

9. A Typological Analysis of Pedestrian Accidents

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9.1.ABSTRACT

For more than 20 years, in France as in many other countries, the number of pedestrians killed in road accidents has tended to decrease. The stakes remain high, however : 1,126 pedestrians killed in France in 1994, and this user category is particularly vulnerable in accidents. To further our knowledge of pedestrian accidents, an analysis of data supplied in reports drawn up by the police forces for road fatal accidents was carried out. Its aim is to highlight the different types of pedestrian accident victims. A typology of pedestrian accidents is proposed based on a multifactor analysis, followed by a classification.

This classification clearly identifies four groups :

- pedestrians age 65 or over crossing the road in a built-up area,
- children in accidents in built-up areas while running or playing,
- drunken pedestrians,
- intermodal changes, secondary accidents.

The resulting typological breakdown should then serve as a basis for in-depth analysis to improve our understanding of these accidents and propose suitable action.

With a view to learning more about road accidents, the INRETS "Accidentology" programme provides for the cross-sectional treatment of themes based on data collected at different levels of information. Pedestrian accidents are one of the themes addressed in this cross-sectional approach. The stakes are high : 1,126 pedestrians were killed in road accidents in France in 1994, i.e. 13% of all deaths on the road, children and elderly people being over-represented.

Research on accidentology is often based on corporal accident statistics, i.e. accidents in which at least one person is killed or seriously or lightly injured¹. Three levels of accident information may be taken into account :

- *national statistical files based on BAACs (Corporal Accident Analysis Forms)*. They have the advantage of being exhaustive, since a BAAC is drawn up by the police for every corporal accident. The national data base into which these reports are fed provides substantial general information on all corporal accidents. The national statistics published by the French Inter-Ministerial Road Safety Observatory (ONISR, 1995) are based on this data.

- *corporal accident reports*. These serve as a basis for subsequent legal action. These reports, also drawn up by the police for every corporal accident, give a detailed description of events and mention the statements made by the different parties involved. They show a plan of the accident scene and sometimes include photographs. They provide an overall view of the accident, but are not as detailed as the detailed accident analyses (see below).

- *detailed accident analyses*. Detailed accident analyses drawn up by multidisciplinary teams sent to the scene of the accident as quickly as possible are often a source of details that might otherwise be missed, such as traces of braking or skid marks, or interviews with witnesses in the heat of the moment (Ferrandez et al, 1986). The aim is to analyze the accidents, to reconstitute what happened in the pre- and post-collision phases, to pinpoint the processes that generate danger and injuries, to identify specific counter-measures and to evaluate safety measures.

Much can be learned by taking these different levels of information into account. Statistical analysis reveals correlations between previously coded criteria. Rather than explain the causes of the accidents, these correlations reflect a "statistical proximity". The detailed accident analyses make it possible to go further in identifying accident factors and mechanisms and the effects thereof on a limited number of cases. This identification then has to be validated by statistical analyses of more representative accident samples and using criteria evidenced by more clinical approaches. This "to-and-fro" process between different levels of information helps to take our knowledge of accident processes a stage further.

This is the context in which this first analysis of pedestrian accidents came about (Fontaine and al, 1995). The purpose here is to present a statistical description of this category of users, based on police reports on fatal accidents that occurred between March 1990 and February 1991 and collected exhaustively by the Accidentology and Biomechanics Laboratory run jointly by car manufacturer Peugeot and Renault. The aim of this descriptive analysis is to identify some very distinct groups of pedestrian accident victims. The results of this typology may then serve as a basis for more in-depth analysis to learn more about how these accidents happen and what might be done to prevent them.

¹ killed : victim who dies on the spot or within 6 days of the accident

seriously injured : victim whose condition requires more than 6 days in hospital

lightly injured : victim whose condition requires between 0 and 6 days in hospital

9.2. METHODOLOGY

We adopted a multidimensional approach to reveal the interactions between the different analysis criteria and thereby deduce homogeneous types of pedestrian accident. The data in the fatal pedestrian accident file is either qualitative (sex) or quantitative (age). Multiple correspondence analysis is a technique for describing qualitative data. It helps to transform similarities or likenesses between individuals and relations between variables into geometric distances easy to illustrate on simple graphs (factorial plans). The method is applied to qualitative variables using their modes or items. Thus the quantitative variable 'age' is transformed into a qualitative variable with four modes : under 15, 15 to 29, 30 to 64 and 65 and over.

