Eur J Pediatr (1996) 155:130–135

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Population-based incidence of injuries among preschoolers

Received: 20 February 1995
Accepted: 10 May 1995

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Abstract A population survey was conducted to determine the incidence of injuries among preschoolers and their risk factors. A systematic sample (15%, $n = 4540$) of families with at least one child aged 0–5 years in 1991 living in the Canton of Vaud (Switzerland) received a mailed questionnaire in February 1992. There were 5827 eligible children in the sample. The response rate was 67.5% after two recall mailings. Injuries were defined as those from all causes with at least one physician contact in 1991. The overall incidence was 224 injuries per 1000 children (95% CI [= confidence intervall]: 211–237); 188 per 1000 children were injured over 1 year (95% CI: 176–200, $n = 746$), of whom 16.5% ($n = 123$) had 32 injuries. Falls represented 66% of all injuries, followed by burns (8%) and poisonings (5%). The proportion of hospitalized cases was 4.8% and the population incidence of hospitalization due to injury was 10.8/1000 children. Socioeconomic factors did not influence the occurrence of injuries.

Conclusion The measured incidence of injuries among preschoolers is among the highest in developed countries. Practitioners could contribute more effectively to injury prevention through routine information and counselling of parents from all social backgrounds.

Key words Wounds and injuries · Child, preschool · Socioeconomic factors · Accident, prevention

Abbreviation *CI* confidence interval

Introduction

Injuries are a major public health problem and the first cause of death among preschoolers in most industrialized countries [20, 25]. They represent 36.7% of deaths in the 1–4 year age group in Switzerland [19]. Injury prevention takes its full meaning at the beginning of life, when avoidable suffering, handicap and death are the least acceptable and the benefits maximized in terms of "years of quality life saved". One of the common obstacles to decision making is the lack of epidemiological data on incidence rates and types of injuries at the local and national levels. Few population-based studies have been published [2, 10, 11]. Most hospital-based studies suffer from selection biases that do not allow the calculation of incidence rates and introduce variations in the distribution of the causes of injuries. They are often limited to the most severe injuries or to selected causes [3, 8, 16, 17, 22, 23]. This is the first study in Switzerland that provides population cause-specific incidence rates. Our objective was to obtain baseline information for the development and evaluation of a prevention programme. Indeed, although childhood injuries have been identified as a priority for action in the Canton of Vaud by a panel of experts in paediatrics in 1990, very few, mostly uncoordinated measures have been undertaken.

Population and methods

There were about 600000 residents in the Canton of Vaud, Switzerland, during the study year (1991), of whom 37993 were children under 6 years of age. In February 1992, a mailing agency identified 29515 families with at least one child born between 1 January 1986 and 31 December 1991 living in this region. The agency's database is regularly updated and includes information from the Office of Vital Statistics on all births, deaths, and changes of address, marital status or occupation. A systematic sampling technique was used where families were sorted by place of residence and every sixth family selected down the list. The sample (n = 4540, 15%) is thus representative of the regions of the Canton. The sample size was determined to maintain the standard error of the estimate below 0.007 for the incidence rate. The questionnaire was pretested with 19 families from different socioeconomic backgrounds, then mailed anonymously to selected families in March 1992. The survey was announced in the media. Data on all injuries to eligible children in the family were collected, defined as "any injury, intentional or not, that occurred between 1 January and 31 December 1991 and led to at least one visit or telephone call to a physician, whether health care was provided or not".

Analysis were performed with SPSS-X for VAX/VMS, Release 4, using cross-tabulations and χ^2 for the comparison of proportions. The unit of analysis was the family, the child or the injury, depending on the purpose. SAS/STAT software, Release 6.06 was used for logistic regression analysis.

