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Fatal Traffic Accidents in Lower Saxony– A New Approach to Accident Sampling and Analysis of Accident Causes and Configurations

Abstract

In the context of this study, different data sources for accident research were examined regarding their possible data access and evaluated concerning the individual quality and extent of the data. Analyses of accidents require detailed and comprehensive information in particular concerning vehicle damages, injury patterns and descriptions of the accident sequence. The police documentation supplies the basic accident statistics and is amended in the context of the forensic treatment by further information, e.g. by medical and technical appraisals and witness questionings.

As a new approach to the data acquisition for the analysis of fatal traffic accidents, the information was made usable which was collected by the police and by the investigations of the public prosecutor. The best strategy for obtaining reliable, extensive and complete data consists of combining the information from these two sources: the very complete, but elementary statistic data of the Niedersächsisches Landesamt für Statistik (Lower Saxony State Authority of Statistics), based on the police documentation as well as the very extensive accident information resulting from the investigation documentation of the public prosecutor after conclusion of the procedure, the so-called Court Records.

Of all 715 fatal traffic accidents, which happened in the year 2003 in the German State of Lower Saxony, 238 cases were selected by means of a statistically coincidental selective procedure based on a statistically representative manner (every third accident). These cases cover the investigation documents of the 11 responsible public prosecutor's offices, which were requested and evaluated while preserving the data security. Of the 238 cases 202 cases were available, which were individually coded and stored in a data base using 160 variables. Thus a data base of a sample of representative data for fatal accidents in Lower Saxony was set up. The data base contains extensive information concerning general accident data (35 variables), concerning road and road surface data (30 variables), concerning vehicle-specific data (68 variables) as well as concerning personal and injury data (27 variables).

Introduction and Purpose

Traffic accident data of a country or a state, which are relevant for the research of accidents, can be collected from a number of different sources. The standard way of accident data acquisition is to use primary police documents in form of the police report. The research report of the BASt from the year 1976 [1] indicates that there are about 50 items of information available, which have changed over the years, and the number of data collected has rather decreased. Further possibilities exist in the data collection at the site of the accident by scientific teams and by the evaluation of insurance documents, for example of the GDV. Alternatively a new approach for the procurement of accident-relevant data was selected: For the year 2003 traffic accidents in Lower Saxony with fatal outcome were examined on the basis of information from the investigation documents of the public prosecutor's offices and collected in a data base. The Niedersächsisches Landesamt für Statistik (Lower Saxony State Authority of Statistics) (NLS) supplies very complete data records containing all the basic data to the extent of the police accident report. In contrast, the documents of the public prosecutor's offices frequently contain quite profound and detailed data. For getting hold of the investigation documents of the public prosecutor, it was necessary to figure out the register number of the public prosecutor's office by using the police documentation.

The Data of the Niedersächsisches Landesamt für Statistik (Lower Saxony State Authority of Statistics)

The first source of accident data concerning traffic accidents with fatal consequences in Lower Saxony is the data set of the Niedersächsisches Landesamt

für Statistik, NLS. The NLS collects data concerning every traffic accident in Lower Saxony which is recorded by the police and where as a consequence of the accident there is at least one tow away vehicle or which resulted in the injury of one or more persons. A defined data record is conveyed to the Federal Statistical Office from the data bases of the states of the Federal Republic, in order to achieve an overview of the total situation in Germany.

The basis of the NLS data base are police statistics based on police reports (level 1). Therefore the data records of the NLS are very similar to those of the police data bases existing at police headquarters. Additionally, here however further data are supplemented (in particular vehicle-specific data) from other national data bases (e.g. the Kraftfahrt-Bundesamt [Federal Motor Transport Authority]) (level 2).

The NLS recorded data concerning 715 traffic accidents with fatalities in Lower Saxony in the year 2003. For each person involved in an accident the NLS data record consists of 108 different variables. This results in the fact that an accident can have several data records according to the number of involved persons. The structure of the NLS data records can be divided into 4 different categories:

1. Accident-specific data. In this category data relating to 57 variables in view of the accident scene, date and time as well as the kind of the accident are collected.

2. Data referring to the road user. Here the focus is on the data of the road user (e.g. the driver of a vehicle, a pedestrian or vehicle-specific data). The 34 variables of this category refer both to personal data and the age, the nationality of a road user or the cause of accident as well as to technical data of the vehicle like e.g. motor vehicle type, load, engine data etc.

3. Injured passengers. In this category, 10 variables, concerning the age, sex and the injury severity of up to 10 passengers per vehicle are indicated.

4. Data processing characteristics. The data in this category are used internally for data processing purposes. These 7 variables are not relevant here.

The Investigation Documents of the Public Prosecutor's Offices as a Data Source

With each traffic accident with fatal consequences the appropriate public prosecutor's office is informed by the investigating police department. The area of Lower Saxony is divided into 11 responsible public prosecutor's offices. Therefore the appropriate public prosecutor's office investigates the accident dependent on the location. Figure 1 shows the competency areas of the 11 public prosecutor's offices in Lower Saxony.

In the context of the public prosecutor's investigation by the corresponding public prosecutor's office an investigation document concerning the traffic accident is established on the basis of the police report. For this reason an investigation document exists at the corresponding public prosecutor's office for every one of the 715 fatal traffic accidents in Lower Saxony in the year 2003. These investigation documents are usually very extensive data sources, which also offer very extensive data for the research of accidents. Since the public prosecutor's offices examine the traffic accidents based on a legal background, the investigation documents can contain a variety of different documents and sources of information (level 3), which may, however, be equally missing in other investigation documents. Among the most frequent documents and sources of information which were gathered in the investigation

Figure 1: Competency areas of the 11 public prosecutor's offices in Lower Saxony

documents concerning a fatal traffic accident belong:

- traffic accident notification of the police,

- traffic accident investigation report of the police,

- photo report of the police,

- death certificate,

- testimonies,

- damage or accident reconstruction appraisals,

- autopsy report or medical injury opinion.

Usable information from the investigation documents of the public prosecutor's office

The data, which can be found in the investigation documents can be subdivided into the following four categories: data of the surrounding area, vehicle data, data concerning the persons and injury data.

The data of the surrounding area contain information concerning the site of the accident, the climatic conditions, the cause of accident etc. This is normally also supplemented by photos of the accident site. In some cases, an expertise of an accident reconstruction is present, which supplies further specific information.

The vehicle-specific data to be found in the investigation documents are fundamental information about the vehicles, the technical condition of the vehicles and the damage to the vehicles. This usually includes also photos of the vehicles. In some cases also an expertise of the damage is present.

The personal data from the investigation documents supply specific data like age, sex, occupation, driving license etc. Rather fundamental information concerning injuries is found in the police reports or death certificates. This information is present in nearly all investigation documents. As very extensive source of injury information some documents additionally contain autopsy reports, injury appraisals and/or photos of injuries as well as of vehicle deformations.

Data Acquisition Methodology

In order to obtain as representative accident data as possible for Lower Saxony regarding the traffic accidents with fatal consequences, there is also the possibility of taking a statistically representative sample aside from the use of all individual documents. Examining all fatal traffic accidents with over 700 investigation documents of the public prosecutor's offices (total data collection) would have entailed an excessive personnel expenditure. For this reason, a representative selection was taken from investigation documents of the Public Prosecutor. In order to ensure that all judicial procedures for the investigation documents were already concluded and therefore the availability of the documents was given, the year 2003 was selected for the collection year.

The number of approx. 200 investigation documents constitutes a sufficient number of investigation documents for statistically representative purposes, which could be examined at a justifiable personnel expenditure.