The sample analyzed comprises 1,275 pedestrians killed in road accidents. We decided to select 17 active variables that serve to define the axes of the factorial analysis :

9 describe the pedestrian involved in the accident : age, sex, reason for outing, type of outing (alone, in a group), action of pedestrian, position, obstacles to progress, intermodal change, alcohol ;

8 are related to the environment or the type of accident : situation in or outside built-up area, straight line or curve, day of week, month, light, weather conditions, type of vehicle, secondary accident.

Criteria correlated with the above variables, such as socio-professional category and age (children come under the "schoolchildren" category and elderly people under "retired") were added as illustrative variables. These do not count in the calculation of factors but are shown on the factorial plans.

The factors thus obtained are then used in an increasing hierarchical classification that reveals very distinct groups of pedestrians involved in fatal accidents. The aggregation criterion is the Ward criterion (Saporta, 1990). The dendrogram or classification tree reveals a significant number of classes. Calculations were made using the SPAD programme.

9.3. RESULTS OF THE MULTIPLE-CORRESPONDENCE ANALYSIS

Axis 1 distinguishes pedestrians in accidents in built-up areas in the daytime from those in rural areas at night. Axis 2 is linked to the age, action and alcohol rate of the pedestrian. The factorial plan formed by axes 1 and 2 (figure 1) reveals certain likenesses : the group of elderly pedestrians in accidents when crossing the road in built-up areas in the daytime, the group of children running or playing, the group of pedestrians with high alcohol rate in accidents in rural areas at night. The hierarchical classification based on the results of this multiple-correspondence analysis will highlight these groups of pedestrians.

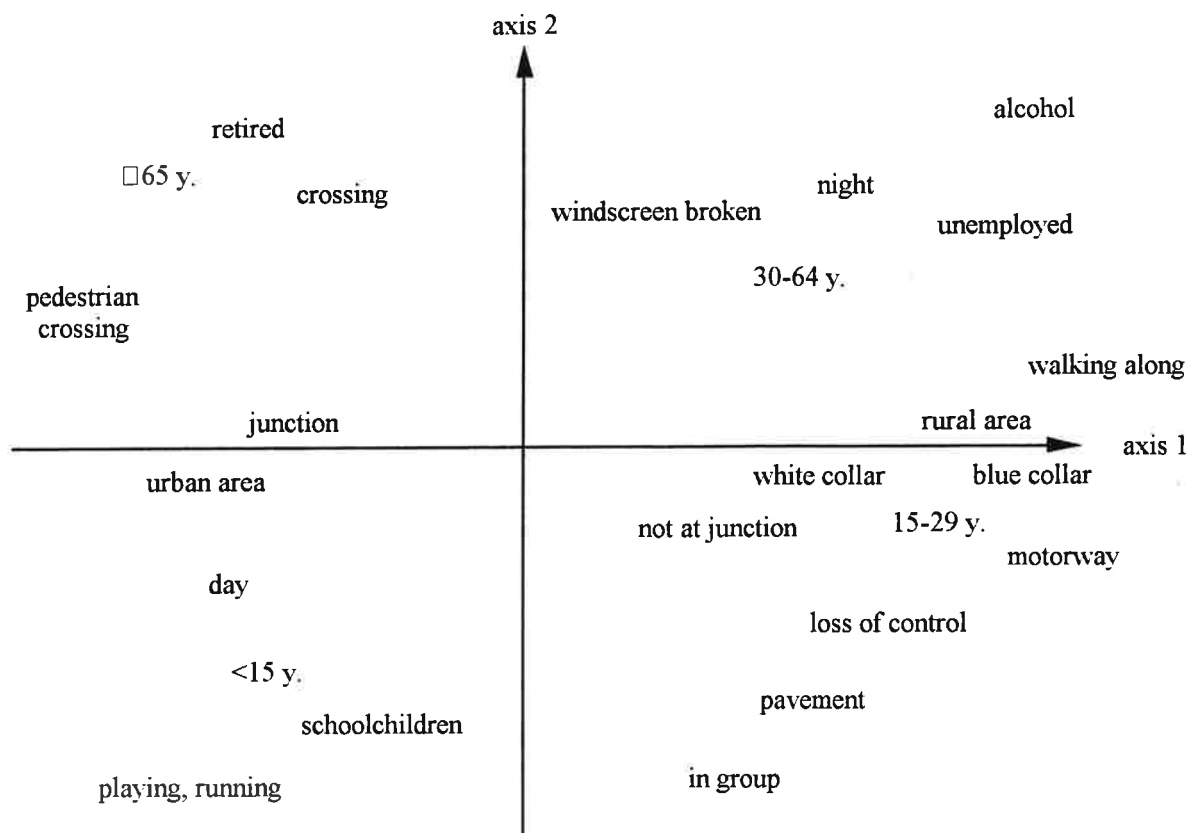


Figure 1:

Analysis of multi-factor correspondences in pedestrian accident victims - axes 1 and 2 (Source: fatal accident reports)

9.4. RESULTS OF THE CLASSIFICATION

The hierarchical classification highlights 4 clearly distinct groups. The 4 classes described never strictly separate the individuals according to the variable modes. The names we have given to the four groups are very summary: when we say "elderly pedestrians" we do not mean all elderly pedestrians but an over-representation of this mode in the group under consideration. In each class we present the most characteristic variables and modes, showing on a graph the percentage in the class and the percentage in the whole pedestrian population. This description includes both active variables and illustrative variables. We classify the most characteristic variables and modes in relation to a test value corresponding to the mean deviation from the norm (Morineau, 1991). This is tantamount to comparing pedestrians of the class with all pedestrians for each of the variables studied, measuring the distance between the percentage of the variable in the class and in the population taking into account the numbers in the variable and the class. These criteria were considered distinctive when the test value was over 3, corresponding to 3 standard deviations. The higher the test value, the more important the variable as a distinguishing factor.

9.4.1. Class 1: elderly pedestrians

This class is made up of 42% of pedestrians. Pedestrians age 65 and over account for 75% of the class, while they make up 39% of the pedestrians in the fatal accident file. Pedestrians are over-represented, of course, but so are women. The accidents occur when the pedestrian is crossing at (or within 50 yards of) a pedestrian crossing, in a built-up area and at a junction, often with traffic lights. These accidents generally take place on weekdays, between 7 a.m. and 12 noon or between 2 and 6 p.m. The pedestrians are usually out on their own, shopping, in a shopping centre. We find here familiar results (OECD, 1985).

