

**The bicyclist's accidents with a counterpart:  
The development from 1980 to 1990 in Odense, Denmark.**

**Lars Binderup Larsen, Erik L. Nordentoft, Claus Falck Larsen,**

**Accident Analysis Group  
Odense University Hospital  
5000 Odense C, Denmark**

**Abstract**

According to data from the emergency room of the Odense University Hospital the number of bicyclists treated following road traffic accidents with a counterpart has increased 90% from 1980 to 1990. In the same period there has been little increase in the intensity of the bicyclist's traffic while motor vehicle traffic intensity has increased.

The objective of this study was to reveal factors in the development of the bicycle accidents which might explain the increase in bicycle collision accidents.

Furthermore we wanted to examine if the official road traffic accidents statistics gave a true picture of the accident development compared to data from the emergency room.

During a number of years the data from all persons treated in the emergency room has been collected by the Accident Analysis Group at the Odense University Hospital and stored in a database. These data are compared with data from the police records from the National Bureau of Statistics.

The largest part of the increase in bicyclist's collision accidents is caused by a higher number of collisions with other bicyclists and motor vehicles. The number of collisions with pedestrians, mopeds and motorcycles is relatively constant. The bicyclists age 20 to 29 years cause the largest part of the increase in the number of accidents.

The male/female ratio is almost constant. The severity of the lesions decreases significantly, whereas the localization of the injuries according to body regions do not change. The decrease in severity of the lesions is accompanied by a smaller rate of hospitalization.

There is a decrease in the rate of police reporting, also if the accidents with minor injuries according to AIS are excluded.

## **The bicyclist's accidents with a counterpart: The development from 1980-1990 in Odense, Denmark.**

**Lars Binderup Larsen, Erik L. Nordentoft, Claus Falck Larsen,**

**Accident Analysis Group  
Odense University Hospital  
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### **Introduction**

Bicyclists constitute 14% of road traffic fatalities in Denmark. In 1989 ninetyfour bicyclists were killed in Denmark in road traffic accidents. 75 % of the road traffic injuries seen in the hospital's emergency room in Odense Denmark are in bicyclists. This number has been unchanged during the recent years despite a number of traffic safety measures for bicyclists have been made. The number of fatal accidents for nearly all other road users has decreased. According to the national traffic accident statistics for Denmark a minor decrease in non fatal collision accidents for bicyclists has been recorded. <sup>(1)</sup>

70 % of the bicyclists treated at the emergency room following road traffic accidents are the victims of single accidents without any counterpart. <sup>(2)</sup>

Data from the emergency room at the Odense University Hospital has shown a considerable increase in the number of injured bicyclists while the number of accidents for nearly all other sorts of road users have decreased. The number of bicyclists injured in collision accidents has increased 67% from 1980 to 1989. <sup>(2)</sup> The catchment area for the emergency room has been 235.000-238.000 in this period. <sup>(3)</sup>

Though 70% of the bicyclist injuries are sustained in single accidents without a counterpart, the collision accidents tend to cause more severe injuries. <sup>(4)</sup>

Traffic census carried out by the national road authorities have shown that the overall bicycle traffic intensity has been nearly constant over the recent years in Denmark while the motor vehicle traffic intensity has increased. <sup>(5)</sup>

In Sweden Kroon found a decrease in the bicycle traffic intensity in Göteborg from 1980-85, and in the same period a stagnation in the total number of injured bicyclist treated at the hospital. <sup>(6)</sup>

For many years the NBS has received data on RTAs covering the police districts on the island of Funen. This is matched with accident statistics from the emergency room of the Odense University Hospital by means of the unique central person number and the date of accident, presuming that a person would not have had more than one accident in one day. In that way it is possible to calculate the under-reporting in the police registry. The reporting rate of course differs with the type of accident <sup>(4)</sup> and normally the police is not called to single bicycle accidents which would be meaningless to report.

## **Objectives:**

The aim of this study has been to examine some of the epidemiological factors in the development of bicyclist's collision accidents which could explain the increase of bicyclist's collision accidents.

Furthermore we would examine if the official road traffic statistics which are based on the police reporting are adequate for describing the development of bicyclist's collision accidents compared to data from the emergency room.

## **Methods:**

The Accident Analysis Group at the Odense University Hospital collect detailed information on all persons treated in the emergency room following road traffic accidents. The information include time, sex, place of the accident, possible counterpart, injuries and the treatment given. All the lesions sustained are coded according to AIS. <sup>(7)</sup>

All data from the latest ten years were collected from the Accident Data Register and compared to the police recordings from the same period.