In order to be able to make representative statements from the data of the public prosecutor's investigation documents for Lower Saxony, a sampling method was used for the selection of the documents, where the sub-sample was formed from all accidents with fatal consequences. Initially for this purpose the basic data concerning all traffic accidents with fatal consequences in the year 2003 were transmitted by the NLS. These data contain:

District, county, municipality, accident day, accident month, accident year, weekday, accident time – hour, accident time – minute, number of participants, number of fatalities, number of severely injured persons, number of slightly injured persons, type of accident, characteristics of the accident scene, special features of the accident scene, set of lights, speed limit, lighting conditions, road conditions, impact on obstacles at the roadside, effect of alcohol, car not road-worthy, general provisional causes, local position, accident category, type of accident, road class, road number, km specification, driving direction, road code, causes of accident – 1. Cause, causes of accident – 2. Cause, causes of accident – 3. Cause, leaving the scene of the accident, date of birth, age in years, resident aliens in Germany, nationality plate, license plate administrative district, number of vehicle occupants, accident consequences of involved persons, 1st passenger: inj./sex, 1st passenger: age in years, 2nd passenger: inj./sex, 2nd passenger: age in years ... 10th passenger: inj./sex, 10th passenger: age in years, blood alcohol concentration, required driving license exists, date

of issue of license: month, date of issue of license: year, type code: vehicle manufacturer, type code: basic type, type code: type execution, type code: check digit, vehicle type, body style, engine performance in kW, capacity in ccm, max. speed, number of axles, propelled axles, curb weight in kg, permissible total weight, registration date, label for additional expert's opinion, hazardous materials hazard category, hazardous materials digit/letter, no. of the exemption regulation, release of hazardous materials, amount of damages to property, registration date in years.

By means of a statistic random principle, every third accident was selected and the appropriate court record was procured from the 11 different public prosecutor's offices. From the complete list of the NLS with 715 deadly traffic accidents from the year 2003, n=238 of cases were selected and were to be examined.

At the different interfaces of the file access (police, public prosecutor's office) the data record structure was described in order to be able to later discuss the possibilities of the use regarding type, scope and quality of the information.

In order to be able to refer to the 238 selected investigation documents of the 11 responsible public prosecutor's offices, first some foundations had to be laid. Since the investigation documents naturally contain personal information and thus are subject to the protection of privacy, all members of the investigation team who handled the investigation documents were obliged to sign a confidentiality agreement. This is a confidentiality agreement according to the Verpflichtungsgesetz (Law on the Commitment of Persons to Secrecy) dated March 2nd, 1974 (BGBl. I S. 469).

In the second step it was necessary to request the public prosecutor investigation documents from responsible public prosecutor's offices using the appropriate reference number. 202 investigation documents could be made accessible by the public prosecutor's offices. All 202 requested investigation documents arrived within a relatively small period of time and had to be returned to the appropriate public prosecutor's offices after a relatively short retention period. For this reason it was necessary to first digitize the investigation documents using scanners and then to store the copies temporarily. These digital copies were then used for coding and entering of the accident-specific data after they were made anonymous regarding personal data.

Data Structure

The data both from the public prosecutor's investigation documents and from the tables of the NLS were combined in a data base. This is a data base that was adapted particularly to the information content of the investigation documents and the data of the NLS. For each case the data in 160 different variables and text fields were coded and stored in the data base. Since the 202 recorded fatal accidents constitute a representative selection of all 715 fatal accidents in Lower Saxony in the year 2003, a representative data base extending beyond the statistic level was created for accidents with fatal consequences in Lower Saxony. The created data base is called FALS (Fatal Accidents Lower Saxony). The structure of this data base with 160 variables per case can be outlined as follows in Figure 2. A list of the variables can be found in table 1 in the Annex.

For the 202 fatal traffic accidents from the year 2003 in Lower Saxony recorded in the data base, the data of 337 traffic participants involved in an
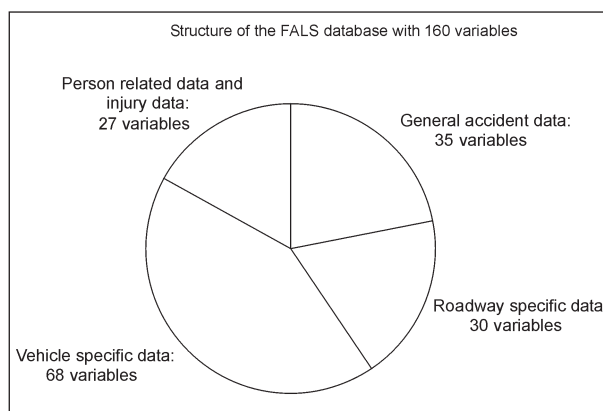

Figure 2: Structure of the data base FALS containing fatal accidents in Lower Saxony
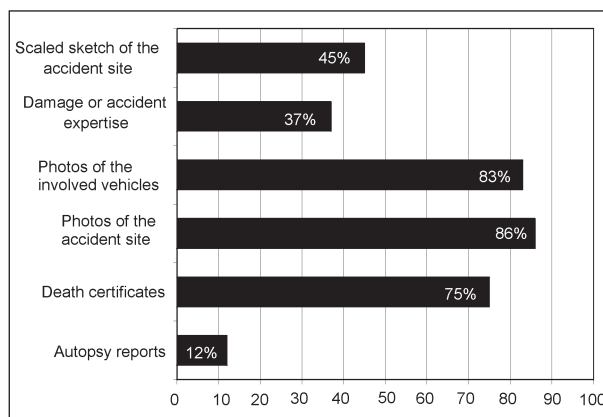

Figure 3: Percentage of the occurrence of information sources in public prosecutor's investigation documents

accident and of 482 participating persons were coded. Of these persons 225 persons (47%) were fatally injured, 67 persons (14%) were severely injured, 75 persons (16%) were slightly injured and 115 persons (47%) remained unhurt.

The public prosecutor's investigation documents can contain a multiplicity of different sources of information. Figure 3 shows an overview of the availability of these sources of information in the investigation documents.

Photos of the accident site and of the vehicles were present in over 83% of the cases. Scaled sketches of the accident place however existed only in 45% of the cases and technical expert's opinions in only 37%. Autopsy reports only existed in 12% of the cases. This surely constitutes a special situation in Lower Saxony. It was reported that for the State of Bavaria for instance in about 80% of the cases an autopsy is performed [2]. In only two cases (1%) there was also a forensic expert's report to answer the question of the use of a belt.

