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# Paediatric head trauma: influence of age and sex

## I. Epidemiology

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**Abstract** A consecutive unselected series of 1812 children (up to 15 years old) admitted for head injuries over a period of 8.5 years was studied. The cases were divided up according to five categories of pathology: benign injury, extradural haematoma, subdural haematoma, open brain laceration and brain contusion in a broad sense. All cases of benign injury were from the Geneva area (57000 children) and 52% of the cases of severe injury were referred from other places. To these 1812 cases were added those of 23 children who died before admission recorded by the police. In the Geneva area the mortality was 6.8/100000 per year. Patients were divided into three age groups: I (0–3 years), II (3–9 years), and III (9–15 years); group I was further subdivided into subgroups Ia (0–1 year) and Ib (1–3 years). The incidence of each type of accident was calculated for each age group, separately for girls and boys. Each type of pathology was correlated, sex by sex and for different ages, with the type of accident. Overall, two boys were injured for each girl. Road accidents were responsible for 15% of head injuries in group I girls, 17% in group I boys, 43% in group II girls, 45% in group II boys, 50% in group III boys and 61% in group III girls. They were responsible for 94% of all deaths and 85% of deaths of hospitalized patients. Falling was the most frequent cause of injury. Benign injuries were more frequent in group I. Only 1 of 25 patients with extradural haematomas died, and there were only 8 patients with subdural haematomas, 4 in subgroup Ia (babies aged less than 1 year).

**Key words** Children · Head injuries
Epidemiology · Mortality

## Introduction

In his paper of 1984, Raimondi [22] regrets that in the literature devoted to head trauma in childhood, little importance is given to the differences either in the type of pathology or in clinical signs according to age. He stresses the differences between the skull with an open fontanelle of a baby and the fixed skull of a child of school age. The brain itself is not fully developed until the age of 3 years, and this influences both the clinical symptoms and the outcome. Usually ages are divided into 5-year periods [19] or decades; moreover "paediatric age" is sometimes extended to 16, 17, or even 19 years of age [13, 21, 24]. Some recent papers [8, 11] escape this criticism, however, as does the 1964 paper of Hendrick et al. [12], at least in some aspects. The sexes are not always separated for analysis and when they are [5], the possible differences between them are not really gone into.

The aim of this paper is to demonstrate the influence of age and sex on the epidemiology and pathology of

head injuries in childhood. In a second part, the pathology will be further studied together with the clinical signs and outcome [4].

## Patients and methods

All children admitted to the Paediatric Surgical Clinic of Geneva between 1 January 1975 and 30 June 1983 were included in the study. Children who died before or on arrival at hospital were not included in hospital records but were registered by the police. These cases are added to the hospital cases in the epidemiological part of this study.

Patients were divided into three groups according to age, and girls and boys in each group were separated for analysis. The first group was further divided into two subgroups. Subgroup Ia contained babies aged from birth to the first birthday, while subgroup Ib went from the first to the third birthday and was thus the toddler group. Group II was made up children aged 3–9 years, referred to as young children. Group III contained the children aged 9–15 years, who can be referred to as schoolchildren.

The hospitalized cases originate from various populations. The first, those living in the Geneva area, is precisely defined. The second population cannot be precisely defined and consists of those living in the environs of Geneva, whether in France or in Switzerland. It may be assumed that the age and sex distributions in the two areas are not very different. With very few exceptions, all patients from Geneva requiring hospitalization are admitted to the same hospital and their details are recorded on computer, just as all immediate deaths due to traffic accidents are recorded by the police. By contrast, only severe cases from outside Geneva are referred, and they made up half (52%) of the severe hospitalized cases.

Head trauma was divided into benign cases and severe cases. "Severe" trauma contained the categories extradural haematoma, subdural haematoma, open brain laceration and brain contusion. Each case was assigned to one of these five categories only, according to the dominant pathology. Contusion was defined on clinical grounds, with or without confirmation by computed tomography (CT), angiography, operation or electroencephalography when there was no extradural or subdural haematoma or open brain laceration. The clinical signs of contusion were defined as comatose state, either primary or secondary, early epileptic seizures and neurological deficits.