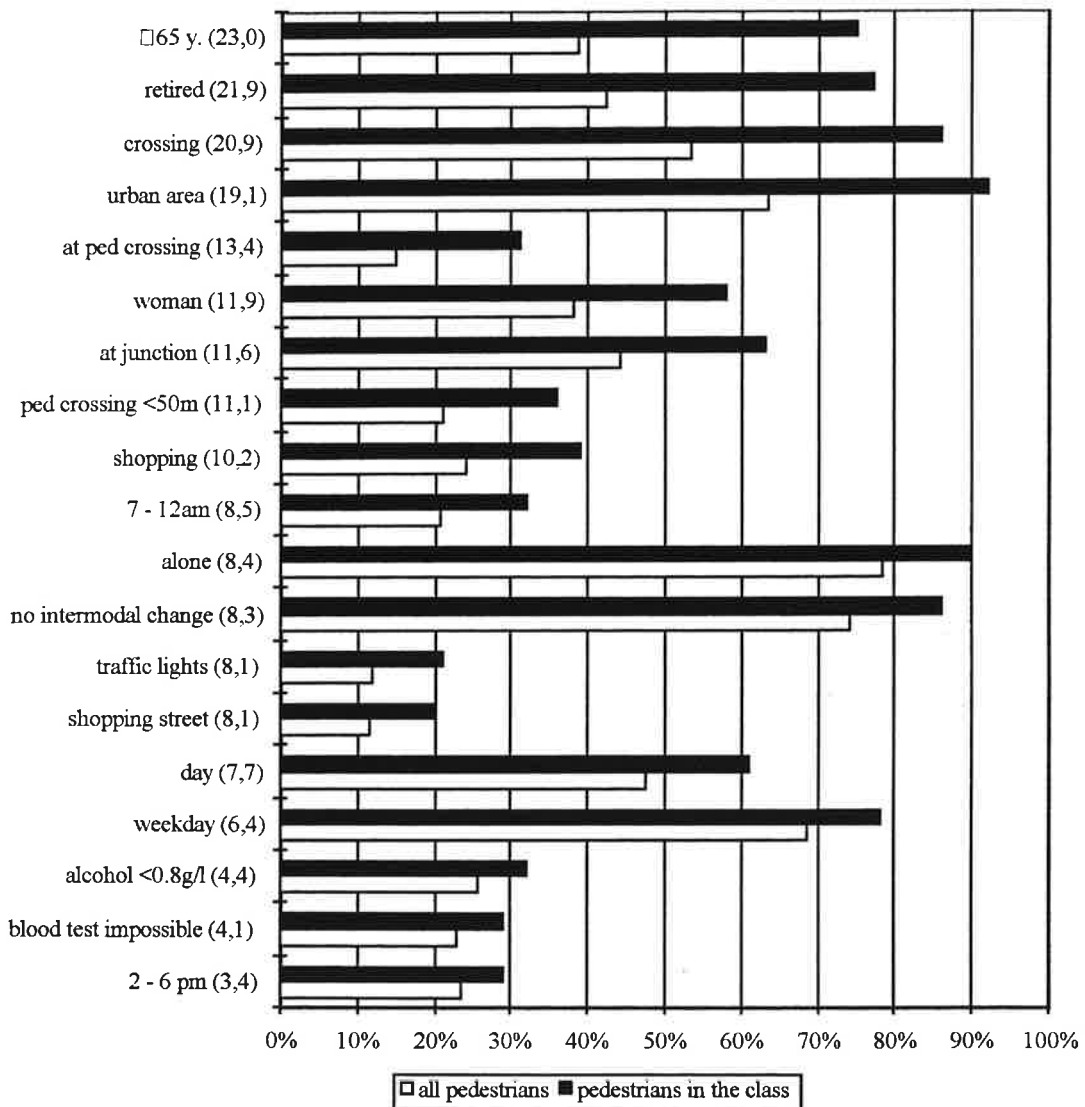


Figure 2:

Characteristics over-represented in Class 1 pedestrians compared with all pedestrians (the figure in brackets is the test value). Source : fatal accident reports.

9.4.2. Class 2: pedestrians in accidents at night, in rural areas, with high alcohol rate

This class comprises 34% of pedestrians. In 9 cases out of 10 these accidents occur at night, in 7 cases out of 10 on country roads with no junction, and in 5 cases out of 10 at the weekend. Alcohol levels in excess of 0.8 g/l are well represented : 42% as against 16% for all pedestrians². The pedestrian is most often a man in the 30-64 age group, and to a lesser extent the 15 to 29 age group. Blue-collar workers and the unemployed are over-represented. The pedestrian is generally walking along the road and had been to a club, a bar or a party. The colliding vehicle is a private car 8 times out of 10 and the windscreen was broken, showing how violent the collision was. These characteristics are also found in other analyses (Everest, 1992).