Classification of accident constellations

In the course of the coding of the selected sample of 202 accidents, the accident type classification of the ISK (Institut für Straßenverkehr Köln – Institute for Traffic Cologne) was applied. This provides an accident type classification in 7 main categories and subsequently into several sub-categories of the respective main categories. However when setting up the accident report, the police uses the classification into the 7 main categories only and not the more extensive classification into the various sub-categories by means of a 3-digit code. In the context of this study regarding the 202 court records the extensive, more detailed classification of the accident type code having 3 digits was used. From the sample of the 202 accidents it turned out that with 96 accidents 48% of all accidents were driving accidents. The second most frequent type of accident was the accident in longitudinal traffic at 15% (30 accidents), followed by turning/intersecting accidents at 12% (25 accidents), turning accidents at 10% (21 accidents) and crossing accidents at 9% (18 accidents). The accident types occurring least frequently were accidents by stationary traffic with only 2% (5 accidents) and other accidents, which could not be classified into the categories already mentioned, at 3%. Figure 4 shows the distribution of the accidents of the sample of 202 accidents classified according to accident types compared with the situation in all 715 deadly accidents in Lower Saxony in the year 2003. It shows that the sample exhibits a good representativeness regarding the classification into the 7 accident types. Slight deviations result from the fact that the
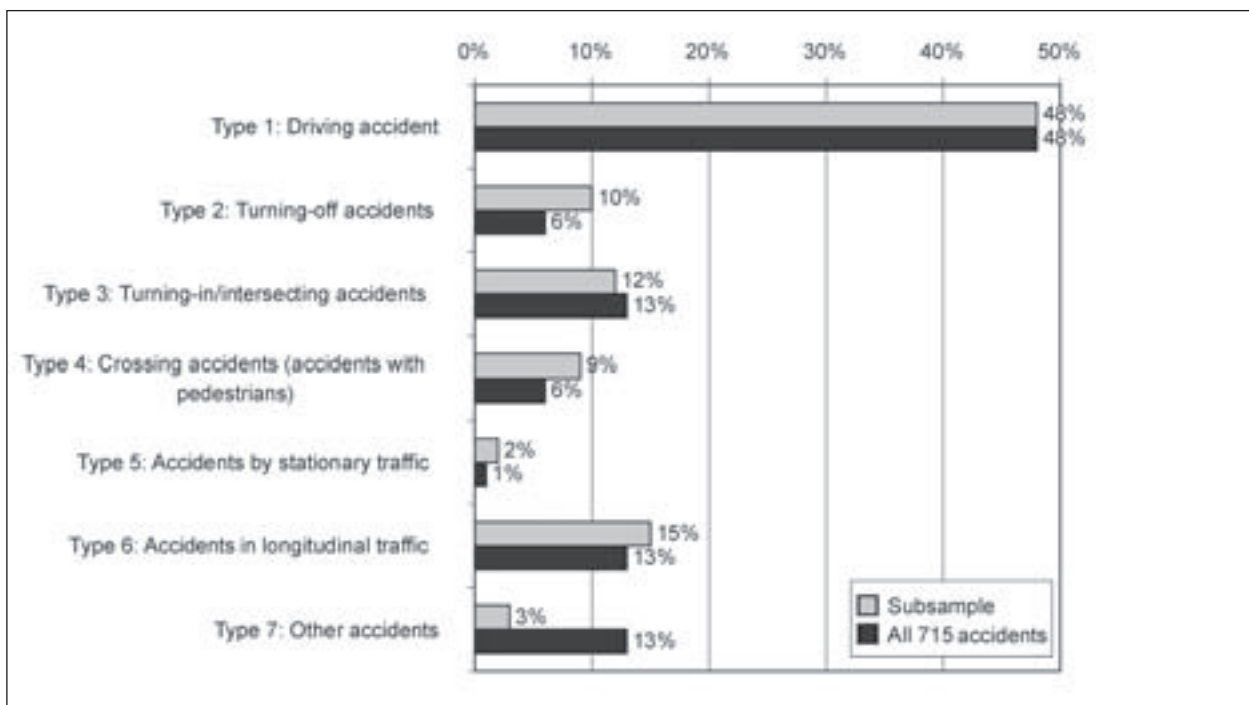

Figure 4: Distribution of the accidents into the 7 accident types. Indicated for all 715 fatal accidents in Lower Saxony in 2003 und for the random sample of 202 accidents

classification of the 715 accidents of the NLS was made by the police at an early stage, when possibly not all circumstances of the accident had been known. The classification of the 202 accidents from the sample, however, was based on the complete information content of the public prosecutor's investigation documents after the conclusion of the forensic procedure.

A detailed evaluation of these accident types in the sub-categories resulted in the following accident structure for the sample:

Driving accidents
Within the 96 driving accidents 60 accidents occurred in a curve. Left and right curves have a similarly high percentage. Of the remaining 36 driving accidents, 34 accidents occurred on straight roads and only 2 accidents in other situations.

Turning accidents
The largest share of the 21 turning accidents were accidents between a vehicle turning left and an on-coming vehicle (14 accidents). Five accidents were accidents between a vehicle turning left and a following vehicle.

Turning/intersecting accidents
Within this category the accidents were distributed predominantly on two sub-categories. 13 of the accidents happened due to conflicts between a vehicle required to wait and one coming from the left with the right of way. Of the remaining 12 accidents in this category 8 accidents happened due to conflicts between a vehicle required to wait and one coming from the right with the right of way and 4 accidents can be distributed to other sub-categories.

Accidents with pedestrians
Of the 18 accidents with pedestrians, 8 accidents occurred due to a conflict between a vehicle and a pedestrian crossing from the right side. Only 4 accidents occurred due to a conflict between a pedestrian coming from the left side and a vehicle. The remaining accidents with pedestrians can be distributed to other sub-categories.

Accidents in stationary traffic
3 of the 5 accidents in stationary traffic happened due to a conflict between a vehicle and a vehicle parking and/or being stationary in front.

Accidents in longitudinal traffic
The majority (13 accidents) of the 30 fatal accidents in longitudinal traffic fall into the sub-category "conflict between encountering vehicles". Another 5 accidents happened due to a conflict between a vehicle and a vehicle preceding it on the same lane. The remaining 12 accidents in this category can be distributed to approximately the same measure on the remaining sub-categories.

Other accidents
Of the 7 accidents not fitting into any of the preceding categories 5 accidents fall into the sub-category "accident by sudden physical inability of the road user".

Figure 5 shows the 10 most frequent types of fatal accidents in accordance with the detailed ISK classification with sub-categories.

It is obvious that the type of accident "driving accident in a curve" is the most frequent type of fatal accident at nearly 30%. The secondary most frequent type of accident is at nearly 17% the driving accident on a straight stretch of the road. The remaining 8 types of accidents lie relatively closely together at frequencies from 2.5% to 7%. Here, no clear order of the frequency of the occurrence can be given, as for only 202 accidents the statistic inaccuracy would be too great.

In order to take the specific characteristics and collision situations of the different road users into consideration, the most frequent type of accident for passenger car drivers, truck drivers, pedestrians, riders of motorbikes and for cyclists was determined (Figure 6). Of the sample containing 202 accidents 167 accidents involved a passenger car, with the most frequently occurring type of accident being a "driving accident in a curve" at 31%. Of the 39 accidents with truck participation the type "accident in longitudinal traffic with oncoming traffic" occurred most frequently at 15%. Of the 32 accidents with motorcycle participation within the sample, the type of accident "turning accident with oncoming traffic" was most frequently represented at 25%. Of the 20 accidents with bicycle involvement, the type "turning/intersecting accident with priority traffic from the left" occurred most frequently at 20%. In fatal accidents, in which pedestrians were involved (21 accidents), in 33% of all cases the most frequent type of accident turned out to be the "crossing accident with pedestrian from the right".
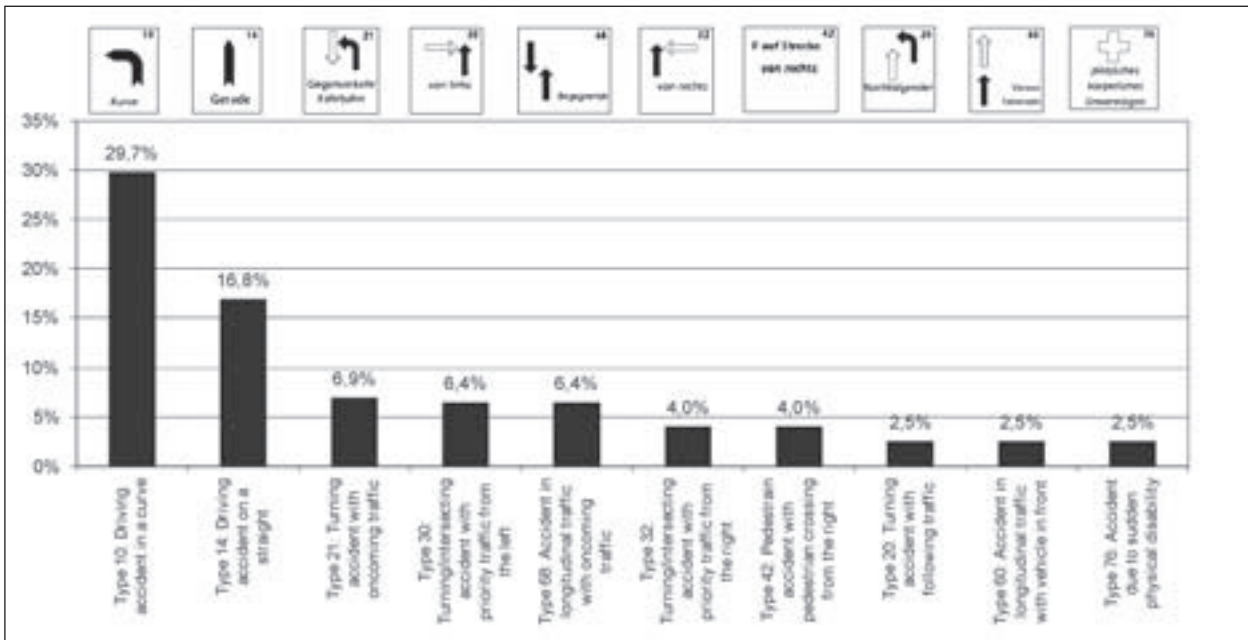
Figure 5: Representation of the 10 most frequent accident types according to the detailed classification
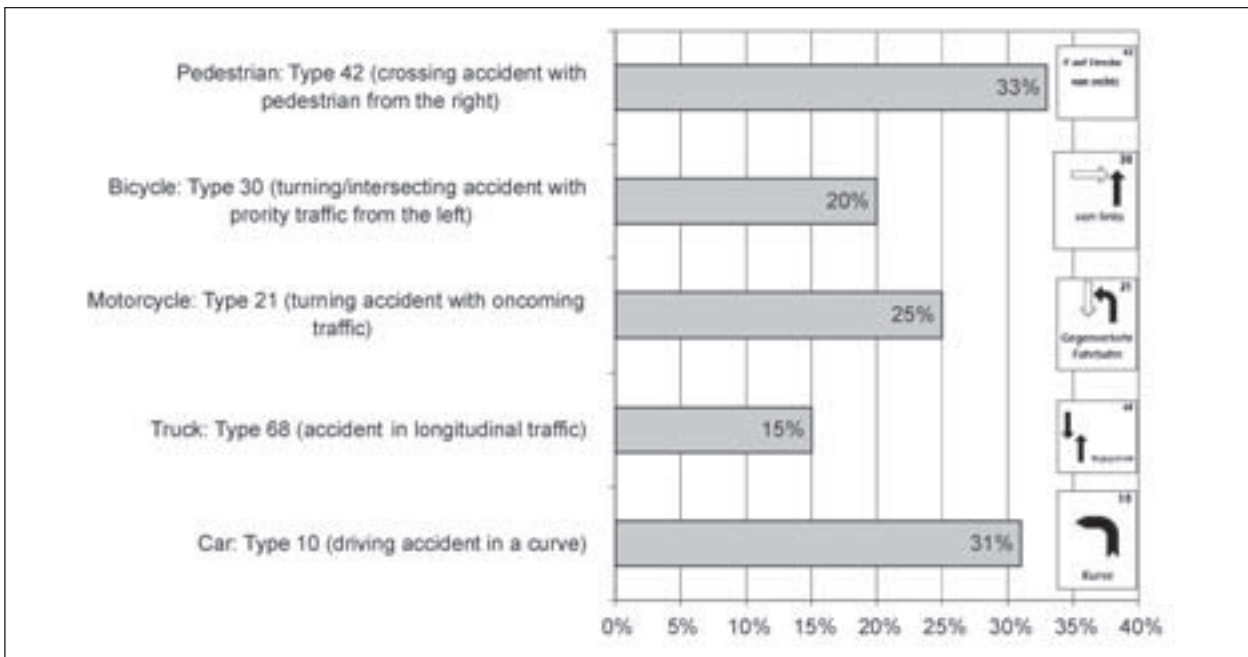