The following categories of accident were defined: fall from a low level (less than 2 m); fall from a height; fall from a horse; fall from a toboggan; patient hit by an object; road accident as pedestrian, cyclist or car passenger; and miscellaneous, otherwise unclassified causes such as child abuse, hit by a door, and other unspecified events, too few to merit a separate category.

The final outcome at discharge from the hospital was defined as death, long-term coma, or recovery (alive and ambulating).

The variables studied were related to age and sex and differences were established by the $\chi^2$ method.

It must be stressed that the Geneva area is mostly urban with relatively little countryside and no long-distance main roads, but outside Geneva traffic on the roads is heavy.

**Table 1** Numbers of children with head injury admitted to the Paediatric Surgical Clinic of Geneva from January 1975 to June 1983

| | *n* |
|---|---|
| Total number of hospitalized children | 1812 |
| Number of patients with benign injury | 1503 |
| Number of patients with severe injury | 309 |
| Number of severely injured patients from outside Geneva | 160 |
| Number of severely injured patients from Geneva | 149 |

## Results

The 1812 patients admitted during the 8.5 years covered by the study are presented in Table 1 and 2. The proportion of accidents accounted for by each patient group divided by the proportion of the population accounted

**Table 2** Total number of children admitted for head trauma over the study period in relation to the paediatric population of Geneva. The ratio % accidents/% population is an indication of the predisposition of each group to be involved in an accident with head trauma. It is assumed that the sex distribution in Geneva and outside it is similar

| | Paediatric population of Geneva | | | | | Children with head injuries | | | | | % Accidents / % Population |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Male (*n*) | Female (*n*) | Male/female ratio | Total (*n*) | % of total | Male (*n*) | Female (*n*) | Male/female ratio | Total (*n*) | % of total | |
| Subgroup Ia (0–1 years) | 1 622 | 1 515 | 1.07 | 3 137 | 5.5 | 78 | 65 | 1.2 | 143 | 7.9 | 1.44 |
| Subgroup Ib (1–3 years) | 3 483 | 3 446 | 1.01 | 6 929 | 12.1 | 134 | 71 | 1.89 | 205 | 11.3 | 0.93 |
| Group II (3–9 years) | 11 366 | 10 911 | 1.04 | 22 277 | 39.1 | 506 | 307 | 1.65 | 813 | 44.9 | 1.15 |
| Group III (9–15 years) | 12 615 | 12 115 | 1.04 | 24 730 | 43.3 | 423 | 228 | 1.86 | 651 | 35.9 | 0.83 |
| Total | 29 086 | 27 987 | 1.04 | 57 073 | 100.0 | 1 141 | 671 | 1.70 | 1 812 | 100.0 | 1.0 |

for by each age group is a ratio indicating of the predisposition to head injury of each group of children: group I (because the influence of the youngest, subgroup I a), and group II were more prone to sustaining head injury than group III and subgroup I b. Roughly speaking, girls were victims of a third of the accidents; this sex difference was at a maximum in subgroup I b and group III, but was already present in babies. These data allow calculation of the annual incidence of head trauma in girls and boys in each age group (Table 3). Because severe cases from outside Geneva were included, the result of the calculation is a slight over-estimation. However the fatalities recorded by the police were not included. They are given in Table 4 (23 cases). If these fatalities are added to half the number of deaths in hospital (because only half of the severe cases were from Geneva; Table 5), an estimate of the number of fatal head injuries in children in Geneva area over the period of 8.5 years is obtained (Table 6). The number of deaths per year and per 100000 individuals was approximately 6.8 (3.9 cases/year in a total population of 360000 inhabitants with 57000 children).