Table 1 Comparison between respondents and non-respondents for selected variables[a]

		All families living in Canton of Vaud (n = 29515)		Respondents (n = 2954 families)		Non-respondents[b] (n = 1586 families)		Comparsion of non-respondents and respondents (χ^2)
		n	(%)	n	(%)	n	(%)	P-value (for comparsions of whole distributions)
Sex	Girls	18409	48.5	1835	47.6	928	47.0	0.66
	Boys	19584	51.5	2018	52.4	1046	53.0	
Year of birth	1986	5988	15.8	610	15.8	333	16.9	0.45
	1987	6021	15.8	608	15.8	323	16.4	
	1988	6391	16.8	644	16.7	322	16.3	
	1989	6370	16.8	670	17.4	306	15.5	
	1990	6638	17.5	652	16.9	352	17.8	
	1991	6585	17.3	669	17.4	338	17.1	
Age of mother (years)	< 20	188	0.6	21	0.7	5	0.3	< 0.0001
	20–30	12518	42.4	1323	44.8	646	40.0	
	31–40	14010	47.5	1355	45.9	745	47.0	
	> 40	1501	5.1	128	4.3	119	7.5	
	missing	1298	4.4	127	4.3	71	4.5	
Married		25521	86.5	2598	87.9	1338	84.4	< 0.001
Region 1 (main city area)		8986	30.5	853	28.9	530	33.4	< 0.001
Region 2 (urban + rural)		14733	49.9	1533	51.9	733	46.2	
Region 3 (urban + mountain)		5796	19.6	538	19.2	323	20.4	
Living in city ≥ 10000 residents		12361	41.9	1157	39.2	747	47.1	< 0.0001
Total number of children in household (eligibles and siblings)	1	13205	44.7	1302	44.1	734	46.3	0.33
	2	11957	40.5	1211	41.0	631	39.8	
	≥ 3	4353	14.8	441	14.9	221	13.9	
Father's occupation[c]	A	5026	17.0	593	20.1	170	10.4	< 0.0001
	B	6224	21.0	672	22.7	281	17.7	
	C	18265	62.0	1689	57.2	1135	71.6	

[a] Data provided by the mailing agency. The construction of the variables in this database is different from the items of our questionnaire, thus the results are not comparable with the analysis shown later in this article. The 80 ineligible families (see the methods section) were included in the non-respondent group by a mailing agency

[b] Twelve families who actually returned the questionnaire were erroneously identified as non-respondents by the mailing agency, which accounts for the differences in the numbers presented in this table and in the text

[c] Categories specific to the mailing agency (A: managers, liberal professions, teachers, magistrates, executives; B: traders, self-employed, farmers, artists; C: qualified and unqualified workers or employees, students)

Results

Response rate

Overall, 3011 of the 4540 selected families returned the questionnaire. When 64 families who had moved out of the Canton and another 16 who were ineligible for the study (children over 5 years of age or childless couples) were removed from the original sample, the response rate was 67.5% (3011/4460). Sufficient data (i.e. at least whether or not the child had been injured) were available for 2966 families, representing 98.5% of the respondents. The distribution of selected variables was very similar between the sample and the total population of families. Nevertheless, while sex, year of birth and family size distributions were comparable for respondents and non-respondents, families with a mother over 30, single parent, living in urban areas or with a less qualified father were significantly underrepresented among respondents ($P < 0.001$) (Table 1).

Incidence rate in 1991

In 2966 participant families, 3974 children aged 0–5 years were identified, among whom 890 injuries were recorded for 746 children. The overall incidence rate of injured children in 1991 was 188 per 1000 resident children (95% CI: 176–200). When the incidence rate was applied to all 0- to 5-year old children living in the defined region, the estimates were about 8500 medically-attended episodes of injury for 7100 injured children. Compared to girls, the relative risk of being injured once or more for boys was 1.25 (95% CI: 1.10–1.43). Overall, the cause-specific distribution of injuries was about the same in both sexes. Of all injuries, 59% involved boys, but traffic injuries were equally distributed among boys and girls (50.0% each), probably reflecting a similar passive exposure.

The most common way to report incidence rates of injuries in the literature is to divide the total number of events by the number of exposed children, since injuries of the same child cannot usually be identified in hospital records. Using this method, the incidence of injuries over 1 year was 224 per 1000 children (95% CI: 211–237). Of all children, 3% had two or more injuries over the year ($n = 123$ "repeaters", 16.5% of the injured or 31/1000 children). Boys ($n = 76/123$) were more likely to be repeaters than girls (17.5% vs 15%). Of the repeaters, 37% were injured the same way (31 boys and 15 girls): 43 fell twice or more, 2 were burned twice and 1 child had 2 traffic injuries.