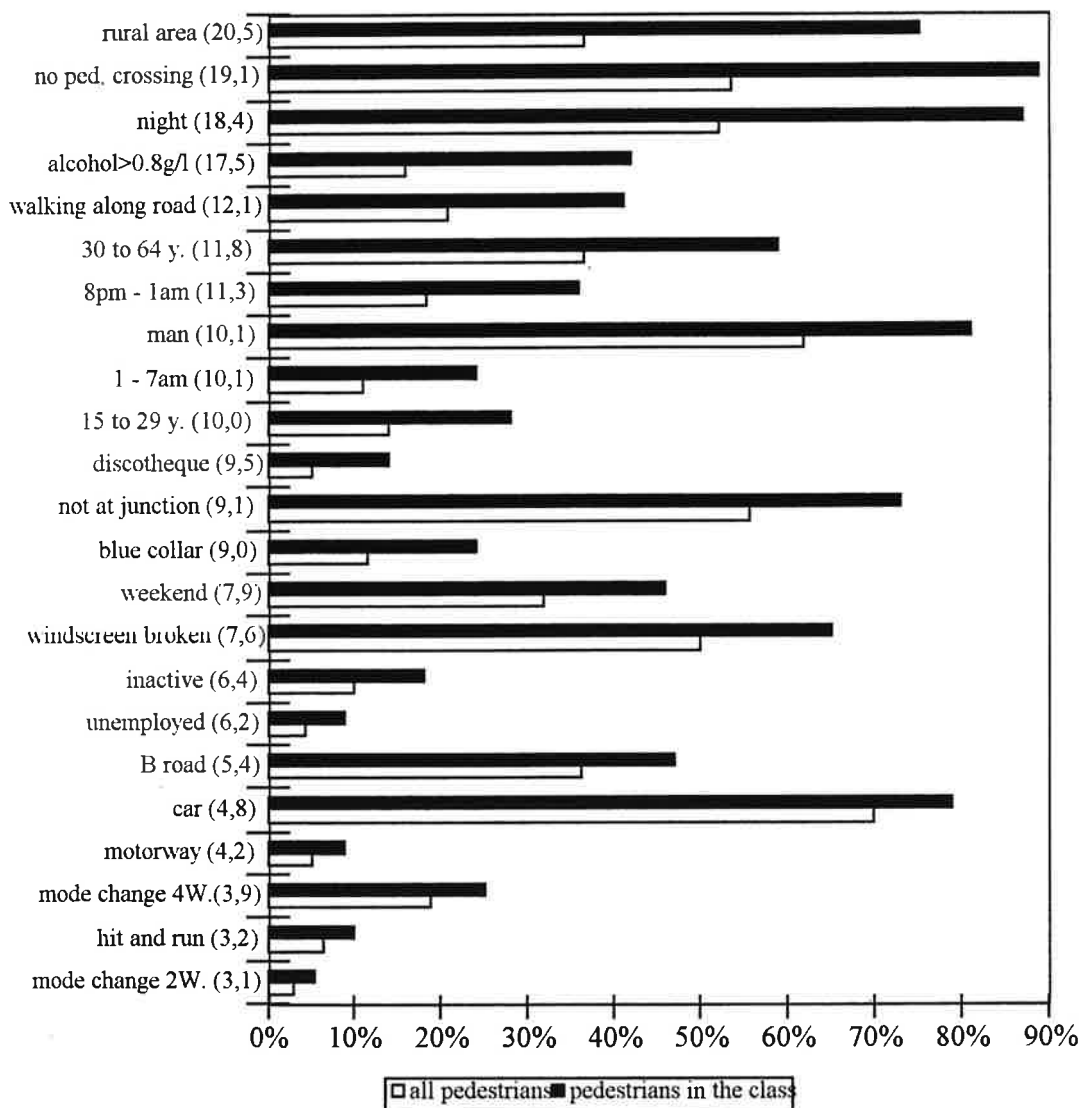


Figure 3:
 Characteristics over-represented in Class 2 pedestrians compared with all pedestrians
 (the figure in brackets is the test value). Source : fatal accident reports.

² This is the percentage of all pedestrians in fatal accidents, whether their blood level is known or not.

9.4.3. Class 3: children

This class comprises 13% of the pedestrians and is characterized by the presence of children under 15 years of age (78% vs 11% of all pedestrians). In almost 7 cases out of 10 the pedestrian was running or playing. 17% of these pedestrians circulate in groups. The accidents happen by day, in built-up areas and generally in the months of March to June, a period during which children are perhaps out most often without any parental supervision. The over-represented reasons for being out are "leisure" and "home-work journey", which in this case probably means "home-school", the two having been combined in the analysis to avoid groups with too few members. Here we find a large number of factors evidenced in research on accidents to children (Assailly, 1992), (Cambon de Lavalette, 1994), (Grayson, 1975), (Lynam and Harland, 1992). Changes of mode with public transport vehicles are also over-represented in this class.