The worst position was occupied by the boys of groups II and III and the girls of group II; injuries in group I were much less severe. Of course all the deaths registered by the police were in road accidents. The vast majority of the accidents resulting in death in hospital were also road accidents, mostly where children on foot or on bicycles were struck by a car (Table 5). Table 7 shows all types of accident involved in head trauma in relation to age and sex. Girls were significantly more frequently injured as car passengers than boys, and also through falling from a horse. From this table were calculated the annual incidences of head injuries due to each kind of accident and for each group of 100000 children according to sex (Fig. 1). Road accidents were responsible for 15% of head injuries in group I girls, 17% in group I boys, 43% in group II girls, 45% in group II boys, 50% in group III boys, and 61% in group III girls. They were also responsible for 94% of all deaths and 85% of the deaths in the hospital.

The correlations between type of accident and pathology induced are shown in Table 8. Table 9 relates the incidence of the different types of pathology to age and Table 10 relates them to sex. The prevalence of each type of pathology, calculated by dividing the number of cases of the pathology by the number of injuries, was not significantly different between age groups, except for benign cases, which were less frequent in age group III (9–15 years) than in the others. At that age the accidents tended to be more severe. Extradural haematomas were more frequent among girls, who had a significantly higher risk of that type of pathology than boys injured. All the girls with extradural haematomas were in groups II and III, and the four cases in group I were actually baby boys (subgroup I a). Subdural haematomas were very rare and half of them were found among children less than 14 months of age. The other four subdural haematomas were in group III.

**Table 3** Annual incidence of head trauma per 100000 children for each age group and for boys and girls separately

| | Male (*n*) | Female (*n*) | Male/female ratio | Total (*n*) |
|---|---|---|---|---|
| Subgroup I a (0–1 years) | 506 | 451 | 1.12 | 480 |
| Subgroup I b (1–3 years) | 405 | 217 | 1.87 | 311 |
| Group I (0–3 years) | 437 | 289 | 1.51 | 364 |
| Group II (3–9 years) | 469 | 296 | 1.58 | 384 |
| Group III (9–15 years) | 353 | 198 | 1.78 | 277 |
| Total | 413 | 252 | 1.64 | 334 |

**Table 4** Number of paediatric fatalities registered by the police over the study period and not included in Tables 1–3

| | Male (*n*) | Female (*n*) | Male/female ratio | Total (*n*) |
|---|---|---|---|---|
| Group I | – | – | – | – |
| Group II | 9 | 4 | 2.25 | 13 |
| Group III | 7 | 3 | 2.33 | 10 |
| Total | 16 | 7 | 2.29 | 23 |

**Table 5** Fatalities among the children hospitalized for head trauma

| | Male (*n*) | Female (*n*) | Male/female ratio | Total (*n*) | Traffic accidents (*n*) | Mortality (%) |
|---|---|---|---|---|---|---|
| Group I | 1 | – | – | 1 | 0 | 0.3 |
| Group II | 4 | 6 | 0.67 | 10 | 8 | 1.2 |
| Group III | 6 | 3 | 2.0 | 9 | 8 | 1.4 |
| Total | 11 | 9 | 1.22 | 20 | 16 | 1.10 |

**Table 6** Estimate of the total number of cases of fatal head trauma among children in Geneva in the study period

| | Male (*n*) | Female (*n*) | Male/female ratio | Total (*n*) | Mortality (%) |
|---|---|---|---|---|---|
| Group I | 1 | – | – | 1 | 0.3 |
| Group II | 11 | 7 | 1.57 | 18 | 2.2 |
| Group III | 10 | 4 | 2.5 | 14 | 2.2 |
| Total | 22 | 11 | 2.0 | 33 | 1.8 |