## **Results:**

The total number of bicyclist's collision accidents has increased 90% from 1980 to 1990 (TABLE 1). In the same period the number of collisions between bicyclists has increased 4 times. The percentage of this type of collision has increased from 16% to 32% of the total number of bicyclist's collision accidents. The number of collisions with motor vehicles has increased significantly while the percentage of this type of collision has decreased from 54% to 48% of the total number of collisions. (TABLE 1)

The age group 20-29 years had the largest increase in collision accidents while the older bicyclists ( $\geq 60$  years) had a more constant number of collision accidents and the children below 9 years a minor decrease. (TABLE 2)

The male/female ratio was approximately 1 in the total period.

The severity according to MAIS of the injuries has changed during the period. (TABLE 3)

The percentage of minor injuries (MAIS 1) has increased from 65% (90% CI 61-69%) in 1980 to 77% (90% CI 74-80%) in 1990.

For the accidents with  $\text{MAIS} \geq 2$  there has been a tendency to an increase in the total number of 131 in 1980 and 164 in 1990.

The percentage of these accidents according to the total number of collision accidents has decreased from 35% (90% CI 31-39%) in 1980 to 23% (90% CI 20-26%) in 1990.

The localization of the injuries according to body region has not varied insignificantly changed significantly during the period. (TABLE 4)

The number of bicyclists hospitalized following collision accidents has varied during the period. (TABLE 5) The median time for hospital stay varied between 1.4 days and 3.7 days.

From 1982 to 1983 a significant decrease in reporting of collision accidents was recorded. (TABLE 6)

This was caused by a changed procedure in police reporting of road traffic accidents. They no longer reported accidents which were judged to be minor.

In the right column of table 6 the percent of police reported accidents according to number of accidents with MAIS $\geq$ 2 seen in the emergency room are shown. In 1981 the police reported 200% the number of accidents with MAIS $\geq$ 2 seen in the emergency room. In 1990 this percent was decreased to 70%.

### **Discussion:**

To our knowledge no other study has analyzed the development of bicyclist's collision accidents over a longer period of time. It is therefore difficult to compare our results with other studies. Our findings indicate that some of the epidemiological factors concerning bicyclist's collision accidents have changed significantly over the period.

Parallel to the increasing number of collision accidents a decreasing percentage of more severe injuries is seen. It seems as the main part of the higher number of bicyclist's collision accidents consists in accidents with only minor injuries according to AIS. Supporting this a decreasing percentage of the injured bicyclists were hospitalized while the absolute number of hospital admitted were unchanged.

From our findings it is not possible to determine the reason for this. The catchment area for the hospital has not changed during the period and the bicycle traffic intensity has not increased. A change in bicycle traffic has been observed in the study period. The bicycle models have changed and the bicyclist's ride with a higher speed.

It might be that the level for seeking treatment at the emergency room has changed in a way that persons with minor injuries seek treatment more often now than earlier. However in nearly all other road users, the number of injured persons treated at the emergency room at Odense University Hospital has decreased or been constant during the latest ten years <sup>(4)</sup>.

The AIS-coding system was made to determine the threat to life. However the minor injuries according to AIS may cause longer lasting disabilities and incapability to work for injured persons.

All types of the bicyclist's collision accidents have increased in the period studied. However the percentage of collision with "hard" road users i.e. motor vehicles has decreased.

In a study from 1986 Lind & Wollin found that 59% of the bicyclist's collisions included a motor vehicle as counterpart, 34% a moped, a bicycle or a pedestrian. <sup>(8)</sup>

Contrary to the bicyclist's single accidents which only were reported by the police in 2% of the cases <sup>(4)</sup> a larger number of the collision accidents are registered in the official statistics.

The pattern of police reporting of these accidents has changed during the period. From 1980-82 the police reported more than half of the collision accidents regardless of the severity of the injuries while in 1990 they only reported 16%.

The changed routine from 1983, where the police no longer reported "minor" bicycle accidents, should have made it possible for the police to concentrate on the more

serious accidents. Despite this it seems that the police report fewer and fewer of the bicyclist's accidents also according to the number of more serious accidents.

The large increase in the number of bicyclist's collision accidents is therefore not included in the official statistics, especially not the accidents with minor injuries.

The official road traffic accident statistics therefore give a misleading picture of the development in the catchment area for the Odense University Hospital according the data from the emergency room.