Causes of injury

Two thirds of injuries were falls ($n = 583$; 65.5%), followed by burns ($n = 68$; 7.6%), poisonings ($n = 48$; 5.4%), traffic injuries ($n = 40$; 4.5%), bites ($n = 28$; 3.1%), foreign bodies ($n = 24$; 2.7%), being struck by an object ($n = 23$; 2.6%) and near-drownings ($n = 3$; 0.3%). Injuries not attributable to one of these categories represented 8.2% of the events. Falls were by far the leading cause of injury at every age (Fig. 1). These data suggest an association between the type of injury and the child's developmental stage as reflected by age. Among the important mechanisms or vectors of injuries were stumbling ($n = 184$; 32% of falls), climbing ($n = 163$; 28%), falling down the stairs ($n = 57$; 10%) or playgrounds facilities ($n = 54$; 9%), and burns by hot-steam humidifiers ($n = 9$; 13% of burns).

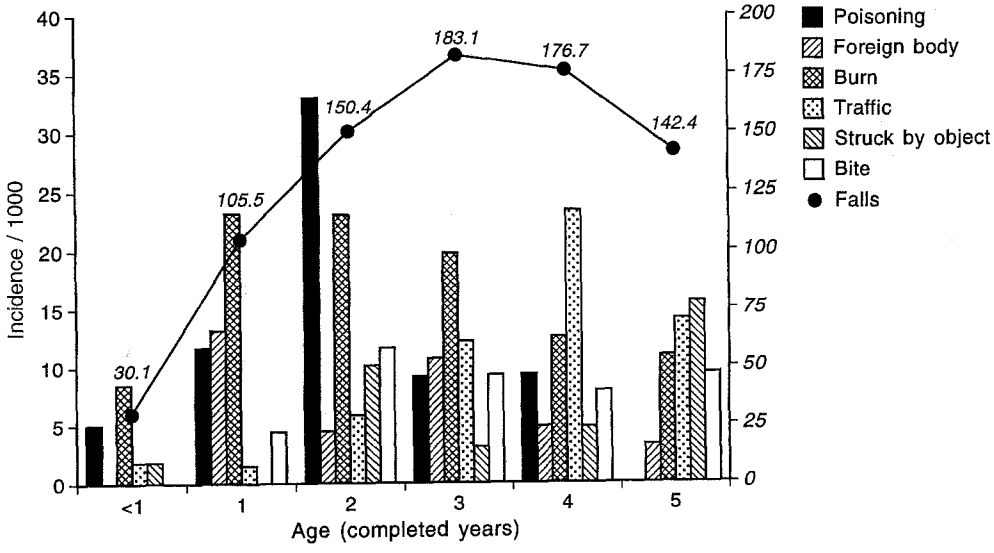

Fig. 1 Cause-specific incidence of injured children by age

Table 2 Proportion of injured children by selected socioeconomic factors (n = 3974 children)

	≥ 1 injury		P-value (for whole distributions
	n	(%)	
Residence			
Urban	343	18.9	
Rural	382	18.1	0.53
Housing[a]			
< 1	36	28.6	
1	7	21.9	
2	218	17.8	
3	294	21.3	
4	113	16.1	
5	78	15.3	0.0005
Net monthly income (Sfr)[b]			
< 2000	21	15.0	
2001–3000	44	15.4	
3001–4000	113	18.9	
4001–6000	234	17.8	
6001–8000	154	20.2	
8001–10000	61	19.1	
≤ 10000	45	19.6	0.54
Mother's education			
None	4	19.0	
Elementary school	81	15.5	
Apprenticeship	349	18.3	
Junior college	71	20.9	
Professional school	77	18.6	
University	144	20.1	0.31
Mother's occupation			
Employee/worker	176	19.8	
Junior executive	95	20.7	
Manager/senior executive	13	20.0	
Self-employed	35	12.8	
Other	6	27.3	
None outside household	403	18.2	0.09
% occupation of mother (if outside household)			
≥ 90%	68	19.2	
50%–80%	135	19.3	
< 50%	114	18.5	0.93
Partners occupation[c]			
Employee/worker	232	18.4	
Junior executive	118	18.9	
Manager/senior executive	115	21.7	
Self-employed	122	17.3	
Other	7	43.8	
None	11	16.4	0.05
Household composition			
Married/living together	707	18.5	
Single parent family	21	17.6	0.80
Mother's nationality			
Swiss	584	18.8	
Other	145	17.5	0.38
Partner's nationality			
Swiss	487	18.7	
Other	192	19.6	0.53
Mother's age at time of injury (years)			
14–19	0	–	
20–24	32	16.7	
25–29	199	17.2	
30–34	300	19.7	
35–39	158	19.5	
40–44	30	14.4	
≥ 45	6	31.6	0.15
Total	746	18.8	