**Table 7** Annual incidence of each type of accident leading to head injury in children, calculated for each age group and each sex. Figures are per 100 000 girls or boys of each age group (*M* male, *F* female)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Low fall | M | 0– 3 years | 277 | Toboggan | F | 3– 9 years | 19 |
| Low fall | F | 0– 3 years | 213 | Miscellaneous | F | 3– 9 years | 19 |
| Low fall | M | 3– 9 years | 179 | Fall from height | F | 0– 3 years | 19 |
| Low fall | F | 3– 9 years | 134 | Car passenger | M | 0– 3 years | 18 |
| Pedestrian | M | 3– 9 years | 131 | Car passenger | M | 3– 9 years | 16 |
| Low fall | M | 9–15 years | 127 | Miscellaneous | F | 0– 3 years | 12 |
| Pedestrian | M | 9–15 years | 111 | Fall from horse | F | 9–15 years | 12 |
| Cyclist | M | 3– 9 years | 92 | Miscellaneous | F | 9–15 years | 12 |
| Cyclist | M | 9–15 years | 80 | Hit by object | M | 9–15 years | 11 |
| Pedestrian | F | 9–15 years | 80 | Car passenger | F | 9–15 years | 11 |
| Pedestrian | F | 3– 9 years | 72 | Hit by object | M | 3– 9 years | 10 |
| Fall from height | M | 0– 3 years | 60 | Miscellaneous | M | 0– 3 years | 9 |
| Toboggan | M | 0– 3 years | 55 | Fall from height | F | 9–15 years | 8 |
| Pedestrian | M | 0– 3 years | 55 | Car passenger | M | 9–15 years | 7 |
| Fall from height | M | 3– 9 years | 51 | Hit by object | M | 0– 3 years | 7 |
| Low fall | F | 9–15 years | 50 | Cyclist | M | 0– 3 years | 7 |
| Cyclist | F | 3– 9 years | 46 | Fall from horse | M | 9–15 years | 6 |
| Cyclist | F | 9–15 years | 46 | Hit by object | F | 9–15 years | 4 |
| Tobbogan | F | 0– 3 years | 31 | Toboggan | M | 9–15 years | 4 |
| Pedestrian | F | 0– 3 years | 26 | Hit by object | F | 3– 9 years | 3 |
| Fall from height | M | 9–15 years | 25 | Fall from horse | M | 3– 9 years | 2 |
| Car passenger | F | 3– 9 years | 25 | Fall from horse | F | 3– 9 years | 1 |
| Fall from height | F | 3– 9 years | 24 | Hit by object | F | 0– 3 years | 0 |
| Toboggan | M | 3– 9 years | 24 | Fall from horse | F | 0– 3 years | 0 |
| Miscellaneous | M | 9–15 years | 23 | Fall from horse | M | 0– 3 years | 0 |
| Car passenger | F | 0– 3 years | 21 | Toboggan | F | 9–15 years | 0 |
| Miscellaneous | M | 3– 9 years | 21 | Cyclist | F | 0– 3 years | 0 |

**Table 8** Correlations between type of accident and type of pathology induced. Data are given as percentages of the total number of cases of each pathology type, and as prevalences in respect to the total number of all injuries. Numbers in *squares* are percentages higher than the corresponding percentage in the whole study group; numbers in *circles* are prevalences higher than the overall prevalence of the same pathology type. Prevalence $= \frac{n \text{ of cases of pathology type}}{n \text{ of injuries overall}}$

| | All head injuries ($n = 1812$) | Benign injury ($n = 1503$) | | Contusion ($n = 257$) | | Open laceration ($n = 19$) | | Extradural haematoma ($n = 25$) | | Subdural haematoma ($n = 8$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | % | Prev. | % | Prev. | % | Prev. | % | Prev. | % | Prev. |
| Low fall ($n = 695$) | 38 | [42] | (0.9*) | 22 | 0.08 | 5 | 0.001 | [40] | 0.014 | – | – |
| High fall ($n = 140$) | 8 | 7 | 0.74 | [11] | (0.2) | [26] | (0.04) | 8 | 0.014 | – | – |
| Fall from a horse ($n = 21$) | 1 | 1 | 0.76 | 2 | (0.19) | – | – | – | – | [12.5] | (0.05) |
| Tobogganing ($n = 82$) | 5 | 5 | (0.91) | 6 | 0.07 | 5 | 0.01 | – | – | – | – |
| Cycling ($n = 268$) | 15 | [17] | (0.93) | 7 | 0.07 | – | – | 8 | 0.014 | – | – |
| Struck by car ($n = 427$) | 24 | 20 | 0.70 | [44] | (0.27) | 21 | 0.009 | [28] | (0.016) | [50] | (0.009) |
| Car passenger ($n = 75$) | 4 | 4 | 0.75 | 7 | (0.23) | [11] | (0.03) | – | – | – | – |
| Hit by object ($n = 33$) | 2 | 2 | 0.79 | 1 | 0.09 | 21 | (0.12) | – | – | – | – |
| Miscellaneous ($n = 71$) | 3 | 3 | 0.75 | [4] | 0.14 | 11 | (0.03) | [16] | (0.056) | [37.5] | (0.042) |
| | 100 | 100 | 0.83 | 100 | 0.14 | 100 | 0.01 | 100 | 0.014 | 100 | 0.004 |