In 1986 Lind & Wollin found that the number of bicycle accidents in the official road traffic statistics based on police reports was underestimated. Police classifications minor or serious did not accord with the subsequent AIS classification.<sup>(8)</sup>

Mills (1989) found that for bicycle accidents as a whole the collisions with other road users and especially with motor vehicles had the highest level of police reporting.<sup>(9)</sup>

## Conclusion:

1. A 90% increase from 1980 to 1990 in the number of bicyclists treated in the emergency room at Odense University Hospital following collision accidents was recorded.
2. The highest increase was found for the number of collisions with another bicycle. The most frequent of bicyclists collision accidents consists in collisions with motor vehicles.
3. The age group 20-29 years had the highest increase in the number of collision accidents. No difference in the male/female ratio was recorded.
4. The increase in bicyclists collision accidents consists mainly of accidents with minor injuries, but also the more severe accidents with  $MAIS \geq 2$  showed a tendency to increase.
5. An increase in the number of bicyclists hospitalized following collision accidents was not recorded.
6. The percent of police reported collision accidents have decreased significantly according to emergency room data, even if the accidents with only minor injuries are excluded.

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**Table 1.**  
**Bicyclist's collision accidents in numbers according to year and counterpart.**

Data from the emergency room at the Odense University Hospital, Denmark.

| Year | Motor veh. | MC moped | Bi-cycle | Pede-strian | Pass. * | Other ** | Total # |
|------|------------|----------|----------|-------------|---------|----------|---------|
| 1980 | 202        | 29       | 58       | 4           | 32      | 48       | 373     |
| 1981 | 223        | 23       | 63       | 8           | 49      | 89       | 455     |
| 1982 | 221        | 27       | 117      | 7           | 44      | 131      | 547     |
| 1983 | 251        | 31       | 117      | 10          | 38      | 112      | 558     |
| 1984 | 263        | 37       | 120      | 6           | 29      | 20       | 475     |
| 1985 | 265        | 31       | 151      | 13          | 39      | 23       | 522     |
| 1986 | 283        | 34       | 169      | 17          | 40      | 18       | 561     |
| 1987 | 282        | 34       | 161      | 23          | 34      | 16       | 550     |
| 1988 | 275        | 41       | 187      | 17          | 31      | 18       | 569     |
| 1989 | 342        | 34       | 177      | 11          | 36      | 23       | 623     |
| 1990 | 344        | 47       | 230      | 23          | 41      | 28       | 713     |

\* - Bicycle passengers.

\*\* - Other counterparts and unknown.



**Table 2.**  
**Bicyclists collision accidents in numbers according to age and year.**

Data from the emergency room at the Odense University Hospital, Denmark.

| Year | 0-9<br>year | 10-19<br>year | 20-29<br>year | 30-59<br>year | >= 60<br>year | Total<br># |
|------|-------------|---------------|---------------|---------------|---------------|------------|
| 1980 | 83          | 152           | 45            | 71            | 22            | 373        |
| 1981 | 95          | 167           | 68            | 93            | 31            | 455        |
| 1982 | 111         | 185           | 85            | 120           | 46            | 547        |
| 1983 | *           | *             | *             | *             | *             | 558        |
| 1984 | *           | *             | *             | *             | *             | 475        |
| 1985 | 77          | 209           | 95            | 111           | 30            | 522        |
| 1986 | 78          | 198           | 120           | 119           | 46            | 561        |
| 1987 | 58          | 199           | 141           | 108           | 44            | 550        |
| 1988 | 65          | 196           | 129           | 142           | 37            | 569        |
| 1989 | 67          | 225           | 135           | 153           | 41            | 623        |
| 1990 | 67          | 264           | 174           | 173           | 35            | 713        |

(Bicycle passengers included)

\* - Missing data

**Table 3.**  
**Severity of Injuries following bicyclist's collision according to MAIS (Maximum AIS) and year.**

Data from the emergency room at the Odense University Hospital, Denmark.

Percent of total number of accidents, and 90% confidence interval.

| Year | Number of accidents<br>with MAIS 1 | Number of accidents<br>with MAIS <sub>&gt;=2</sub> | Total number<br>of accidents |
|------|------------------------------------|--|------------------------------|
| 1980 | 242<br>65% (61-69)                 | 131<br>35% (31-39)                                 | 373                          |
| 1981 | 332<br>73% (69-76)                 | 123<br>27% (24-31)                                 | 455                          |
| 1982 | 344<br>63% (59-66)                 | 203<br>37% (34-41)                                 | 547                          |
| 1983 | 445<br>80% (77-82)                 | 113<br>20% (18-23)                                 | 558                          |
| 1984 | 356<br>75% (72-78)                 | 119<br>25% (22-28)                                 | 475                          |
| 1985 | 391<br>75% (72-78)                 | 131<br>25% (22-28)                                 | 522                          |
| 1986 | 421<br>75% (72-78)                 | 140<br>25% (22-28)                                 | 561                          |
| 1987 | 422<br>77% (74-80)                 | 128<br>23% (20-26)                                 | 550                          |
| 1988 | *                                  | *  | *                            |
| 1989 | 484<br>78% (75-80)                 | 139<br>22% (20-25)                                 | 623                          |
| 1990 | 549<br>77% (74-80)                 | 164<br>23% (20-26)                                 | 713                          |

(Bicycle passengers included)

\*- Missing data

**Table 4. Localization of Injuries according to body region at bicyclists following collisions.**

Data from the emergency room at the Odense University Hospital, Denmark.