[a] Ratio of number of rooms (excluding the kitchen) / number of children in household

[b] Includes both parents' salaries, pensions, alimony and all other income in the household, after deduction of social security premiums

[c] The partner may or not be the child's father

Severity

The hospitalization rate (injuries with at least one hospital stay ≥ 24 h/all injuries) was 4.8% in this study. Using the child as the unit of analysis (43 hospitalized children/746 injured children), the hospitalization rate was 5.8%. The population incidence of hospitalization for injury was 10.8 per 1000 children (43 hospitalized/3974 children from the participating families).

In the absence of medical severity scores, hospitalized cases are often considered as the most severe injuries, implying that 95% of injuries were benign in the study population. But when the definition of serious injuries was extended to those with at least one reported serious consequence such as fractures, scalds, sequelae, loss of consciousness, more than three medical visits or a hospitalization, then 27% of the injuries were selected. Mortality was not analysed because "only" two children (who were not in the sample) died of an injury in the Canton during the study year.

Socioeconomic risk factors

At all ages the proportion of children with at least one injury did not differ according to whether the child was first born or not; family size, as measured by the number of

siblings living in the household, did not influence the occurrence of injuries. There was no difference in the frequency of injuries by place of residence, housing, income, mother's education, age and percentage of professional activity, parents' occupation, nationality or family composition (Table 2), even after grouping categories. Only a negative correlation between the number of rooms per child and the frequency of injuries was significant ($P < 0.001$). It may be due to chance only ("multiple comparisons") since this finding contrasts with the slight non significant excess of injuries in children from the highest socioeconomic groups defined by a net monthly income above Sfr. 6000, mother with at least some college education, mother or father managers or senior executives. Similarly, no difference was observed in the proportion of each main type of injury by socioeconomic groups. The above socioeconomic factors were used as independent variables in a stepwise logistic regression analysis, using different outcomes: "at least one injury versus none", "at least two injuries versus none", "hospitalization versus none" and each type of injury as dichotomous variables. Only age and sometimes sex significantly contributed to the models, but odds ratios never exceeded 1.3. None of the socio-economic variables stayed in the equations.

Prevention

Paediatricians/general practitioners did not appear to provide systematic counselling on injury prevention. Only 20% of parents ($n = 593$) reported that the physician gave such information in the first 6 months of their child's life, 10% ($n = 292$) did not remember and the remaining 70% ($n = 2026$) declared they had received no counselling. These percentages were the same whether the child was injured or not. More mothers below 30 years of age (25% vs 21%, $P < 0.05$), with lower education (until apprenticeship, 25% vs 19%, $P < 0.001$) or income below Sfr. 4000/month (27% vs 21%, $P < 0.01$) reported information given by a physician. Yet our results show that these groups were not at increased risk of having an injured child.

Discussion

This survey underlines the importance of injuries as a public health problem in this region of Switzerland. It suggests that significant morbidity is not limited to hospitalized children and stresses the need of also collecting data on ambulatory cases in injury studies.