* Statistically significant difference

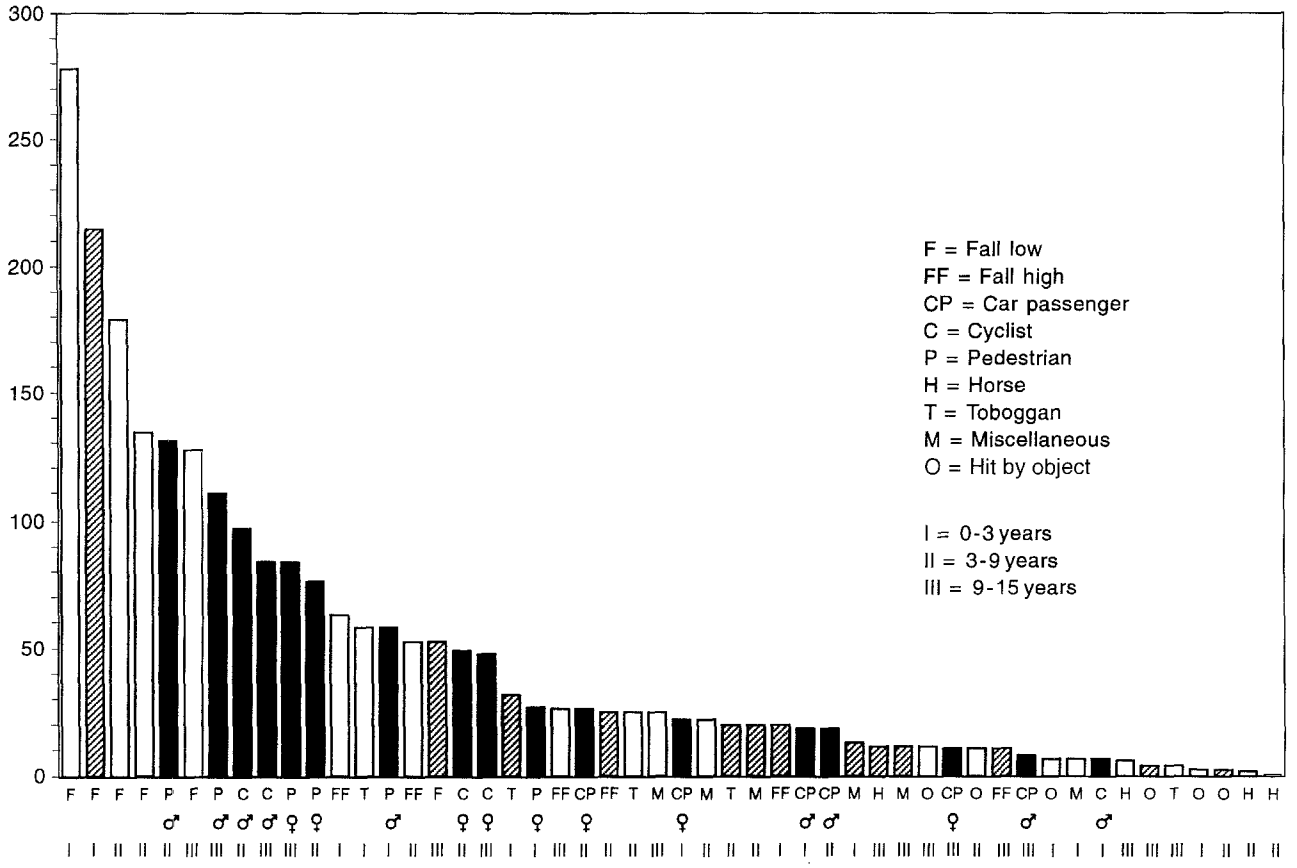


**Fig. 1** Annual incidence of each kind of accident for each age group and sex, calculated for 100 000 children of the corresponding age and sex. Road accidents are shown in *black columns* with patient sex indicated below; otherwise column shading indicates sex (*hatched* female, *open* male)

## Discussion

Head injuries are extremely frequent among children and hospitalized cases are only a small proportion of the total, depending on hospital admission policies [10] (Table 11). The paper of Kraus et al. [15] gives an estimate of 185/100 000 per year (235 boys, 132 girls). The figure calculated in the present paper is 334/100 000 per year (413 for boys, 252 for girls). These differences are no doubt mainly due to the different criteria for hospital admission, which will lead to differences in the proportions of severe cases and in mortality rates. As can be seen from Table 3, the babies (subgroup I a) had the highest risk, followed by the young children of group II. Toddlers and older children had a lower risk, which disagreed with the findings of Kraus et al. [15] but not those of Luerssen et al. [18], who found the peak risk to be at 4 years of age. Girls were much less frequently injured than boys, a well-known phenomenon that is evident in all the literature

**Table 9** Influence of age on the type of pathology induced by head trauma. Prevalences calculated as in Table 8

| | Total ($n = 1812$) | | Group I ($n = 348$) | | Group II ($n = 813$) | | Group III ($n = 651$) | |
|---|---|---|---|---|---|---|---|---|
| | *n* | Prev. | *n* | Prev. | *n* | Prev. | *n* | Prev. |
| Benign injury | 1503 | 0.83 | 296 | 0.851 | 679 | 0.835 | 528 | 0.811 |
| Contusion | 257 | 0.142 | 41 | 0.117 | 115 | 0.142 | 101 | 0.155 |