Figure 6: Proportion of the most frequent type of accident as a function of the motor vehicle type involved in a fatal accident

Evaluation of Representativity – Accident Structure and Injury Situation

The question regarding the representativity of the methodically collected information here by means of procedures of random sampling arises, so that in the following a selection of statistic evaluations was conducted, in order to also create a comparison of this sample to the known results of all accidents besides the comparison of accident and injury situations of killed road users in Lower Saxony. For this purpose most figures show the values from the table of the NLS (for all 715 fatal accidents in Lower Saxony 2003) as well as the values from the data base FALS with the data from the public prosecutor's files of inquiry (selection of 202 fatal accidents in Lower Saxony 2003). While the data from the NLS were frequently coded on site by the police, after the study of the files of inquiry the data were coded again, independently of the police

coding. On the one hand the police may not have had access to all information (e.g. appraisals) at the time of coding and on the other hand some variables leave more room for different interpretations (e.g. lighting or road conditions). The larger deviations in some areas are possibly due to this fact.

1. Structure of fatal accidents in Lower Saxony

A reasonable accordance between the selected sample and all road users killed in Lower Saxony appears in the distribution of the characteristics: type of accident, kind of road and type of local area. With the detailedness of the available information of the sample cases even accident parameters such as collision speed could be determined.

As Figure 7 shows, according to the sample most fatal accidents in Lower Saxony occurred on federal highways and state highways at 30% and 29% in the year 2003. Significantly fewer fatal accidents occurred on the motorways in Lower Saxony at 8% and on the usually calm rural roads (10%). The percentages of the total group of fatalities showed almost identical values (±1%). This confirms the good representativity of the database of FALS and thus of the selective procedure.

Also Figure 8 giving the distribution of the fatal accidents depending on the local area shows the same data in the sample as in the total data collection, 79% of the accident victims occurred outside urban areas (total data collection 80%).

Due to the high proportion of passenger cars in traffic, in the sample 63% of the vehicles involved were passenger cars (65% in the total data collection) – Figure 9. Trucks were involved at only 15% (total data collection 14%) and motorcycles only at 9% (also 9% in the total data collection). Of the non-motorized road users, cyclists were involved in 6% and pedestrians in 7% (total data collection in each case 6%) of the cases.

Figure 10 shows the most frequently occurring kinds of fatal accidents. Leaving the carriageway (to the left or to the right) occurs in 43% of all accidents. The second most frequent kind of accident among the fatal accidents is a collision with an oncoming vehicle or with a crossing vehicle.

37% of the public prosecutor's files of inquiry from the sample (202 cases=100%) contain a technical
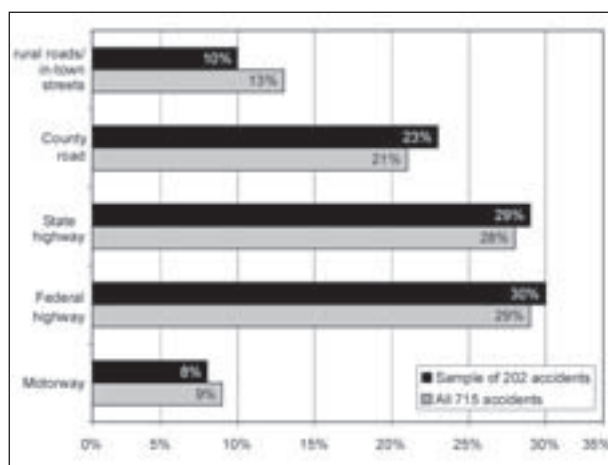

Figure 7: Distribution of the fatal accidents according to the type of road for the situation in Lower Saxony in 2003 (715 accidents) and for the selected 202 accidents
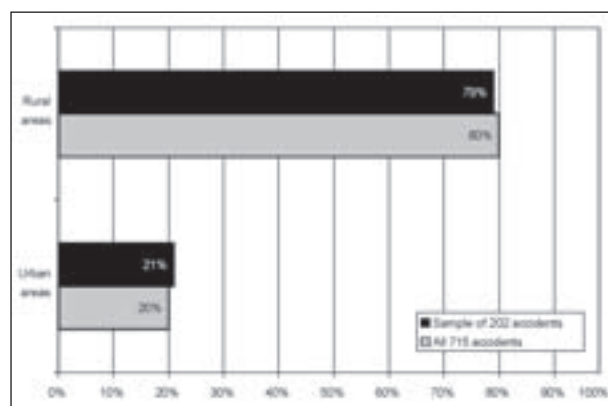

Figure 8: Distribution of the fatal accidents according to the local area in Lower Saxony in the year 2003 (715 accidents) and for the sample of the 202 accidents from the data base
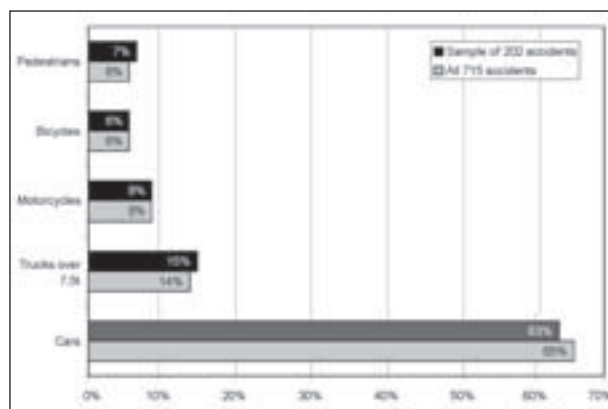