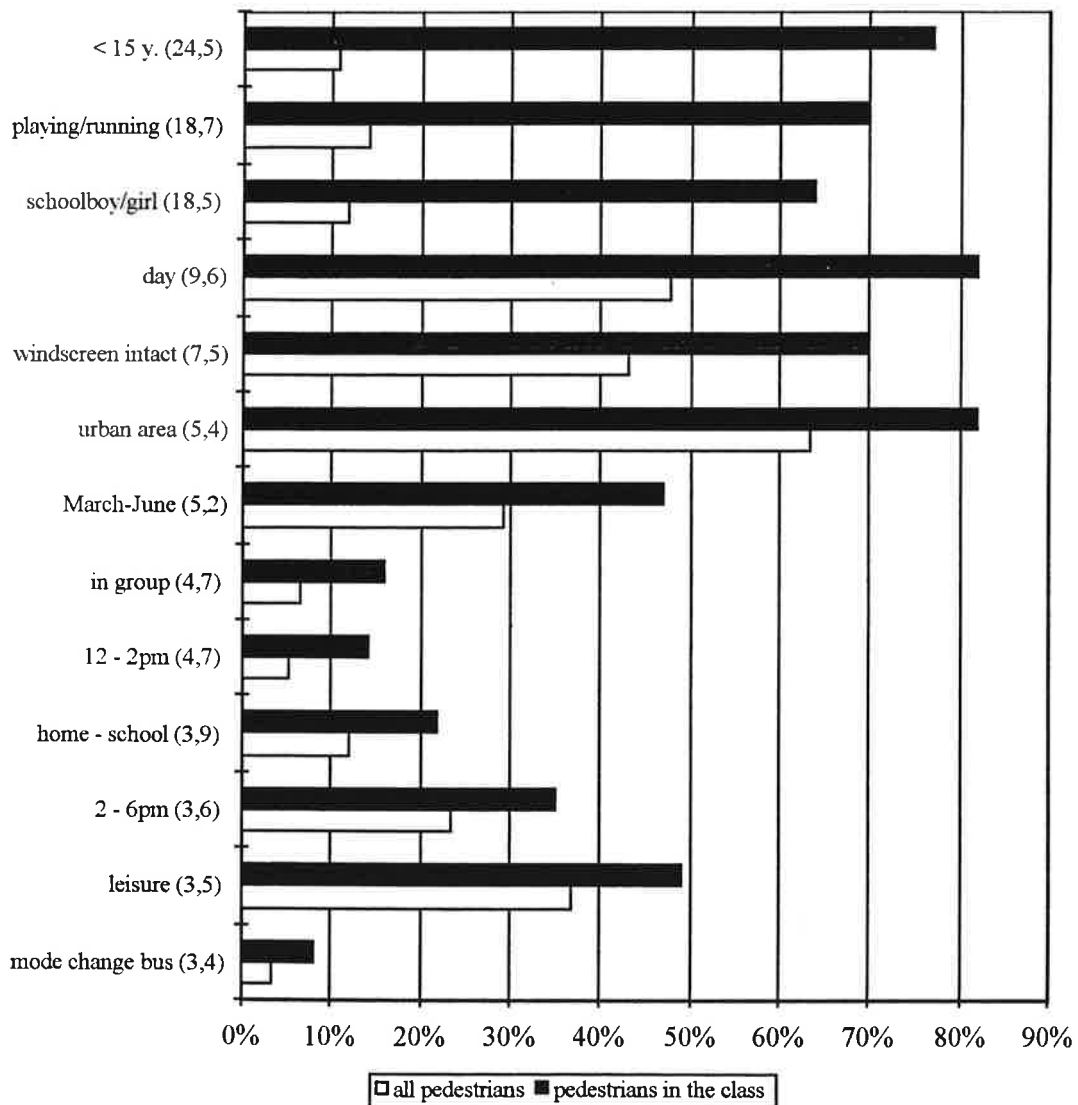


Figure 4: Characteristics over-represented in Class 3 pedestrians compared with all pedestrians (the figure in brackets is the test value). Source : fatal accident reports

9.4.4. Class 4: secondary accidents

In this class, which comprises 11% of all pedestrians, the victim was on a pavement in 64% of the cases. This group is characterized by secondary accidents or collisions, i.e. the pedestrian accident occurred subsequent to an initial accident or incident. A driver may lose control of a vehicle, for example, then hit a pedestrian on the pavement, or after an initial accident involving several vehicles the drivers may alight (becoming pedestrians) and then be struck by other vehicles. Changes of mode with a light vehicle (LV) or a heavy vehicle (HV) are over-represented, as are collisions with fixed obstacles. Most of the pedestrians (58%) are in the 30-64 age group and 31% were on their way to or from work. 14% of these pedestrian accidents occurred on motorways (compared with 5% for the whole pedestrian population), and 29% happened on bends in the road (compared with 13% for the whole population).