| Open brain laceration | 19 | 0.01 | 3 | 0.01 | 9 | 0.011 | 7 | 0.011 |
| Extradural haematoma | 25 | 0.014 | 4 | 0.011 | 10 | 0.012 | 11 | 0.17 |
| Subdural haematoma | 8 | 0.004 | 4[a] | 0.011 | – | 0.00 | 4 | 0.006 |

[a] All cases were in patients less than 14 months old

(male : female ratio 1.7 : 1). This sex difference was already present in subgroup I a, the 0- to 1-year age group, as in other papers [5, 11, 15], but to a much smaller degree (male : female 1.2 : 1) and was highest between 1 and 3 years of age (1.89 : 1) and between 9 and 15 years (1.86 : 1). Luerssen et al. [18] came to the same conclusions.

For each group and sex the risk of each type of accident is given in Table 7 and shown graphically in Fig. 1. A fall from a low height was the most frequent, particularly for babies and young children of both sexes, followed by pedestrians and cyclists in groups II and III, both boys and girls. "Pedestrians" in group I were injured either walking with their mother or in their pram. Car passengers were not frequently involved, but girls were significantly more frequently involved than boys; this was, however, not true for babies. It was surprising to find a significant number of falls off a toboggan among children of 0 to 3 years, boys being affected twice as frequently as girls. The responsibility of adults in all these events was not only as car drivers but also as parents. Due to their well-known enthusiasm for horses, girls had more falls from horseback than boys. Although most of these data merely confirm other studies (Table 9), there are some differences from the American statistics of Kraus et al. [15], which report, for instance, a relatively large number of assaults, particularly against young children. Kraus et al. separated cycling injuries in on-road accidents from those sustained in recreation activities, which we did not.

