

## EPIDEMIOLOGY OF SPINAL CORD INJURY IN THE RHÔNE-ALPES REGION, FRANCE, 1970-75

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*Abstract.* Three hundred and fifty-one cases of traumatic spinal cord injuries concerning only inhabitants of the Rhône-Alpes region have been collected at Henry Gabrielle Hospital. Incidence and prevalence are discussed, as well as male/female ratio, causes of accidents, and their relationship to sex, race, age, vertebral level, associated injuries and profession.

**Key Words:** Epidemiology; Spinal cord injuries; Rhône-Alpes region.

FIVE HUNDRED AND FORTY inhabitants of the Rhône-Alpes region have sustained spinal cord lesions from 1 January 1970 to 31 December 1975: 351 are traumatic (65 per cent), and 189 non-traumatic (35 per cent). These figures are comparable to those of Guttman (1973).

Related information has been assembled for a retrospective study concerning 783 cases during the same period, but covering a larger geographical area. We limited ourselves to the Rhône-Alpes region, a well-defined administrative entity, of which social and economical structures correspond fairly well to the rest of France. This region had a population of 4 780 723 at the 1975 census, divided into eight departments: three with agricultural vocation, Ain, Drôme, Ardèche; three largely urbanised, Isère, Loire, Rhône; two with 'mixed' population, Savoie, Haute-Savoie.

The study only takes into account the 351 traumatic cases for 6 years (1970-1975).

### *Traumatic Spinal Cord Injury per Department and per Year of Accident (Fig. 1)*

Only one department (Ardèche) shows a gradual increase. In all cases except one (Haute-Savoie), 1975 has about the same number of accidents as 1972 with between, especially in departments with large cities, an increase in 1973 and 1974. There is no special relationship between the number of spinal cord injuries and the relative annual increase of the population.

One must bear in mind, for this period in the Rhône-Alpes, the following factors:

1. The modification of the French traffic legislation (safety belt, speed limit) and the increase of the fleets of cars, and above all motorcycles.
2. A best prevention of occupational accidents during the past 10 years.
3. The possible referral of some cases to other centres than Henry Gabrielle Hospital, especially from the borderline districts (some parts of Ardèche, Drôme, Haute-Savoie).
4. The *de facto* exclusion of some cases of mild lesions, as they did not need rehabilitation, at least as in-patients.
5. It was not possible to collect the cases listed dead on arrival to hospital or morgue.