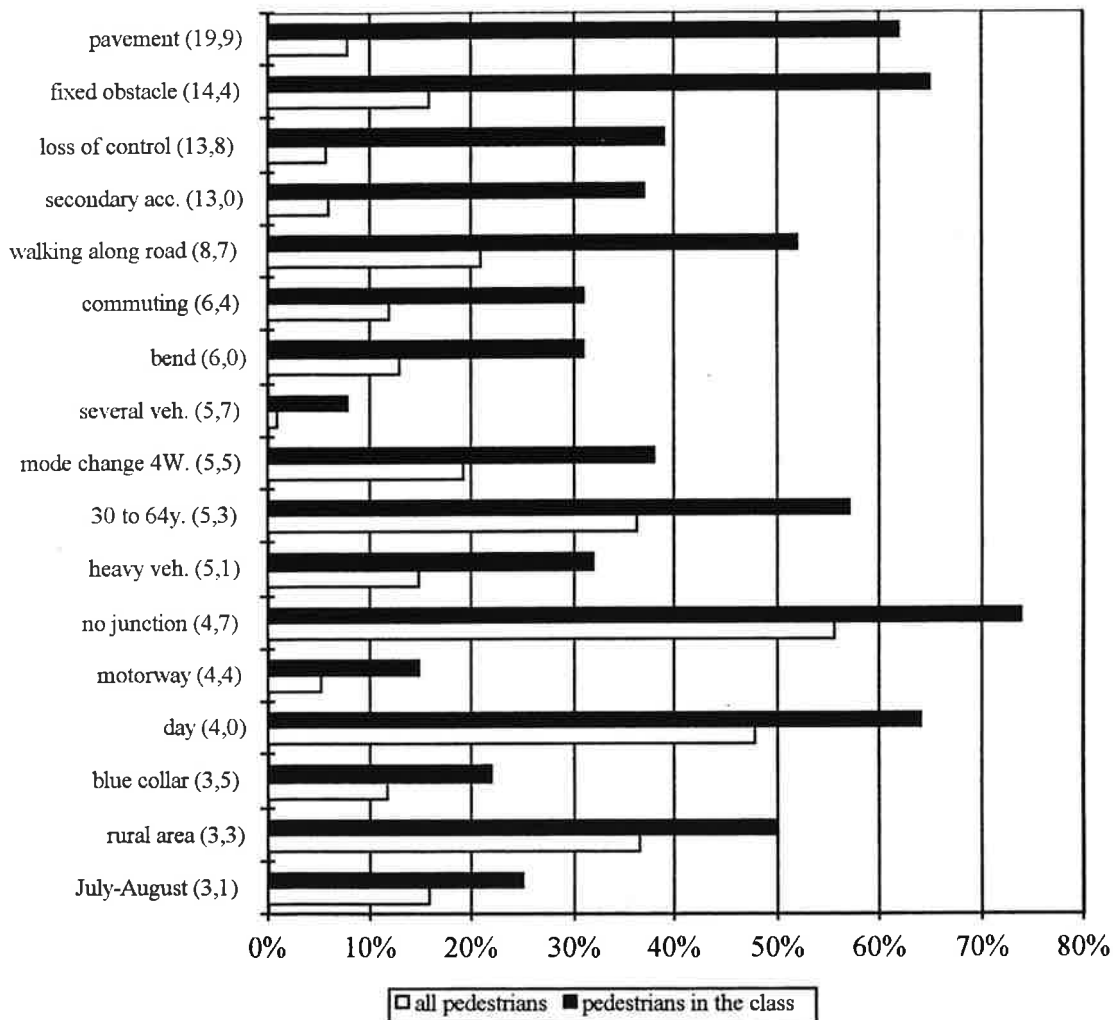


Figure 5:
Characteristics over-represented in Class 4 pedestrians compared with all pedestrians (the figure in brackets is the test value). Source : fatal accident reports.

Figure 6 summarizes the main characteristics of the four groups thus obtained. Individuals in the same class are homogeneous and well differentiated from the other classes. These classes

reflect the pattern of pedestrian exposure : elderly people crossing the road, children playing or running in the street, pedestrians under the influence of alcohol at night on country roads, and changes of mode. Two of these classes reflect familiar results : accidents to children and to elderly people. Alcohol, secondary accidents and intermodal changes, however, have drawn less attention (Muhlrad, 1995). They are categories which involve more violent collisions insofar as the accidents generally occur in the country. There is enough at stake for it to appear important to study these types of accident more closely, either by further analysis of the accident reports or by detailed analysis of the accidents.