**Table 10** Differences in type of pathology in relation to sex. Prevalences calculated as in Table 8

| | Total ($n = 1812$) | | Female ($n = 671$) | | Male ($n = 1141$) | |
|---|---|---|---|---|---|---|
| | *n* | Prev. | *n* | Prev. | *n* | Prev. |
| Benign injury | 1503 | 0.83 | 557 | 0.830 | 946 | 0.829 |
| Contusion | 257 | 0.142 | 88 | 0.131 | 169 | 0.148 |
| Open brain laceration | 19 | 0.01 | 6 | 0.009 | 13 | 0.011 |
| Extradural haematoma | 25 | 0.014 | 15 | 0.022* | 10 | 0.009* |
| Subdural haematoma | 8 | 0.004 | 5 | 0.008 | 3 | 0.003 |

* Male vs female, $P < 0.05$

Although young children were at much higher risk of being admitted to hospital, they usually suffered much less severe accidents than older ones. No death due to an accident was recorded by the police in children in group I, and the mortality rate in hospital was actually extremely low (0.3%), whereas in children between 3 and 9 years the mortality rate was 1.2% without and 2.8% with police-recorded cases, and in those between 9 and 15 years it was 1.4% without and 2.9% with the police cases. This increase in the severity of injury was due road accidents, which took first place among the oldest children. Pedestrian were at highest risk. This very low mortality in children aged 0–3 years is in complete contradiction to the data of other authors [6, 17, 22], and the increasing mortality with age (Table 6) found in this study also contradicts what was found by Luerssen et al. [18]. The mortality due to head injuries including the cases recorded by the police was calculated at 6.8/100000 per year. Annegers and Kraus et al. [2, 15] in the USA give the higher figure of 10, whereas Sharples et al. [23] in England gives the lower figure of 5.3/100000 per year, including patients who died before or on admission.

The types of pathology elicited by head injuries were directly connected to the type of accident and explained the increased severity of outcome. In this study the total number of cases was nearly the same as in the work of Luerssen et al. [15] (1812–1906), and the numbers of extradural haematomas (EDH) were not very different (25 vs 21), but the numbers of subdural haematomas (SDH) were

**Table 11** Comparison of the data of four comparable studies with those of the present study

| | Lazorthes et al. [16] (France) | Besse [5] (France) | Luerssen et al. [18] (USA) | Kraus et al. [15] (USA) | Present study |
|---|---|---|---|---|---|
| Study period | 1963–1967 (5 years) | 1975 (5 years) | 1980–1981 (2 years) | 1981 (1 year) | 1975–1983 (8.5 years) |
| No. of cases hospitalized | 1193 | 1019 | 1906 | 688 | 1657 |
| Benign injuries | 90% | 93.5% | 86% | 88% | 90.7% |
| Severe + moderate injuries | 10% | 6.5% | 14% | 12% | 9.3% |
| Extradural haematoma | 1.2% | 0.4% | 1.2% | ? | 0.7% |
| Subdural haematoma | 1.5% | 0.3% | 1.9% | ? | 0.25% |
| Contusion | 7.5% | 4.1% | 10.8% | ? | 8.35% |
| Overall mortality | 0.9% | 0.9% | 2.5% | 2.8% | 0.6% |
| Mortality from severe injury | 9% | 13.4% | 17.6% | 23.2% | 6.5% |
| Mortality from extradural haematoma | 50% | 50% | 4.3% | ? | 5.0% |
| Mortality from subdural haematoma | 11% | – | 40.5% | ? | 12.5% |