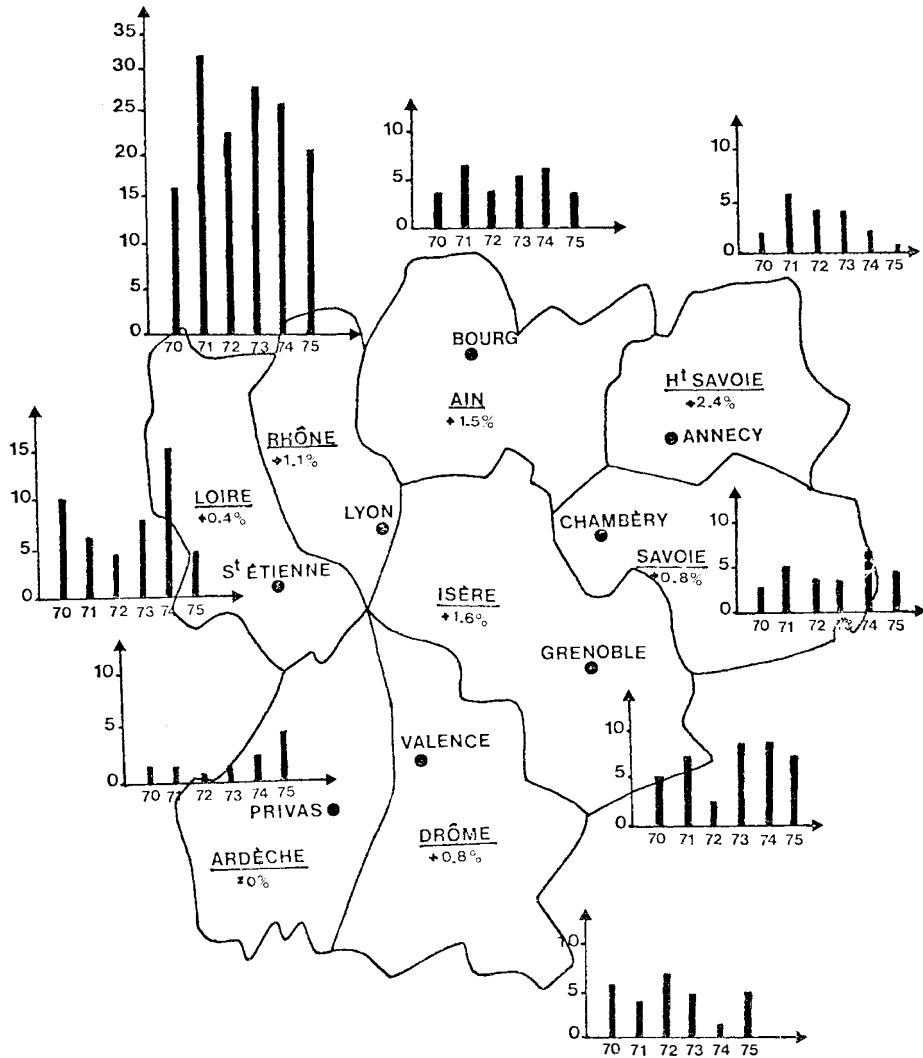


FIG. 1

Distribution of traumatic spinal cord injuries per year of survey and per department of Rhône-Alpes region, with mention of the annual increase of population per department.

We only count those who reached the hospital alive, and whose main problem was spinal cord injury. Henry Gabrielle Hospital is the only spinal cord injury centre of the Rhône-Alpes region.

The incidence of spinal cord injury is 1.27/100 000 population in the Rhône-Alpes region. For the Rhône department, the most populated (Fig. 2), where the centre is located, the incidence is 1.85/100 000. This figure is lower than those of Kraus *et al.* (1975) for Northern California, 3.32/100 000, and Tusji and Fujishana (1975) in Japan, 2.71/100 000. They are close to those of Gehrig and Michaelis (1968) for Switzerland, 1.34/100 000; Key and Retief (1970) for Cape

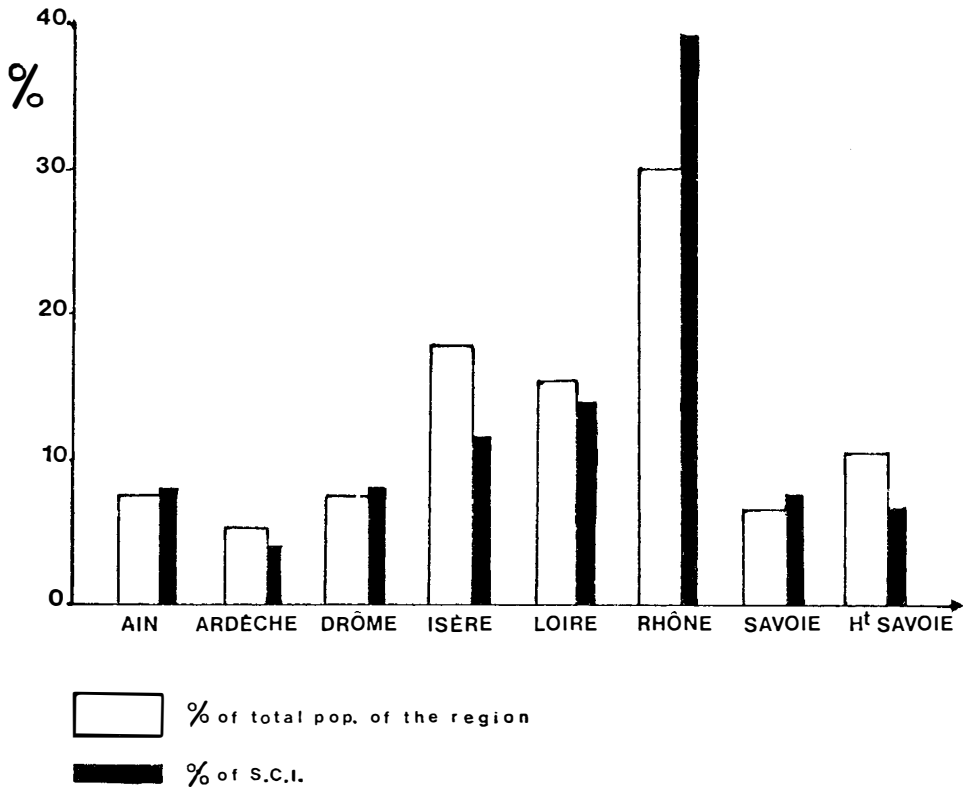


FIG. 2

Comparison of percentages of total population of the region and of total number of traumatic spinal cord injuries, for each department.