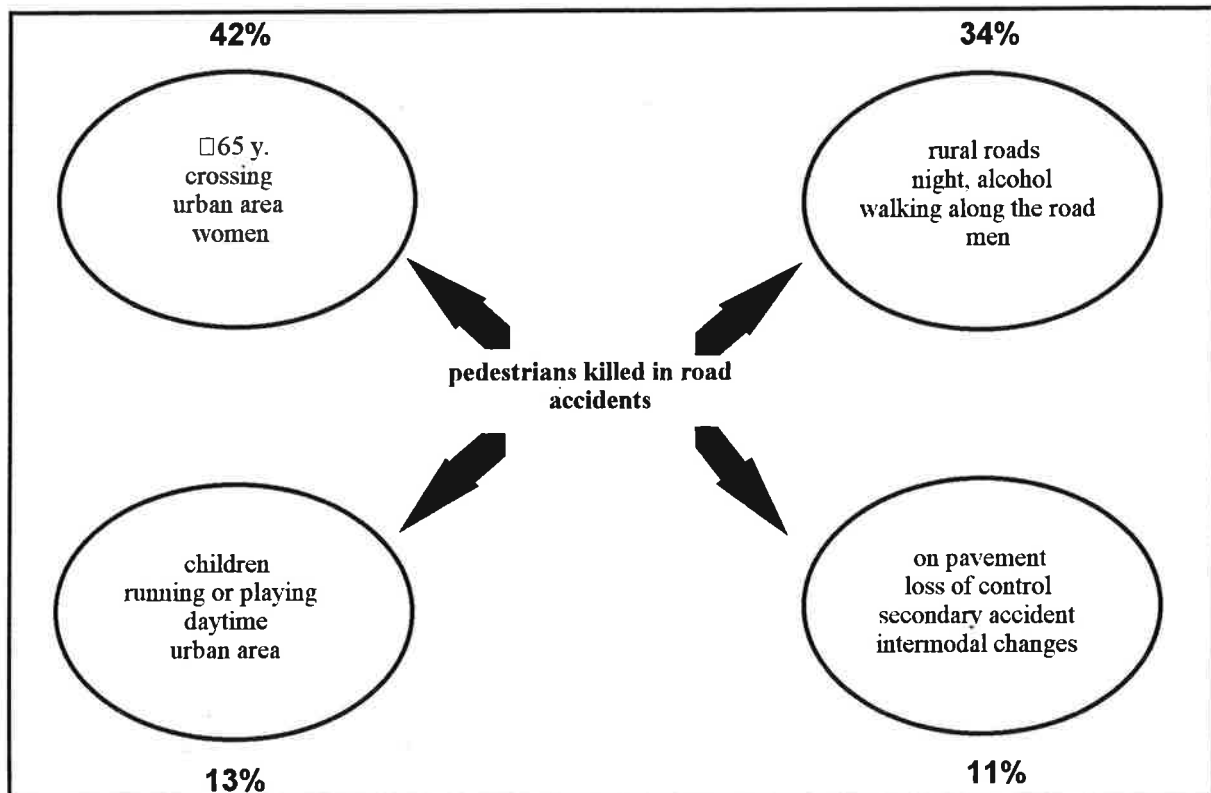


Figure 6:
Types of pedestrians killed in road accidents. (Source : fatal accident reports).

The typology merely reveals the most distinctive characteristics, i.e. those over-represented in each class compared with the pedestrian accident population as a whole.

9.5. CONCLUSION

To improve our knowledge of pedestrian accidents, a descriptive analysis of data from the accident reports drawn up by the police in the event of fatal accidents was undertaken. The idea was to identify types of pedestrian accidents in order to provide a basis for subsequent research on related themes.

The classification of pedestrians involved in accidents clearly identifies four groups :

- pedestrians age 65 or over crossing the road in a built-up area, with women over-represented;
- children in accidents in built-up areas while running or playing;
- pedestrians in accidents at night on country roads while walking along the road, with more than 0.8 g/l of alcohol in the blood;
- pedestrians on the pavement, loss of control of vehicle, secondary accidents, changes of mode.

The typology produced by this analysis reveals correlations between criteria, without necessarily indicating a "causal link" with the accidents. The accident reports and accident analysis forms drawn up by the authorities have their limitations when it comes to explaining road accidents. In the case of fatal accidents to pedestrians, for example, if there are no eye witnesses the driver's account is the only one reported, and drivers obviously tend to arrange the story in their favour.

This type of analysis is also limited in the lack of risk exposure data. Exposure may be expressed by various indicators (Ward and al, 1994) : distance walked, time spent walking, number of roads crossed... The relevance of an indicator depends on the population studied : the number of roads crossed is more significant in the case of elderly pedestrians, while the time spent in the street is a better reflection of children's exposure to risk.

Further research is therefore needed to improve our knowledge of risk exposure to put the situation in better perspective, and we must analyze certain types of pedestrian accident in greater depth, by re-examining the accident reports and taking other analysis dimensions into account, or by studying detailed accident analyses identifying accident mechanisms.

9.6. REFERENCES

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