completely different (8 vs 37). This is difficult to explain. Perhaps severe cases were reckoned as operated contusions in this study whereas they were regarded as SDH by Luerssen et al. Otherwise, the two sets of statistics are not very different, as 4.6% of the 1812 patients in this study were in a comatose state and 5.6% in the Luerssen series had a Glasgow Coma Scale score of 3–8. It is surprising to find in the Luerssen series 47 children with bilaterally fixed pupils and 73 with a unilaterally fixed pupil, which makes a total of 120, and only 95 patients in coma (GCS 3–8). This must mean that there were more severe cases in the whole Luerssen series than in the present one. What is confirmed, however, is the fact that SDH was a pathology of babies [11, 17, 22], half of them being less than 14 months old, the other 4 cases being among children of group III (age 9–15 years), one falling from horseback and three struck by cars as pedestrians. EDH were found at all ages, four of them in babies under the age of 12 months, none between the ages of 1 and 3 years, and the rest equally distributed between group II (10) and group III (11), the risk, defined as number EDH divided by number of injuries, increasing with age: 0.011 for group I (but 0.028 for babies), 0.012 for group II and 0.017 for group III. The figures are small and the differences no significant. Only one child with EDH died, in 1975 before computed tomography was available, and one child with acute SDH.

Battered children were very rarely encountered and were included in the group called "miscellaneous". This group contained three of the eight patients with SDH, two being babies, and four of the EDH. It is not the purpose of this paper to underplay the importance of this social problem [6], but only to put it in its due place in a statistical study such as this. Ferrier et al. [9], who have published several papers on this subject, give an approximation of ten new cases up to the age of 5 years every year in Geneva, a minority of them suffering from head injury. The differences in mortality in babies reported in the literature may be due to different proportions of victims of child abuse. Seemingly, this may also explain the striking differences in the proportion of SDH, a pathological entity very characteristic of child abuse [6, 17].

It has already been said that boys were more frequently involved in accidents than girls. Their injuries were somewhat different. Girls fell from horseback and were more frequently injured as car passengers. Unexpectedly, and significantly, EDH were in this study more frequent among girls than among boys, and this was even more the case when groups II and III were considered only, as the four babies with EDH were boys. This was not due to the falls from horseback or to accidents as car passengers, where girls were predominant, because there were no cases of EDH in these categories. EDH was usually due to a low fall, being struck by car as a pedestrian, or miscellaneous events (Table 8). One explanation could be that girls are more awkward when they fall and are unable to protect themselves from hitting their head.

The effect of associated injuries was not studied in this investigation. In children, unlike in adults, associated injuries are less frequent and less determinant of outcome [5, 21], even if they may well be a risk factor in regard to death [24].

This study certainly has some imperfections and some figures are only approximations. All the same, no matter how careful one is, any study will be somewhat biased [10] by the difficulty of collecting all cases and establishing from exactly what population they come. Another difficulty is the variation in definitions of what constitutes a severe case. The definition given by Jennett and Teasdale [14] and used in many recent papers allows comparisons between studies, but leaves out many patients who need active treatment and whose injuries consequently have psychological effects on both patient and parents and certainly cannot be considered as "benign". This intermediate class of cases is more difficult to define. Lastly, in many places children are treated on an outpatient basis, and criteria for hospital admission, as already remarked earlier, vary and are certainly not always rigorous, as discussed by Fife [10].

The differences between boys and girls are very striking, particularly in the fact that girls, less frequently injured than boys, sustained not only as severe lesions as boys, which might be expected, but rather more severe in some respects: EDH, fractures, coma and loss of consciousness, as will be seen in part II of the present paper [4]. They may be more clumsy when they fall, and slower to avoid danger. At least this shows some differences in behaviour between sexes, which is interesting to see at a time when education tends to diminish them. However, if girls fall more frequently from horseback, this is not due to their clumsiness, but to the fact that they are much more fond of horses than boys. But how is it to be explained that they are more frequently injured as car passengers than boys? These points are difficult to confirm because they are not mentioned in the literature.

Although road accidents are responsible for the most severe injuries and almost all deaths, it must be stressed that most head injuries in childhood are due to domestic accidents difficult to fight with prophylactic methods. These methods, public education, traffic regulation – must, however, of course be regarded as the most important means to combat head injury, prevention being far more effective than the best management. The whole fight against head injuries must include management of brain and skull lesions, protection against injuries and prevention of accidents.

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