Province, South Africa, 1.67/100 000; Sutton (1973) for Brisbane, Australia, 1.44/100 000; and Cheshire (1967) for Victoria, Australia, 1.71/100 000.

Extrapolation from our incidence rate of 1.27/100 000 and an average duration of life of about 20 years in Western countries gives a prevalence of traumatic spinal cord injuries in the Rhône-Alpes of 25/100 000. This figure is close to that of Kraus, 20/100 000, for complete lesions in Northern California. But, according to the above-mentioned factors, the real prevalence in Northern California would rather be around 50/100 000. It is likely then that the prevalence rate of 25/100 000 for the Rhône-Alpes is underestimated.

### Age

The average age of the spinal cord injured patients in the Rhône-Alpes region is 39 years and 3 months, with little variations between extreme figures: Ardèche, 36 years, and Ain, 41 years.

The repartition of ages of patients in percentage and by 5-year groups is compared to that of the whole population of the region (Fig. 3). Spinal cord injured people are overwhelmingly under 50. The largest proportion of cases is between 20 and 30. These findings are similar to other surveys, except for the fact that teenagers are only 13 per cent (from 16 to 28.6 per cent, except Japan). Nevertheless, 50 per cent of our patients are less than 35 years old.

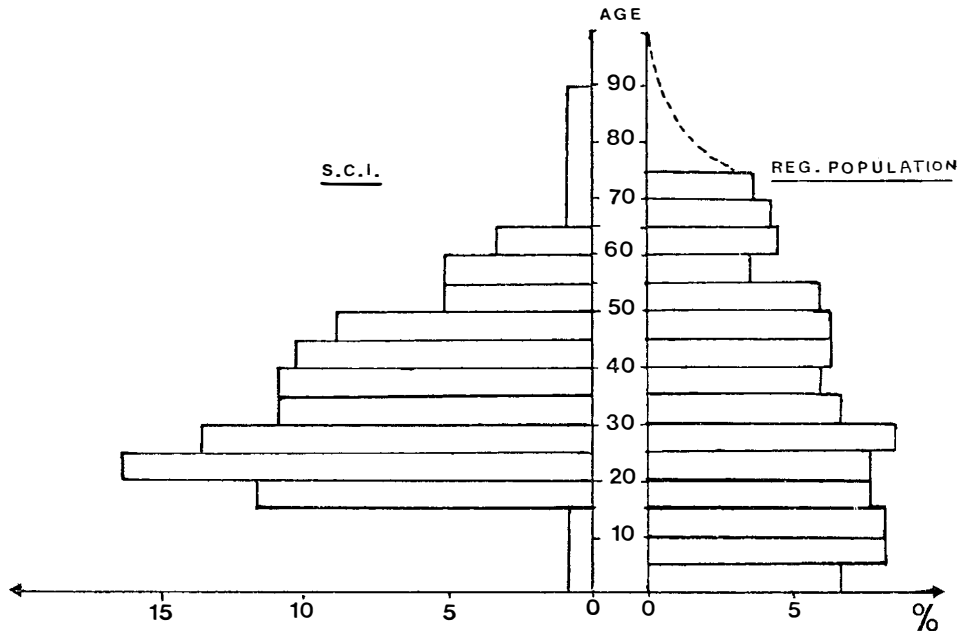


FIG. 3

Percentage frequency distribution for age at injury in spinal cord injury: comparison of spinal cord injury cases and population of the region (males + females).

#### *Sex Distribution*

There are 276 males, and 75 females, respectively 78.63 per cent and 21.37 per cent. The male/female ratio is 3.68 in our region—the precise ratio of Kraus *et al.* (1975) in Northern California. But it is much higher in other countries (Table I) where professional activity of women may be more limited.