Figure 9: Distribution of the kind of the road users, who were involved in fatal accidents

expertise. In the context of these appraisals for 84 people involved in 53 traffic accidents a collision speed was determined by experts. Figures 11 and 12 show the distribution of the determined velocity
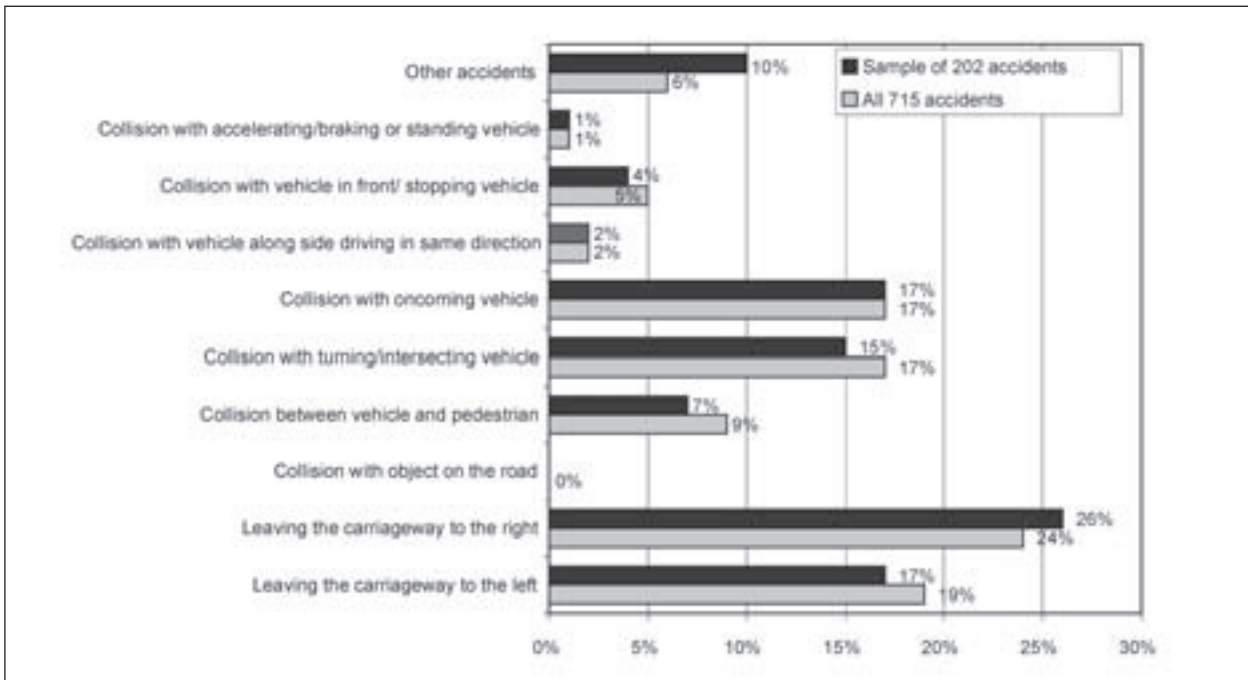
Figure 10: Distribution of the type of accident in all fatal accidents as well as in the accidents of the database from the public prosecutor's files of inquiry
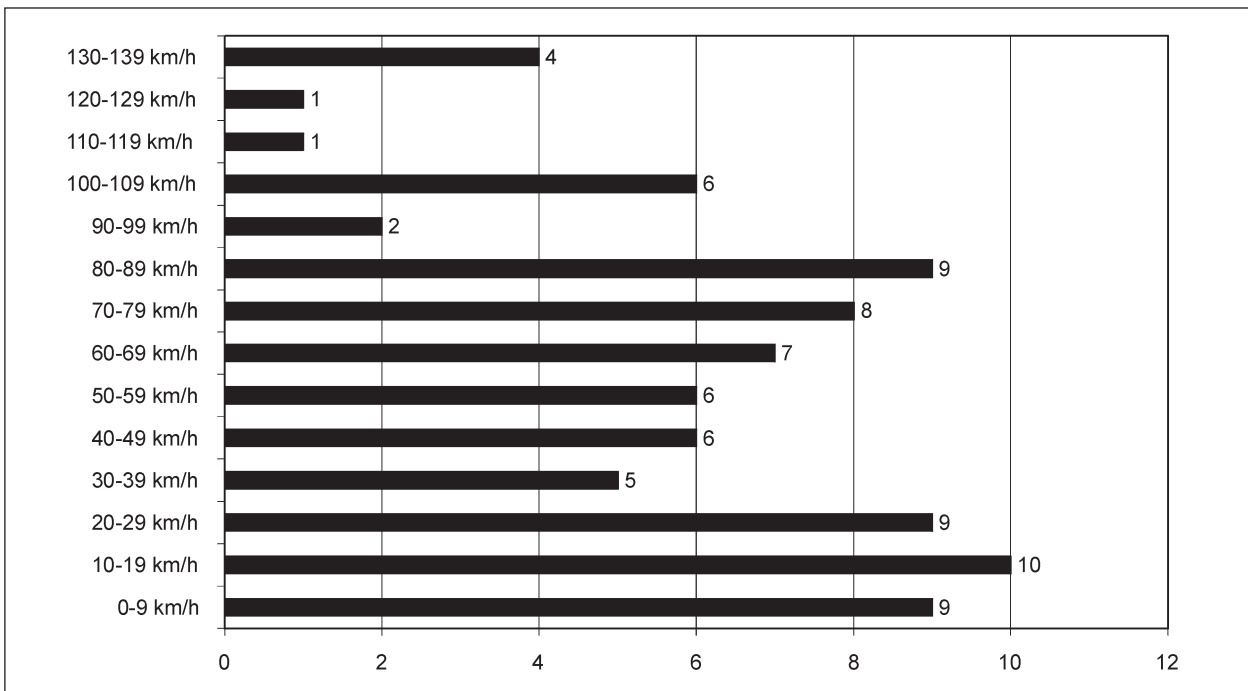

Figure 11: Distribution of the number of people involved in an accident on the collision speeds in fatal accidents with expert's opinions

