50,000 Child-Years of Accidental Injuries

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THE LARGE NUMBER of children who are accidentally injured or killed each year makes it urgent to develop effective means to reduce the frequency and severity of childhood injuries. As a step toward reducing accidents, the California State Department of Public Health in 1955 undertook a series of investigations (*1–4*) culminating in a large-scale study of childhood accidents. This paper, on the first phase of this study, describes in detail the distribution of injury rates for the study population as a whole and for subgroups determined by age, sex, race, and sibling order. It includes rates for severe injuries, various types of injuries, different parts of the body affected, and major types of accidents causing injuries.

The ultimate aim of the study was to determine whether some children persist in having significantly more accidents than others over a period of time and, if so, to identify the behavioral, personality, and environmental factors which distinguish such children.

Although a number of studies with the same broad purpose of determining how accident repeaters differ from other children have been undertaken (*5–7*), none has investigated either the extent of accident repeatedness per se or whether the difference in number of injuries sustained by children over a given period of time is due merely to chance.

In the first phase of our study, data were collected and analyzed on the accident experience of 8,874 children receiving prepaid medical care over a period of years. These data not only allowed us to study accident repeatedness but also provided a wealth of information on the pattern and nature of childhood accidents. The study was restricted to medically attended, nonfatal injuries. Whenever we mention injuries or accidents incurred by the study children, therefore, reference is to nonfatal, medically attended injuries.

The literature abounds with data on children's accidents (*8–11*). This is the first large-scale study, however, on the accident experience of children over long periods of time. The study also includes variables not reported elsewhere,

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such as sibling order. Furthermore, the data are not limited to accidental injuries which occurred in one place (home, school, and so forth) or which were treated in hospital emergency rooms.

Method

Study population. The study population comprised all of the 8,874 children who as of May 1960 were (*a*) members of families subscribing to the Kaiser Foundation Health Plan, (*b*) residents of Berkeley or Oakland, Calif., (*c*) at least 4 years old, but no older than 18, and (*d*) enrolled in the plan for one or more of the following 4-year periods of their lives: birth through 3 years, ages 4 through 7, 8 through 11, and 12 through 15. Some of the study children were enrolled at birth; others, later. Of the 8,874 study children, 51.5 percent were boys and 48.5 percent, girls. These children were born between 1941 and 1956 as follows:

Year of birth	*Percent of study children*
1941–44	23.5
1945–48	34.2
1949–52	30.0
1953–56	12.3

The Kaiser Foundation Health Plan is a prepaid medical service entitling members to comprehensive medical care given by the Permanente Medical Group at any of several facilities in the San Francisco Bay area. While it cannot be claimed that the Kaiser membership is statistically representative of the Berkeley-Oakland population or of the urban population of the country as a whole, table 1 shows that the study population covered a broad spectrum of social and economic backgrounds as reflected by the father's occupation and the child's racial origin.

Data collection. The major source of accident data for the study was the medical records of the Oakland facility of the Permanente Medical Group. Providing a complete history of all inpatient and outpatient services obtained at this facility, these records offered an unusual source of data on each child's medically attended injuries for the period of his enrollment in the plan.

The following information on each injury was obtained from the medical records of each child: age when the injury occurred, nature of the injury, part of body affected, type of accident leading to the injury, number of outpatient visits, and whether or not the injury resulted in hospitalization. The last two items were combined to form an index of injury severity. A severe injury was designated as one which resulted in three or more outpatient visits or in hospitalization. All other injuries were classified as minor. (As a methodological control, a pediatrician from the California State Department of Public Health independently coded a sample of 264 injuries on a medically explicit severity scale. The results obtained by this coding agreed sufficiently well with those obtained from the severity index to assure us of the validity of the index.)

We also recorded the following background information for each child: sex and birthdate, age at enrollment in the plan, race, father's

Table 1. Distribution of study sample by father's occupation and child's race

Father's occupation [1]	Percent by each racial group				
	White (N=6,334)	Negro (N=1,876)	Oriental (N=404)	Other and unknown (N=260) [2]	Total (N=8,874)
Professional, technical, managerial	36.8	5.0	39.9	3.8	29.3
Clerical, sales, skilled labor	38.9	27.4	33.9	15.8	35.5
Semiskilled and unskilled labor	11.0	54.3	17.8	28.9	21.0
Other: father deceased, not living with family, retired occupation unknown	13.3	13.3	8.4	51.5	14.2
Total	100.0	100.0	100.0	100.0	100.0
Sample distribution by race—percent	71.4	21.1	4.6	2.9	100.0

[1] At time of child's enrollment in Kaiser Foundation Health Plan.
[2] Includes some children of Latin-American extraction whose race did not appear in the Kaiser records.

occupation at time of child's enrollment, and number of older siblings. (Data on number of younger siblings were not available for analysis because the family composition was obtained for the Permanente records at the time of the child's enrollment in the plan and was not always brought up to date by the hospital staff as more siblings were born.)

To assure completeness of the accidental injury history obtained for each child, we did extensive methodological checks to assess the extent to which Kaiser members living in Oakland and Berkeley obtained medical care at Kaiser facilities other than the one in Oakland and the extent to which they used non-Kaiser medical facilities.

Although the study population was limited to residents of Berkeley and Oakland, each child was entitled to medical care at any of the other 12 Kaiser facilities in the San Francisco Bay area. Records of a subsample were therefore cross-checked with the files of the other centers to see how much these facilities had been used. We did a 100 percent cross-check at the three centers where the proportion of study children having medical records was found to be more than 2 percent (San Leandro—8 percent, Walnut Creek—5, Richmond—4). Additional data were found at these three centers for approximately one-fifth of all study children and were incorporated into the information previously obtained from the Permanente-Oakland files.