#### *Repartition of Traumatic Spinal Cord Injuries According to Race*

We have differentiated French, Mediterraneans (Italians, Spanish, etc.) and North Africans (Algerian, Moroccan, Tunisian). Mediterranean and North

TABLE I

Male/female ratio, as compared to other surveys

Study	Site	Period	Males	Females	M : F ratio
Gehrig & Michaelis (1968)	Switzerland	1960-67	461	93	4.96
Frankel <i>et al.</i> (1969)	England	1951-68	593	69	8.59
Jousse <i>et al.</i> (1967)	Toronto	1945-66	842	123	6.85
Kassa & McAdam (1967)	Norway	1949-57	36	6	6.00
Key & Retief (1970)	Cape Province	1963-67	268	32	8.38
Kraus <i>et al.</i> (1975)	North California	1970-71	252	68	3.7
Sutton (1973)	Brisbane	1962-71	212	30	7.07
Tusji & Fujishama (1975)	Fukuoka	1969-74	106	11	9.64
This study	Lyon	1970-75	276	75	3.68

African are temporary or permanent immigrants. There were 287 French (79.7 per cent), 42 Mediterraneans (11.6 per cent), 25 North Africans (6.9 per cent), and six others (1.6 per cent) giving a total of 360 cases from 1 October 1969.

The percentage of foreigners in our survey (people born out of France) is 20.1 per cent. In Rhône-Alpes region, this percentage was 9.3 per cent in 1975. To explain this discrepancy, one must realise that in 1976 30 per cent of occupational accidents concerned foreigners.

#### *Causes of Traumatic Spinal Cord Injury*

They are presented in Table II, and compared to the results of three comprehensive studies from England, Australia, and United States. Cases listed 'others' include various accidents: pedestrians (three cases), spinal cord lesions through disk protrusion as long as they are legally caused by an accident.

Car accidents total a third of traumatic spinal cord lesions in the Rhône-Alpes region, slightly more than in England, less than in U.S.A., and above all Australia. Motor and bicycle accidents are very frequent, more than 15 per cent of all lesions. Only the studies of Frankel *et al.* (1969) and Zrubecky (1974) show higher figures, respectively 20.1 per cent and 17.9 per cent. It is likely that the numbers of motorcycles and bicycles are smaller in 'new' continents (longer distances?). Cord injuries by falls have the higher incidence in the Rhône-Alpes region. Except 4.31 per cent of voluntary falls (attempted suicides), they are occupational, in industrial and agricultural environments.

Incidence of direct blow is the same as in England. Sports injuries have about the same incidence in England, Northern California or Rhône-Alpes, but not in Australia, especially for diving accidents: 3.78 per cent *vs* 14 per cent. It is comforting to establish that the percentage of gunshot wounds is only 0.8 per cent in Rhône-Alpes region, *vs* 5.8 per cent in Brisbane, Australia, and 12.3 per cent in Northern California.

TABLE II

Types of accident compared with Australian, English and American studies

Cause	Rhône-Alpes		Sutton (1973) Brisbane, Australia, 1963-70	Frankel <i>et al.</i> (1969) England 1951-68	Kraus <i>et al.</i> (1975) Northern California, 1970-71
	1970-75	Rhône alone			
	%	%	%	%	%
Auto	31.8	30.7	44.4	26.7	37.5
Motorcycles, bicycles	15.4	12.1	4.3	20.1	5.3
Falls	24.25	25	26.6	25.7	19.2
Voluntary	4.3	4.5			
Struck by object	7.5	7.7		6.1	
Sport					
Diving	3.8	5.1	14.0	6.2	5.3
Others	4	3.8	3.9	4.2	1.6
Gunshot wounds	0.8	1.3	5.8	0	12.3
Others	8.1	9.6	1.5	11.3	5.5
N	351	153	207	682	604

TABLE III  
Causes of spinal cord injury per year of survey

Cause	1970	1971	1972	1973	1974	1975
Auto	7	22	10	15	15	16
Motorcycles, bicycles	8	6	10	9	9	5
Falls	8	13	10	7	17	10
Struck by object	6	2	4	4	7	2
Sports	5	2	2	4	5	4
Others	3	5	3	9	8	4
Total	37	50	39	48	61	41

Distribution of types of accident according to the year of accident (Table III) does not show any particular trend, even after 1973 (speed limit). Nevertheless, during the 6 years of our survey, the number of all vehicles (two and four wheels) increased from 1 352 640 to 1 710 180 (26.4 per cent).

The causes of accident according to the sex of the patient are clearly different (Fig. 4). Car accidents are the leading cause of spinal cord injuries in females: 48 per cent *vs* 28 per cent. But motor- and bicycle accidents are rare: 3.9 per cent *vs* 16.5 per cent. Falls, direct blows, sports accidents are strongly predominant in males. But falls by attempted suicide concern mainly females.