values for the 84 people involved in accidents. It is obvious that the range up to a collision speed of 30km/h is most frequently represented. Within this range the accidents with pedestrian and cyclist occurred. Beyond 30km/h, the number of people involved in accidents increases with the corresponding collision speed up to a range of 90km/h, as higher collision speeds generally result in a greater injury severity. People involved in an accident with collision speeds of more than 80km/h are still relatively frequently found at approximately 25%. It is to be kept in mind that generally a speed-reducing condition preceded the collision, such as braking or swerving. The driving speeds at accident
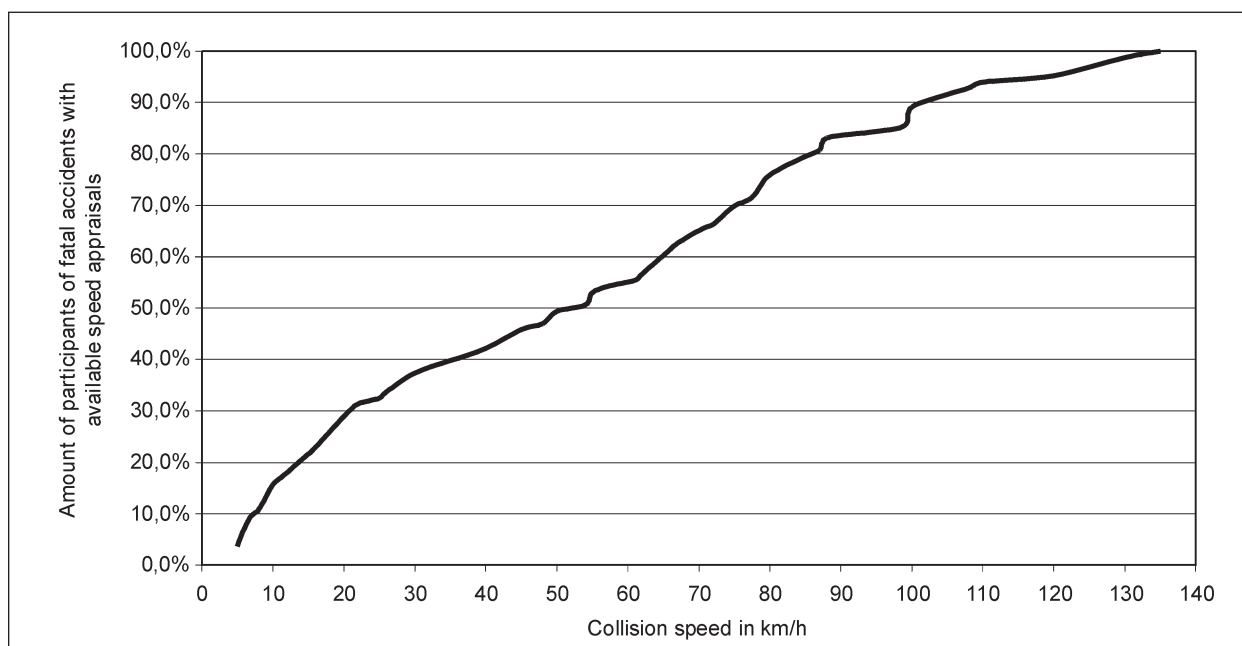
Figure 12: Number of persons involved in fatal accidents with speed appraisals as a function of the collision speed applied as cumulative incidence
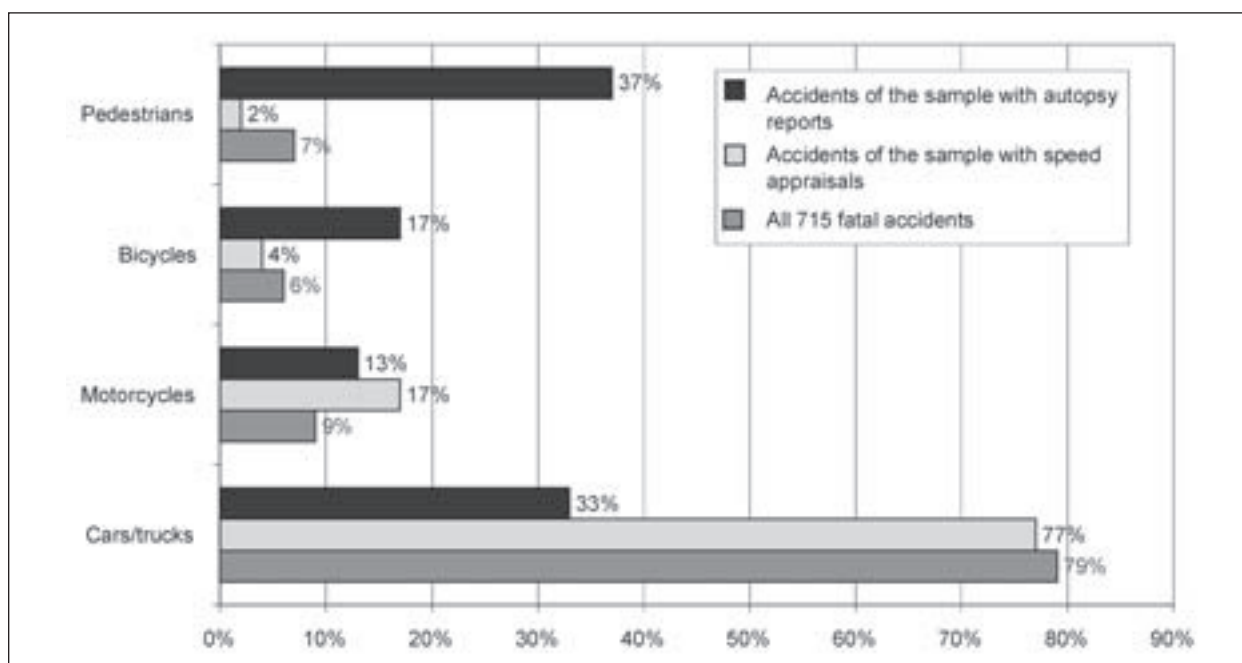

Figure 13: Distribution of the type of road user with all 715 fatal accidents in Lower Saxony in 2003 as well as in all accidents of the sample in which a speed appraisal is present and in all accidents of the sample in which an autopsy was performed

initiation usually exceed the corresponding collision speeds (Figure 11 and 12).

For the statistically representative significance of the represented distribution of the collision speeds (Figure 11 and 12) it is of importance that the speed appraisals which were ordered by the police and/or by the public prosecutor's office show a certain representativity regarding the total situation.

Figure 13 shows the distribution of the road users for all 715 fatal accidents in Lower Saxony compared to the sub-sample for all accidents with speed appraisals from the sample of 202 fatal accidents as well as for all accidents with autopsy reports from the sample. The proportional frequency of the participation of the 4 road user types pedestrians, cyclists, motorcycles and passenger car/truck is represented in each case.

Here the representativity of the cases where a technical appraisal with collision speeds is present is given, at least regarding cars/trucks and cyclists. The portion of the motorcycles with the speed appraisals at 17% is nearly twice as high as the total number of accidents that occurred (9%). Fatal accidents with pedestrians however are underrepresented at 2% of the cases as opposed to 7% of the total number of accidents that occurred. This is surprising, since it has been assumed that in fatal pedestrian accidents there would be a particular interest at the side of the public prosecutor to determine the speed by means of a technical appraisal. It seems to be greater however, if passengers in cars suffer from fatal consequences of accidents.

A relatively clear correlation of autopsy orders for certain groups of road users can be seen. At 37% of the autopsies the pedestrians are strongly over-represented, as their corresponding proportion in the 715 fatal accidents in Lower Saxony is 7%. The same applies to bicycle riders. While 17% of all traffic fatalities from the sample on whom an autopsy was performed were cyclists, these were involved only to 6% in fatal accidents. Autopsies were performed on 13% of the motor cyclists, whereas only 9% were involved in fatal accidents. A different picture is revealed when the road user is a passenger car/truck. Persons in this type of motor vehicle are involved in 79% of the fatal accidents in Lower Saxony. They were subject to autopsies only at 32% of the traffic fatalities that occur, however. Thus clearly a statistically representative analysis from autopsy data is not possible, autopsy protocols are often oriented at forensic criteria and provide a detailed description of the injuries. Of the selected sample of 202 fatal accidents in Lower Saxony in the year 2003, autopsies were performed on only 24 cases (12%).

2. Injury severity and injury pattern of fatal accidents in Lower Saxony

The injuries of the autopsy reports were coded in accordance with the "Abbreviated Injury Scale" AIS 2005, so that a statistic evaluation was possible. The distribution of the injury severity of all 278 coded injuries in accordance with the AIS classification is represented in Figure 14. AIS 1 corresponds to a slight injury, AIS 2 to a moderate injury, AIS 3 to a severe injury, AIS 4 to a serious injury, AIS 5 to a critical injury and AIS 6 to an injury not treatable at the time. The AIS value of 9
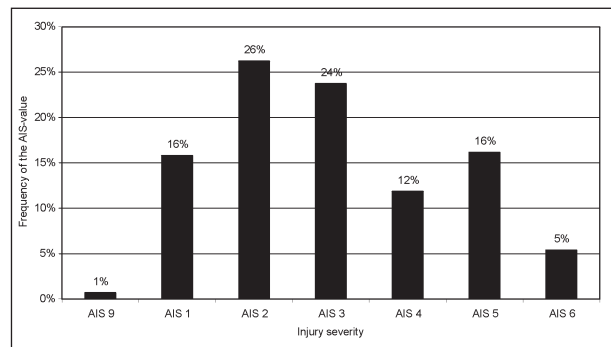

Figure 14: Distribution of injury severities in accordance with AIS covering all 278 injuries of the 24 traffic fatalities on whom autopsies were performed

designates unknown injuries, which are represented at less than one per cent here.