Comparisons with other studies abroad are hindered by inconsistencies in classification systems and differences in age grouping, case definition and emergency care organization [7, 15]. The incidence of injuries was higher in the Canton of Vaud (224/1000 children) than in the Statewide Childhood Injuries Prevention Program (SCIPP) in Massachusetts (177/1000 children) [10]. However, the SCIPP surveillance system did not involve practitioners and Health Maintenance Organizations, which would have increased the incidence substantially, and it did not identify repeaters. Our results show that the incidence rate differs sizeably when using injured children (188/1000) or episodes (224/1000) as the numerator. A French survey similar in design but limited to home injuries found an incidence of 121/1000 children aged 0–4 years, with a hospitalization rate among the injured of 9.1% between 0 and 16 years [2]. In our population, the incidence was still 214/1000 after removing traffic injuries. In Jerusalem, 98/1000 children aged 0–17 years were injured in 1986, of whom 2.4% were hospitalized [11]. Before a preventive intervention, 120/1000 Norwegian children aged 0–6 years had an injury in 1983, with 9% of them hospitalized [16]. The boys to girls relative risk as well as the distribution of causes are similar in the Canton of Vaud and in Massachusetts [10] if differences in classification are taken into account.

Some drawbacks of mail surveys may influence the results, like recall bias. Parents may underreport the most severe injuries because they feel embarrassed to acknowledge what they consider as flaws in their parental role. On the other hand, less severe injuries could be underreported because they are easier to forget. The criterion of medically-attended injuries should help standardizing reports. The second problem is the length of the recall period. A 12-month period has recently been shown to decrease the rate by more than 40% compared with a 1-month recall period, with the most important decrease for preschoolers and for minor injuries [12]. However, in our small population, decreasing the recall period would have required to increase the sample size substantially to obtain a sufficient number of events for analysis. There is no evidence of an important recall bias in our data: injuries were equally distributed across the four trimesters, with a slight increase during the summer (28% in April-June and in July-September), and the distribution of causes as well as the hospitalization rate were the same for the last trimester (October-December) as during the whole year.

The participation rate was satisfactory for a mail survey (67.5%) and in the highest range of general population surveys conducted in Switzerland. Similar recent surveys on child health obtained 65% in Australia [13] and 81% in a small town in Iceland [5]. Most of the slight differences in participation were found for correlated variables (for example, more unqualified workers live in the main city). Non-respondents may differ from respondents on unmeasured factors or in the frequency or severity of injuries, although the data for respondents indicate that the pattern of injuries is similar in all socioeconomic groups.

Our data were limited to the legal resident population. Recent and illegal immigrants, whose children may sustain an excess of injuries due to cultural misadaptation and unsatis-

factory living conditions [1], are excluded since they are not registered officially, thus not part of the sampling frame. The various measures of validity that we have discussed suggest a possible underestimation of the incidence rate.

No socioeconomic risk factor could be identified after controlling for age and sex, even when only hospitalized cases were considered. These results differ from those of other studies, most of which used estimations based on census tracts rather than individual socio-demographic data [6, 9, 14, 21]. One hypothesis is that the population of families with small children was relatively homogenous in the Canton of Vaud in 1991, undertaking similar activities whatever the social background, since there are no large impoverished groups in Switzerland comparable to those living in inner cities of other industrialized countries. Alternatively, injuries, as opposed to illnesses, may be determined more by environmental, situational and developmental factors than by the sociodemographic milieu.

These results indicate that preventive interventions must be directed towards all children of both sexes and from all social backgrounds. The content and form of the preventive message must of course be tailored to the needs and level of understanding of their parents. Environmental measures appear particularly appropriate under those circumstances. In addition, the important proportion of "repeaters" (17%) suggests opportunities for hospital staffs and community paediatricians to promote preventive measures directed towards injured children and their parents, based on educational and behavioural change. Preventive actions known to be effective [4, 18, 24] could significantly reduce the incidence of injuries if they were more widely and systematically applied in Switzerland. Paediatricians and general practitioners should be encouraged to adopt a higher profile in injury primary prevention.

Acknowledgements This study was partially supported by the Canton of Vaud Public Health Department. We are also grateful to Prof. Alan Ross for his assistance in sample size calculation, and to Dr Bernard Burnand and Prof. Fred Paccaud for their helpful comments on the manuscript.