The distribution of the causes according to the age of the patient reveals a

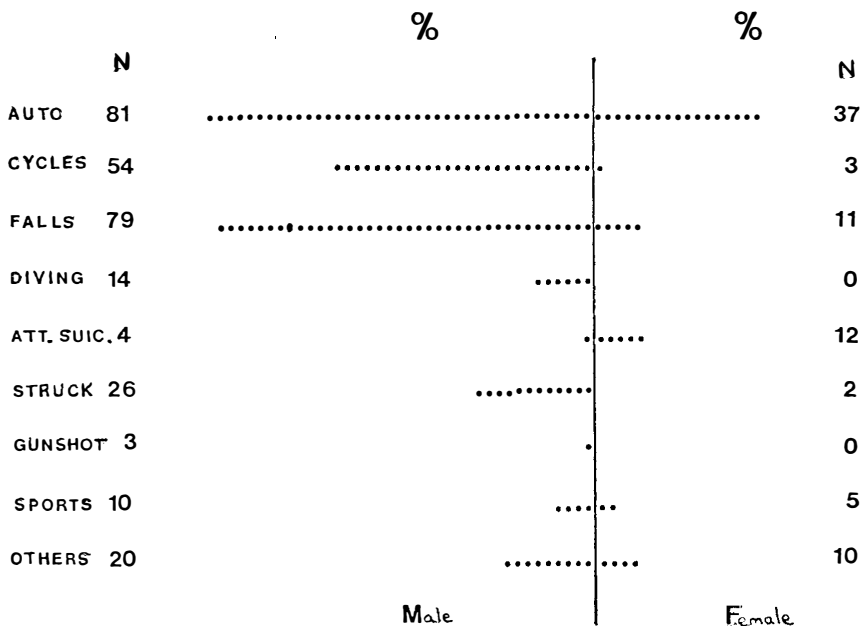


FIG. 4  
Causes of accident according to sex.

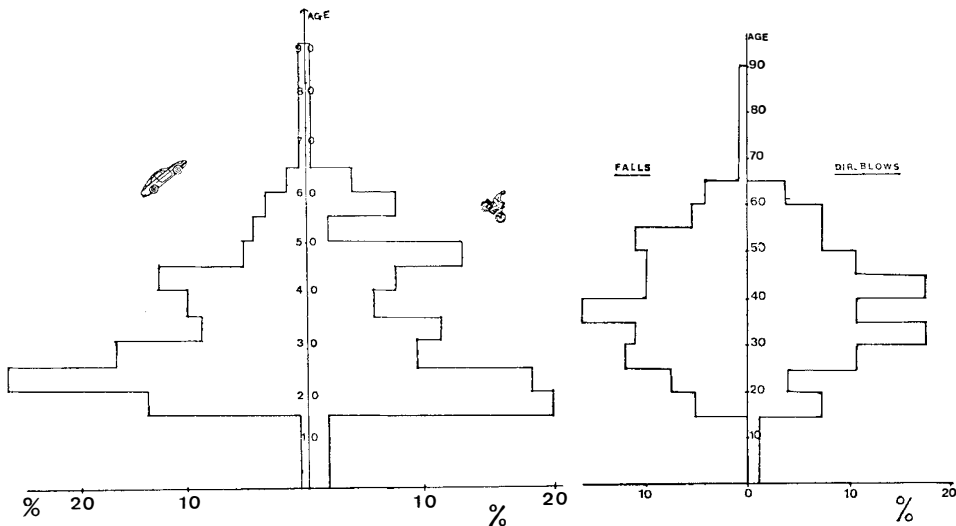


FIG. 5

FIG. 5

Distribution of ages for car and motor-bicycle accidents causing spinal cord injuries.

FIG. 6

FIG. 6

Distribution of ages for falls and direct blows causing spinal cord injuries.

wider range of ages for motor- and bicycle accidents (Fig. 5), perhaps in relation with a greater proportion of occupational injuries in this group: 17/40 instead of 19/99 for car accidents. Incidence of falls and direct blows increases with age, at least until age 50 (Fig. 6). This point is confirmed by Kurtzke (1975) in United States.

There is a different repartition of causes according to race (Fig. 7). If Mediterraneans and North Africans have a smaller incidence of spinal cord injuries by car accident, they have on the other hand the same incidence of motor- and bicycle accidents, and a much greater incidence of falls and direct blows. Sports injuries are rare among them.