It is shown that moderately severe injuries AIS 2 and AIS 3 occurred most frequently at around 25% each with the accident victims. However only 16% of the injuries were slight injuries (AIS 1). Of the severe injuries, which often led to fatality, 12% were AIS 4 as well as critical injuries (AIS 5) at 16% and AIS 6 (5%), altogether thus 21%, were particularly frequently represented.

In Figure 15, the distribution of the 159 heaviest injuries (all injuries starting from AIS 3) is represented according to the body regions. Additionally these injuries are sub-divided according to the injury severity into the categories AIS 3, AIS 4, AIS 5 and AIS 6. It is shown that head injuries are strongly represented within the 4 groups of the most severe injuries. There were virtually no injuries to the face or to the neck of AIS values of AIS 3 and more. Thorax and stomach injuries however occurred more frequently in all groups of AIS 3 and more, just like head injuries. Severe injuries to the spinal column are rare. This finding contradicts the statement of Figure 16, where at 7% of the cases, spinal column injuries were the most severe injuries. It is questionable whether this is due to the fact that relatively more autopsies were performed on pedestrians and cyclists. The remaining body regions of the upper and lower extremities play an underpart where the location of severe injuries is concerned. Only with decreasing injury severity, the lower extremities seem to be more frequently represented.

Figure 16 gives an overview over the distribution of the most severely injured parts of the body for persons, who were fatally injured in Lower Saxony in the year 2003 in the course of a traffic accident. This information originates from the public
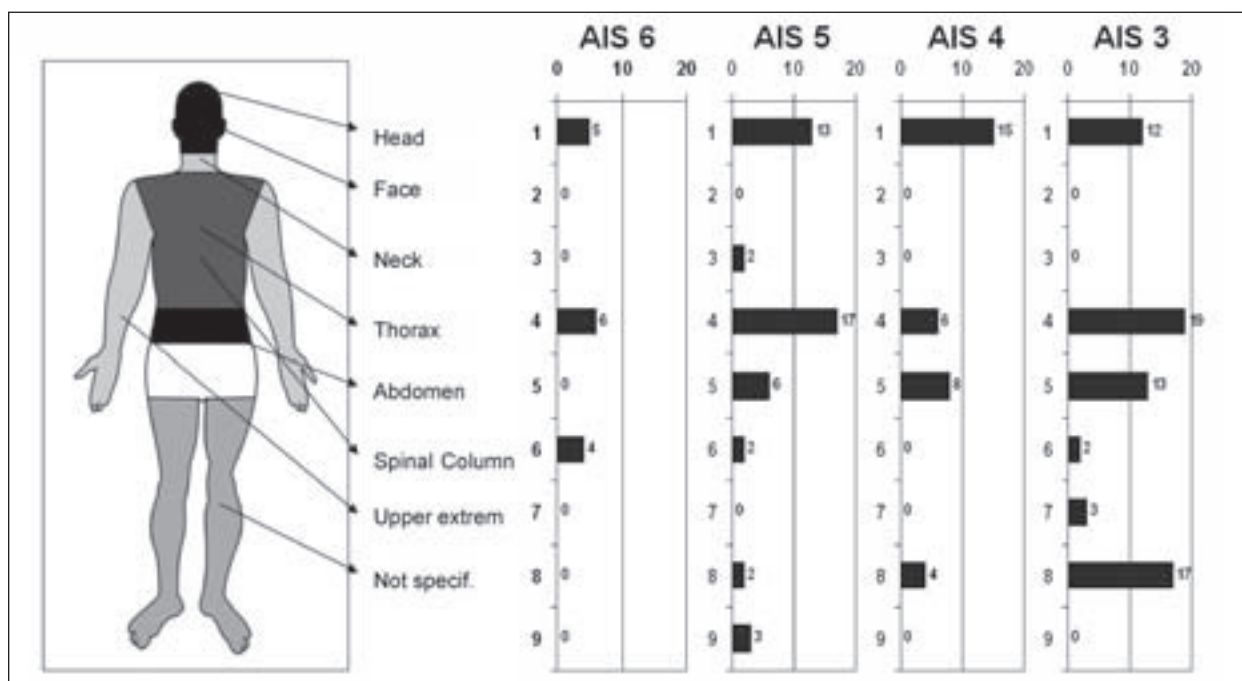
Figure 15: Distribution of the injuries of the 4 most serious degrees of injury severity (AIS 3 to AIS 6) on the corresponding body part
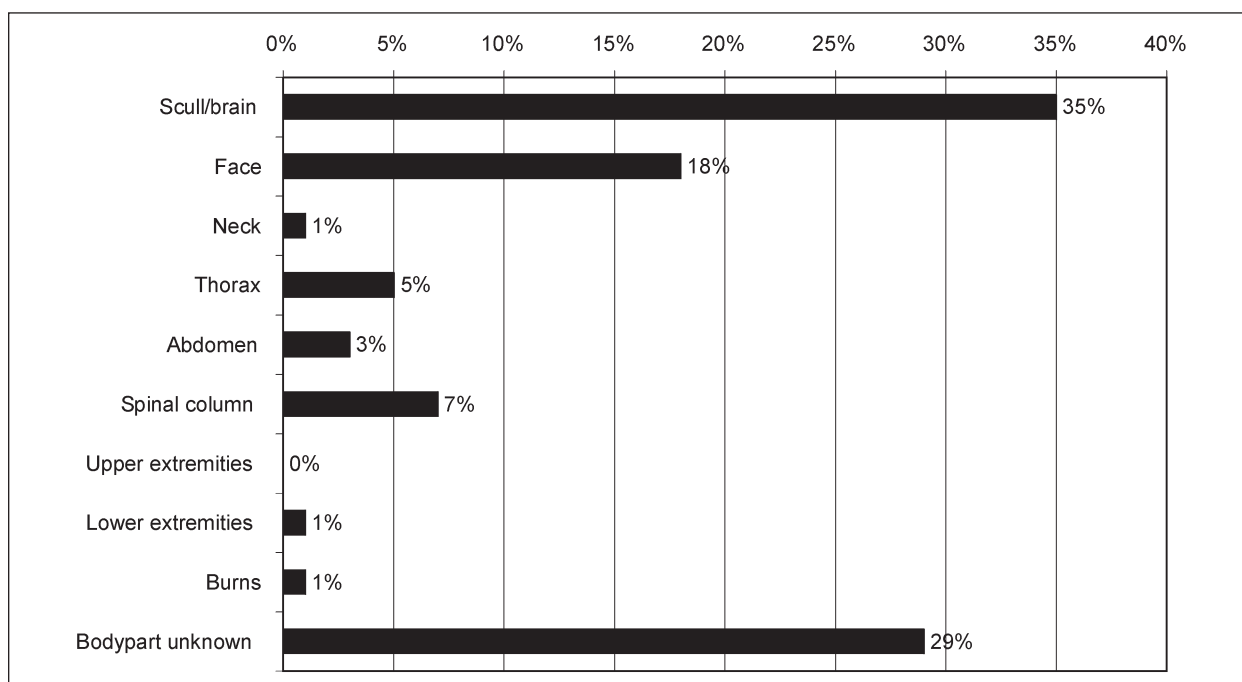

Figure 16: Distribution of the most severely injured body parts of persons fatally injured in traffic accidents in Lower Saxony in 2003

prosecutor's files of inquiry and the physician reports and autopsy reports contained in them. In 12% of all cases such documents were available, in 75% of the cases these could be gleaned from death certificates or police reports, however not in an exhaustive manner. Only for 146 fatalities of altogether 225 in the database containing 202 accidents, the most severely injured body parts could be determined.

