May to September inclusive. Three-fourths of the accidents took place between 3 and 12 p.m. and were fairly evenly distributed over that period. Three accidents out of five took place

during hours of daylight. Only 8 per cent of the accidents occurred during adverse weather conditions. While 27.3 per cent of all fatal traffic accidents occurred on slippery surfaces (ice, snow or wet) only 15 per cent of the bicycle accidents occurred on such surfaces. In nearly all cases the bicycle was going straight ahead. In three cases the bicyclist was overtaking a car and in one case making a left turn.

Most of the bicycle riders were under 20 years of age; a few were over 40; there was only one between 20 and 39 years of age.

#### SUGGESTED PROBLEMS FOR RESEARCH

Even though this detailed analysis of 1715 fatal traffic accidents has yielded further information, there is still much to be learned about the nature of traffic accidents. Much of the time and money spent on the gathering of accident statistics which now only serve to confirm what is already known and accepted might be used more profitably in special studies of factors on which information is sadly lacking. We are particularly deficient in data on accident exposure under various circumstances. For the guidance of those interested in pursuing further some phases of traffic accidents several suggestions for further research are offered:

1. Interviews with pedestrians who have been hit, but survived in order to obtain more information as to what they did to become involved in the accident and what they might have done to avoid it.
2. The miles driven per year for vehicles of various ages. Where inspection is required taking speedometer readings at successive inspections would give a good deal of information. (Washington, D. C. asks for this information when license plates are issued.)

3. The prevalence of defects among vehicles of various ages.
4. The number of vehicles of each age registered. An analysis of registration would yield this information.
5. The relationship of the age of the car driven to the age of the driver.
6. The prevalence of defects among cars involved in accidents and other cars.
7. The relative number of miles driven by commercial and non-commercial vehicles for various days of the week and for various hours of the day. A count of traffic on the highway for various locations would give an approximate figure.
8. The relative number of vehicle miles for various hours of the day, various days of the week and various months of the year.
9. The relative amount of driving done by friends of the owner, relatives of the owner, employees of the owner and the owner of the car itself.
10. The amount of driving done by men and women during the day and during the night. A count of traffic at several points would give some indication of the relative amount of driving done by the sexes.
11. The amount of driving done by the various age groups during the various hours of the day.
12. The partial correlation of accident records with age and experience of the driver to determine if it is age or experience which makes the record of young drivers so poor.
13. The percentage of operators over-driving their headlights for various age groups.
14. The percentages of the time various weather conditions prevail such as snow, rain, clear, cloudy, etc.
15. The relative number of pedestrians crossing the street at the various locations as in the crosswalk, in the middle of the block, with the green signal, etc.
16. Additional data on the relative percentage of pedestrians and drivers who have been drinking for the various hours of the day.
17. The prevalence of the various types of unsound walking practices among pedestrians of various age groups.
18. The number of persons riding in cars involved in fatal accidents to determine if the greater likelihood of a passenger being killed than a driver is due to the greater number of passengers involved.