#### *The Level of Fracture*

It is a good approach to the severity of the lesion from a functional point of view. Completeness or incompleteness of lesions is not mentioned in this paper, as well as the percentage of recovery.

The incidence of tetraplegia is greater in car accidents and above all sports accidents (Table IV). If we distribute the causes of accidents according to five vertebral levels (cervical, upper-thoracic, lower-thoracic, thoraco-lumbar and lumbo-sacral), it appears a high incidence of involvement of the upper thoracic vertebrae in motorcycle and bicycle accidents (Figs. 8 and 9). Thoraco-lumbar lesions are largely predominant in falls and direct blows (Figs. 10 and 11). In case of fall by attempted suicide, fractures are mostly located in thoraco-lumbar and lumbo-sacral vertebral. Sports accidents concern almost exclusively the cervical spine (Fig. 12). This distribution is comparable to the figures of Goutelle *et al.* (1968) for the same region, but concerning only tetraplegias.

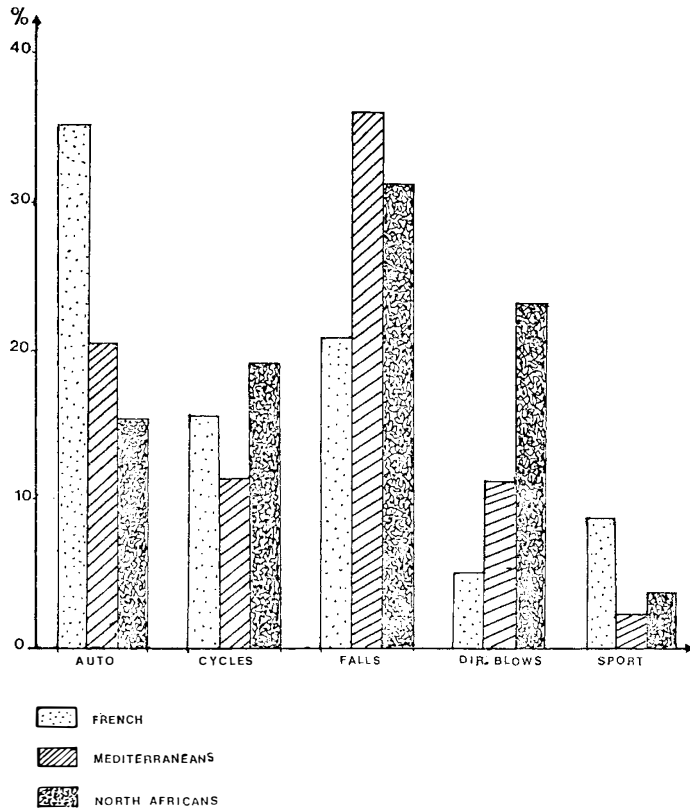


FIG. 7  
Causes of accident according to race.

TABLE IV  
Causes of injury *vs* level of lesion in traumatic spinal cord injuries

Cause	Paraplegia, %			Tetraplegia, %			
	(1)	(2)	(3)	(1)	(2)	(3)	(4)
Auto	32.5	51.7	22.2	41.6	39.0	34.0	26.5
Motorcycles, bicycles	15.0	6.8	20.8	9.9	2.5	18.9	12.7
Falls	30.3	29.3	30.9	17.6	13.6	17.0	24.4
Voluntary	7.4	—	—	1.4	—	—	—
Struck by object	8.2	—	8.3	4.2	—	2.3	3.2
Sport							
Diving	0	1.1	0.2	13.4	23.7	15.8	14.6
Others	3.8	0	3.6	5.6	6.8	5.4	7.3
Gunshot wounds	1.3	9.0	0	0.7	3.4	0	4.6
Others	1.3	3.4	14.1	5.6	—	6.7	7.0
N	(366)	(89)	(423)	(142)	(118)	(182)	(506)

- (1) This study, Lyon, France: 1970-75.
- (2) Sutton (1973), Brisbane, Australia: 1963-70.
- (3) Frankel *et al.* (1969), Aylesbury, England: 1951-68.
- (4) Guttman (1973), Aylesbury, England: 1944-64.