It can be read from Figure 16 that injuries of the head are frequently the most severe injuries of traffic fatalities and thus represent the most frequent cause of death for the persons involved in fatal accidents. With the exception of injuries of the spinal column and the thorax the other parts of the body are rather underrepresented.

Conclusion and Discussion

Recapitulatory, it can be stated that the selected methodology of the analysis of traffic accidents based on information from the public prosecutor's files of inquiry offers quite a good base of scientific analysis and data acquisition after conclusion of the forensic procedure. The methodology "Statistical Analysis of Prosecution Accident Cases" is called SAPAC. Such a methodology offers an additional possibility at a justifiable expenditure of scientifically using the collected information of a forensic public prosecutor's preliminary investigation, beyond the possibilities of the statistical accident documentation by means of police reports and the detailed in-depth investigations with very comprehensive and detailed information, concerning vehicle deformation, local accident conditions and injury details, conducted by scientific teams. By the application of the legal framework conditions of data security for scientific use, the possibility of data acquisition and analysis for scientific purposes is given.

In the context of this study, a process of random sampling and a methodical procedure for the scientific use of the public prosecutor's files of inquiry were developed and a data base for the analysis of accidents was established, here using accidents from the German state of Lower Saxony, called FALS (Fatal Accident Data Lower Saxony), in order to determine the accident structure and injury situation of killed road users with SAPAC. In contrast to the analysis of the data of the official statistics, the public prosecutor's files usually contain more comprehensive information concerning the sequence of the accident, the causes as well as the damage and injury patterns.

The study showed that in fatal accidents frequently speed is a parameter substantially affecting the accident. Accidents on state and federal highways constitute the major share (approx. 60%), 80% occurred outside urban areas. Head and thorax injuries are among the most severe injuries.

Occupants of cars were frequently killed in curve accidents, pedestrians while crossing a road away from pedestrian crossings, bicyclists when turning and crossing privileged roads with traffic from the left. Motor cyclists were frequently killed when turning left and colliding with oncoming vehicles. Truck drivers frequently suffered fatal injuries in accidents in longitudinal traffic.

The study showed a good method for extracting information, which is otherwise not possible using the typical national statistics on the basis of the unchanged police reports. With this type of collection on the basis of the files of inquiry of the public prosecutor's offices and courts SAPAC, the average of 160 accident characteristics for each accident are usable. This is a fraction of the information gleaned from large-scale in-depth investigation teams. For example, in GIDAS for each accident about 2000 to 3000 items of information are collected. But the FALS database supplied a good overview of the accident structure and the corresponding injuries. A comprehensive study of the causes of accidents cannot be accomplished on the basis of this information. One is limited to the information given by the police, witnesses and the expert, all of whom are not present to an equal degree in all cases and therefore differ in quantity and quality. The data base permits statements concerning the avoidability of fatal accidents, however. In 8% of the cases, where passenger cars caused the fatal accidents, the accident would have been avoidable, 38,5% of the passenger car drivers that did not cause the accident, could have avoided it. This demonstrates the possibilities of the acquisition of detailed information by means of SAPAC, whose data structure is described in Table 1 in the Annex.

SAPAC can also be used to supply statements concerning the types of head injuries. Thus brain injuries and fractured skulls turned out to have occurred particularly frequently for killed passenger car occupants, which with a larger amount of cases could also be depicted for different collision speeds and EES values (Energy Equivalent Speed). The opportunity of making very detailed evaluations from the database requires breaking the total collective down to few cases for certain questions. Only 1 applicable case emerged, when head injuries of car occupants were known and EES in the case of passenger cars turning left was available. Thus in-depth analyses based on this methodology are limited. This deficit can be met only by increasing the number of cases. It would be sensible in this context to either extend the radius of action to several states or to analyze the data collected for several years, in order to be able to

analyze positive and negative developments or trends.

That process of data collection and data analysis from public prosecutor's files of inquiry and court records SAPAC, selected here as a methodical approach, appears sensible and should be continued further. Here the data base FALS (Fatal Accidents Lower Saxony), established using accidents from the year 2003, is available and is scientifically usable.

Annex

References

1 H. APPEL, U. WANDERER, J. BLÖDORN: Forschungsbericht Nr. 206, Technische Universität Berlin, im Auftrag der Bundesanstalt für Straßenwesen, 1976

2 E. SCHULLER, G. BEIER: Verletzungsmechanische Fragestellungen bei der Rekonstruktion von Verkehrsunfällen, Kongressbericht der Deutschen Gesellschaft für Verkehrsmedizin e. V. im Auftrag der Bundesanstalt für Straßenwesen, Heft 56, 1986

General accident data	Traffic lights present	Trailer used	Personal/inury data
Day of week	Road surface type	Alcohol involvement	Seat row
Autopsy report available	Condition of roadway	Blood alcohol level	Seating position
Technical expertise available	Surface contaminants	Drug involvement	Driver y/n
Local area	Construction site present	Drivers licence since	Seatbelt used
Accident category according to the NLS	Bicycle lane/type	Driver is foreigner living in	Ejection from vehicle
Accident type according to the NLS	Lighting conditions	Nationality of driver	Entrapment
Accident category acc. to CARE defin.	Weather conditions	Nationality of veh. license	Person run over
Accident type according to the ISK	Fog present	Is driver owner of vehicle	Age
Accident kind according to the NLS	Visibility	ABS	Sex
Amount of involved cars	Strong winds	ESP	Hight of person
Amount of involved trucks	Transient factors	Vehicle manufact/type code	Weight of person
Amount of involved two-wheelers	Artificial lighting	Vehicle type	Marital status
Amount of involved pedestrians	Traffic calming	Car body style	Occupation
Amount of vehicles damaged	Division of lanes	Amount of doors	Suicide
Amount of involved poeple not injured	Type of crossing	Drive of vehicle	Injury severity
Amount of involved poeple slightly injured	Alignment of roadway	Color of vehicle	Consciosness arrival first aider
Amount of involved poeple heavily injured	Vehicle specific data	Engine power	Taken to hospital
Amount of involved poeple killed	Type of accident participant	ccm	No. of night in hospital
Total damage in EUR	Manufacturer	Vehicle max. speed	Died at scene
Accident with influence of alcohol	Vehicle model	Amount of axles	Days to death
Object struck off road	Amount of occupants	Driven axles	Bodyregion of heaviest injuries
At least one tow-away vehicle	Accident causer according to police	Kerb weight	Injury description
Hit and run	Vehicle movement before accident	Max. permitted weight	AIS-code
Accident with animal involvement	Accident evasion manoeuvre	Year of manufacure	Road user type specific var.
District	Omitted reaction of driver	Age of vehicle	Airbag availability
County	Driving direction before accident	Has veh. passed mand. inspection	Airbag deployment
Community	Collision type	Hazardous cargo	Helmet used
Collision type	Collision angle	Hazardous cargo classification	Reflecting clothing used
Roadway specific data	Amount of collisions	Hazardous cargo discharged	Bicycle lane available
Road classification	Driver/Pedestrian handicapped	Most heavilily injured occupant	Bicycle lane used
Local area	Hit and run	Place of damage	Direction of collision
Type of road	Accident cause 1 according to NLS	Interacted with	Type of Motorcycle
Driving-direction of accident causer	Accident cause 2 according to NLS	Vehicle catch fire	Helmet type
Type of vincinity	Accident cause 3 according to NLS	Vehicle submersion	Dedicated Motorcycle clothing
Traffic density	Accident avoidable acc. to expertise	Vehicle tow-away vehicle	Helmet lost on accident
Roadway characteristics acc. to NLS	Collision speed according to expertise	3rd column of CDC	Chin strap torn apart
Particularities according to NLS	Speed before accident	Jacknife	
Amount of lanes in incr. direction	EES according to expertise	Vehicle roll over	
Amount of lanes in decr. direction	Object hit off road	Vehicle came to rest on	
Amount of lanes in both directions	Is vehicle defect a cause	Vehicle width	
Speed limit	Reckless driving before accident	Vehicle lenght	
Type of speed limit	Type of vehicle according to NLS	Damage on vehicle in EUR	

Table 1: Variables of FALS Data base