References

1. Abdelilah M, Mabé B (1991) Prévention auprès des populations immigrées. In: Félix M, Tursz A (eds) Les accidents domestiques de l'enfant: un problème majeur de santé publique. Institut de l'enfance et de la famille, Centre international de l'enfance, Coll. Syros Alternatives, Paris, pp 217–226
2. Alies-Patin AM, Holla H (1987) Les accidents de la vie domestique chez l'enfant. Caisse nationale de l'assurance maladie des travailleurs salariés, Département statistique, Dossier Etudes et Statistiques No. 7), Paris
3. Baruch M, MacKenzie EJ, Deshpande JK, Ramsy AI, Haller JA (1992) Hospitalizations for traumatic injuries among children in Maryland: trends in incidence and severity, 1979 through 1988. Pediatrics 89: 608–613
4. Bass JL, Christoffel KK, Widome M, Boyle W, Scheidt P, Stanwick R, Roberts K (1993) Childhood injury prevention counselling in primary care settings: a critical review of the literature. Pediatrics 92: 544–550
5. Benediktsdottir B (1993) Upper airway infections in preschool children: frequency and risk factors. Scand J Prim Health Care 11: 197–201
6. Bijur PE, Golding J, Kurzon M (1988) Childhood accidents, family size and birth order. Soc Sci Med 26: 839–843
7. Christoffel KK, Scheidt PC, Agran PF, Kraus JF, McLoughlin E, Paulson JA (1992) Standard definitions for childhood injury research: excerpts of a conference report. Pediatrics 89: 1027–1034
8. Davidson LL, Durkin MS, O'Connor P, Barlow B, Heagarty MC (1992) The epidemiology of severe injuries to children in Northern Manhattan: methods and incidence rates. Paediatr Perinat Epidemiol 6: 153–165
9. Durkin MS, Davidson LL, Kuhn L, O'Connor P, Barlow B (1994) Low-income neighborhoods and the risk of severe pediatric injuries: a small-area analysis in Northern Manhattan. Am J Public Health 84: 587–592
10. Gallagher SS, Finison K, Guyer B, Goodenough S (1984) The incidence of injuries among 87'000 Massachusetts children and adolescents: results of the 1980–81 Statewide Childhood Injury Prevention Program surveillance system. Am J Public Health 74: 1340–1347
11. Gofin R, Israeli I, Palti H (1991) The incidence of childhood and adolescent injuries and their outcome: a population-based study. Isr J Med Sci 27: 566–571
12. Harel Y, et al (1994) The effects of recall on estimating annual nonfatal injury rates for children and adolescents. Am J Public Health 84: 599–605
13. Hort KP (1992) Health problems and services use by parents of normal infants in the first 6 months of life. J Paediatr Child Health 28:286–290
14. Jolly DL, Moller JN, Volkmer RE (1993) The socio-economic context of child injury in Australia. J Paediatr Child Health 29: 438–444
15. Robertson LS (1992) Injury epidemiology. Oxford University Press, New York
16. Sahlin Y, Lereim I (1990) Accidents among children below schoolage: changes of incidence after intervention. Acta Paediatr Scand 79: 691–697
17. Shanon A, Batshaw B, Lewis J, Feldman W (1992) Nonfatal childhood injuries: a survey at the Children's Hospital of Eastern Ontario. Can Med Assoc J 146: 361–365
18. Sibert JR (1991) Accidents to children: the doctor's role: education or environmental change? Arch Dis Child 66: 890–893
19. Spuhler T (1991) Statistique des causes de décès 1986–1990. Office Fédéral de la Statistique, Info à la carte, Berne
20. Taket A (1986) Accident mortality in children, adolescents and young adults. World Health Stat Q 39: 232–256
21. Towner EML, Jarvis SN, Walsh SSM, Aynsley-Green A (1994) Measuring exposure to injury risk in schoolchildren aged 11–14. BMJ 308: 449–452
22. Tursz A, Lelong N, Crost M (1990) Home accidents to children under 2 years of age. Paediatr Perinat Epidemiol: 408–421
23. Walsh SS, Jarvis SN (1992) Measuring the frequency of "severe" accidental injury in childhood. J Epidemiol Community Health 46: 26–32
24. Wilson MH, Baker SP, Teret SP, Shock S, Gabarino J (1991) Saving children: a guide to injury prevention. Oxford University Press, New York
25. World Health Organization (1994) Causes of death, by sex and age. In: World Health Statistics Annual. World Health Organization, Geneva, pp D10-401