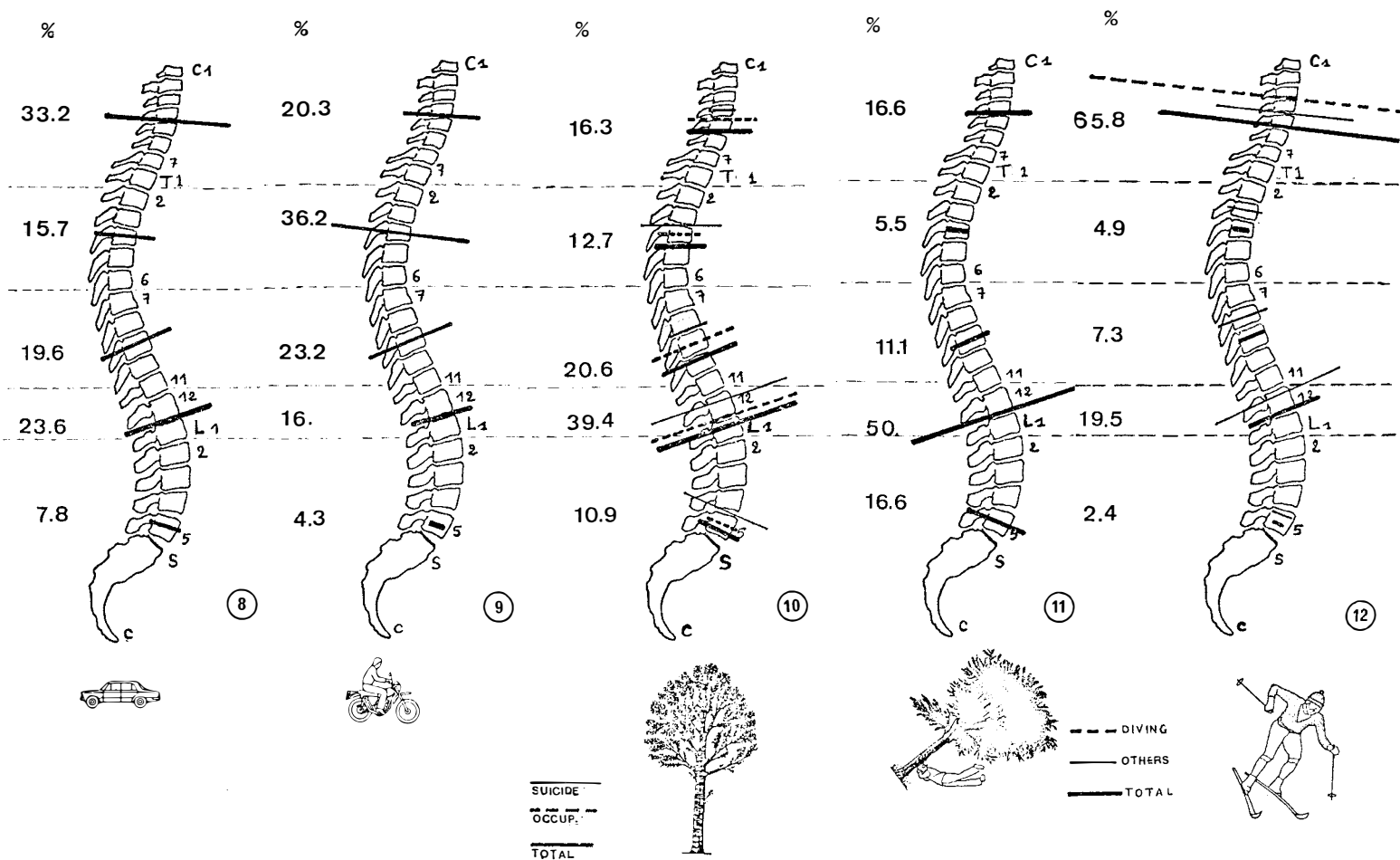


FIG. 8

FIG. 9

FIG. 10

FIG. 11

FIG. 12

FIG. 8 Car accidents: vertebral level of injury. FIG. 9 Motor-bicycle: vertebral level of injury. FIG. 10 Falls: vertebral level of injury. FIG. 11 Direct blows: vertebral level of injury. FIG. 12 Sports accidents: vertebral level of injury.