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**Percent of total number of Injuries.**

| Year | Head, face & neck | Trunk | Arms | Legs | #    |
|------|-------------------|-------|------|------|------|
| 1980 | 33%               | 12%   | 25%  | 30%  | 622  |
| 1981 | 37%               | 13%   | 23%  | 27%  | 833  |
| 1982 | 35%               | 10%   | 28%  | 27%  | 1030 |
| 1983 | 31%               | 9%    | 28%  | 32%  | 880  |
| 1984 | 34%               | 10%   | 26%  | 30%  | 976  |
| 1985 | 34%               | 7%    | 28%  | 31%  | 1012 |
| 1986 | 33%               | 9%    | 29%  | 29%  | 1076 |
| 1987 | 37%               | 7%    | 28%  | 27%  | 1014 |
| 1988 | 33%               | 8%    | 31%  | 28%  | 1028 |
| 1989 | 34%               | 5%    | 31%  | 30%  | 1241 |
| 1990 | 34%               | 6%    | 30%  | 30%  | 1317 |

#- Total number of injuries  
More than one injury in many of the bicyclists.  
(Bicycle passengers included)

**Table 5.**  
**Hospitalisation in numbers of bicyclists following collision accidents according to year.**

Data from the emergency room at the Odense University Hospital, Denmark.

| Hospita-<br>lization | Total     | Median time<br>days * |
|----------------------|-----------|-----------------------|
| 1980                 | 92 (25%)  | 3.5                   |
| 1981                 | 104 (23%) | 3.3                   |
| 1982                 | 136 (25%) | 3.5                   |
| 1983                 | 76 (14%)  | 3.7                   |
| 1984                 | 65 (14%)  | 3.4                   |
| 1985                 | 83 (16%)  | 2.4                   |
| 1986                 | 71 (13%)  | 3.1                   |
| 1987                 | 66 (12%)  | 2.1                   |
| 1988                 | 70 (12%)  | 1.4                   |
| 1989                 | 77 (12%)  | 3.5                   |
| 1990                 | 91 (13%)  | 2.7                   |

\* - Median time = 50% of hospitalized patients discharged.

(Bicycle passengers included)

Percent of total number of bicyclists treated at emergency room following collision accident on bicycle.

**Table 6.**  
**Number of police reported collision accidents for bicyclists**  
**according to year and severity of the injuries.**

Data from the Emergency Room at the Odense University Hospital, Denmark combined with data from the National Bureau of Statistics.

(Percents of total number of bicyclists treated at the emergency room, Odense University Hospital following collision accidents)

| Year | Collision accidents<br>(Emergency room) | Accidents with<br>MAIS $\geq$ 2<br>(Emergency room) | Police reported accidents<br>% of emergency room<br>number<br>(90% CI) | % of police reported<br>accidents according to<br>accidents with<br>MAIS $\geq$ 2<br>(90% CI) |
|------|---|---|--|---|
| 1980 | 373                                     | 131   | 208<br>56% (52-60%)  | 159% (132-191%)   |
| 1981 | 455                                     | 123   | 246<br>54% (50-58%)  | 200% (167-240%)   |
| 1982 | 547                                     | 203   | 281<br>51% (48-55%)  | 138% (119-161%)   |
| 1983 | 558                                     | 113   | 119<br>18% (15-20%)  | 105% (85-130%)  |
| 1984 | 475                                     | 119   | 122<br>26% (23-29%)  | 103% (83-127%)  |
| 1985 | 522                                     | 131   | 119<br>23% (20-26%)  | 91% (74-112%)   |
| 1986 | 561                                     | 140   | 114<br>20% (18-23%)  | 81% (66-100%)   |
| 1987 | 550                                     | 128   | 109<br>20% (17-23%)  | 85% (69-106%)   |
| 1988 | *                                       | *   | *  | *   |
| 1989 | 623                                     | 139   | 121<br>20% (17-22%)  | 87% (71-107%)   |
| 1990 | 713                                     | 164   | 113<br>16% (14-18%)  | 70% (57-86%)  |

\* - Data missing.  
 (Bicycle passengers included)