TABLE V  
 Profession *vs* causes of injuries in traumatic spinal cord injuries

	No profession	Professional worker	Non-special worker	Agriculture	Liberal commerce	Executive	Employees	Students
Auto	17	26	22	3	22	6	11	7
Motorcycles, bicycles	7	13	14	7	2	0	4	8
Falls	9	28	17	14	7	4	5	4
Voluntary falls	8	2	0	1	2	0	1	1
Struck by object	1	11	8	6	0	1	0	1
Sport								
Diving	0	2	2	0	1	1	3	5
Others	0	0	0	0	1	0	4	9
Others	10	6	8	2	4	2	2	1
Total	52	88	71	33	39	14	30	36

*Associated Injuries*

They are, too, a sign of severity. The incidence of head injuries is the same in car and motorcycle accidents: 66/118 *vs* 35/57, as well as fracture of the limbs: 32/118 *vs* 16/57. But visceral traumas (thoraco-pleural, abdominal, pelvic) are more frequent in car accidents: 25/118 *vs* 6/57. Associated injuries are comparable in falls and direct blow to those in car accidents.

*Profession*

The distribution of the professions according to the cause of accident is displayed in Table V.

## SUMMARY

1. From 351 cases of traumatic spinal cord injuries recruited exclusively in the Rhône-Alpes region (4 780 000 population in 1975), it is possible to calculate an incidence rate of at least 1.27/100 000 and a prevalence rate of at least 25/100 000. The incidence for the department of Rhône only is 1.85/100 000.

2. Mean age is 29 years 3 months.

3. Male/female ratio is 3.68.

4. 79.7 per cent of subjects were born in France, 11.6 per cent are Mediterraneans and 6.9 per cent North-Africans.

5. Car accidents are the most frequent (32 per cent), followed by motor- and bicycle accidents (15 per cent), sports accidents (7.8 per cent), direct blows (7.5 per cent). Gunshot wounds have a percentage of 0.8 per cent.

6. There is no particular trend in the distribution of causes during the 6-year period covered by the survey.

7. Distribution of causes of accident is different in males and females, with races, age, and type of accident.

8. Visceral lesions are less frequent in motor- and bicycle accidents. Head injuries and fractures of the limb have the same distribution, for each cause of accident.

9. There is a difference of distribution according to professional categories.

## RÉSUMÉ

1. A partir de 351 cas de lésions médullaires traumatiques recrutés exclusivement dans la région Rhône-Alpes, il est possible de calculer une incidence d'au moins 1,27/100 000 et une prévalence d'au moins 25/100 000. L'incidence pour le seul département du Rhône est de 1,85/100 000.

2. L'âge moyen est de 29 ans 3 mois.

3. Le rapport hommes/femmes est de 3,68.

4. 79,7% des blessés étaient nés en France, 11,6% dans les pays méditerranéens, 6,9% en Afrique du Nord.

5. Les accidents d'automobile étaient les plus fréquents (32%), suivis par les deux-roues (15%), les accidents de sports (7,8%), les chocs directs (7,5%). Les blessures par armes à feu représentent 0,8%.

6. Il n'y a pas de différence de distribution des causes d'accident sur les 6 années de l'étude.

7. Les causes d'accidents diffèrent chez les hommes et les femmes, selon les races, selon l'âge, selon le niveau vertébral.

8. Les lésions associées montrent quelque différence selon le type d'accident.

9. La distribution des causes d'accident est différente selon la profession de l'intéressé.

## ZUSAMMENFASSUNG

1. Bezugnehmend auf 351 traumatische Querschnittslähmungen, ausschliesslich aus dem Gebiet 'Rhône-Alpes', werden jedes Jahr 1,27 von 100 000 Personen neu betroffen, wobei 25 von 100 000 Personen schon betroffen sind. Die Häufigkeit für das Rhône Halbgebiet ist: 1,85/100 000.
2. Das Durchschnittsalter beträgt 29 Jahre und 3 Monate.
3. Das Verhältnis Männer und Frauen ist 3,68.
4. 79,7% der Leute sind in Frankreich geboren, 11,6% in den Mittelmeerländern, 6,9% in Nord Afrika.
5. Die Autounfälle waren am häufigsten (32%); darauffolgend Zweiräder (15%), Sportunfälle (7,8%), direkte Einschläge (7,5%), sowie Schussverletzungen (0,8%).
6. Das Verhältnis der Fälle für die 6 Jahre ist gleichbleibend.
7. Die Ursachen dieser Unfälle unterscheiden sich zwischen Männern und Frauen gemäss der Rasse, dem Alter, und dem Abschnitt der Wirbelsäule.
8. Gemäss der Unfallart, unterscheiden sich die zusätzlich auftretenden Verletzungen.
9. Gemäss des Berufes, unterscheiden sich die Unfallursachen.

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