To determine the extent to which study group children received non-Kaiser medical care, we conducted three additional methodological checks:

1. Mothers of children whose Permanente records showed no entries for more than 1 year were contacted. When these mothers indicated that their children had been taken to non-Permanente physicians, we contacted the physicians whenever possible. As a result, additions were made to the accident histories of less than 2 percent of the sample. About 4 percent of the entire sample was dropped because either the mother or the physician could not be reached or because the child's family had been out of the area for a considerable time.

2. We completely cross-checked the names of the study children against the files of two pediatric practices (the practices of Jennings, Payne, Rogerson, and Grossman of the Berkeley Pediatric Medical Group and of Harris and Hatoff, a private partnership in Oakland). The mothers we contacted had mentioned these two practices more frequently than others as a source of care. This check provided additional accident data on less than 1 percent of the study group.

3. Other files which we cross-checked were those of the accident reporting program initiated in mid-1957 by the Alameda-Contra Costa Medical Association in cooperation with the California State Department of Public Health. All major and most minor hospital emergency facilities in the counties of Alameda and Contra Costa participated in this program. Slightly more than 1 percent of the study group turned up in these records, and all relevant information was incorporated into the basic data.

In summary, the extensive methodological work that we performed to evaluate the completeness of the Permanente medical records as a source of data on medically attended injuries confirmed our initial assumption that these records represented a reasonably complete source. To the minor extent that the Permanente records were not complete, the additional investigations enabled us to supplement the accident histories of the study children.

All injury rates shown were calculated according to the age of the child at the time of injury regardless of the child's year of birth. Thus, some children who incurred injuries in the age period 0–3 years may have been born as early as 1941 and others as late as 1956. Combining the children born recently with those born earlier is justified, of course, only if injury rates have not changed appreciably over the years. An analysis of the data by child's year of birth indicated that there was not enough change in rates to affect our findings although there was a slight increase over the 16-year interval.

The criteria used for selecting cases resulted in an age distribution for the study population which differed considerably from that of the general population. Therefore, all rates not shown for specific age groups were standardized for age, on the assumption that there were equal numbers in each age group.

Rates were not standardized for sex since there was no evidence that the selection procedure distorted the true ratio of boys to girls. (For further details on the methodology of the study, see reference *12*.)

Results

The 8,874 children whose medical record data were studied reflected an aggregate of 53,448 child years and 13,154 medically attended injuries. Thus, the injury rate per 1,000 children per year was 246.1, or about one accident per child every 4 years. This rate, however, varied considerably for different groups of children—as defined by sex, age, race, father's occupation, and number of older siblings.

Sex and age. Like other investigators, we found that sex and age were closely related to the childhood accident rate (table 2). Differences in the kind and range of activities in which boys and girls engage undoubtedly accounted for the difference in accident rates according to sex, and obviously, these differences become even more pronounced among teenagers. Thus, boys had more accidents than girls at all ages, but the pattern of accident rates by age differed for each sex. Boys tended to have more injuries as they grew older—

Table 2. Medically attended injuries by sex within each age period—annual rates per 1,000 children for all injuries and for severe injuries

Age period and sex	Rates		Number of children [1]
	All injuries	Severe injuries	
0–3 years:			
Boys	287. 8	30. 8	1, 648
Girls	212. 5	22. 5	1, 488
4–7 years:			
Boys	288. 7	40. 9	2, 307
Girls	192. 9	25. 9	2, 098
8–11 years:			
Boys	302. 5	53. 0	2, 082
Girls	187. 0	31. 2	1, 901
12–15 years:			
Boys	328. 6	69. 4	948
Girls	146. 6	21. 3	890

[1] The sum of children for the 4 age groups is more than 8,874 because many children were enrolled for more than a single age period.

NOTE: "All injuries" referred to in tables and text includes severe injuries.

a tendency even more marked for severe injuries. For girls, in contrast, the number of injuries was highest in the first 4 years of life and declined steadily in successive periods. The rate of severe injuries for girls rose somewhat with age but then dropped again at early adolescence. Thus the differences in rates for boys and girls became more pronounced with increasing age; for severe injuries, this trend was even sharper.

Race and father's occupation. There were also fairly sizable variations in injury rates among children of different races. The rate for white children was noticeably higher than that for Negroes, while Orientals had the lowest rate of all (table 3). This pattern among the three groups held true for almost all age and sex categories, for all injuries, and for severe injuries (data not shown).

If one looks at the rates for all races combined in table 3, the occupation of the father also shows a direct relationship to injury rates. Rates for all injuries were highest among children of professionals and lowest among children of semiskilled and unskilled workers. Rates for severe injuries showed a similar but less marked pattern. By and large, these patterns were consistent for all sex-age groups (data not shown).

When we examined race and father's occupation simultaneously, we continued to find sharp differences between injury rates of white and nonwhite children (table 3). Within a race, however, the differences in rates for all injuries by occupation tended to be greatly reduced and, in some instances, to disappear altogether. Thus, a child's race seemed to be a more important determinant of accident frequency than his father's occupation. The discovery that the Negro children in our study had lower rates than the white children merits further consideration, since it runs counter to the national findings of a higher accident mortality rate among Negro children (*13*).

Older siblings. Injury rates for white children with no older siblings were compared with rates for children with older siblings (table 4). As stated earlier, injury rates for boys tended to increase with age; rates for girls tended to decrease. For boys, the main effect of having one or more older siblings was to accelerate the

Table 3. Medically attended injuries by father's occupation and child's race—annual rates per 1,000 children for all injuries and for severe injuries

Father's occupation [1]	White			Negro			Oriental			All groups [2]		
	Rates		Number of children	Rates		Number of children	Rates		Number of children	Rates		Number of children
	All injuries	Severe injuries		All injuries	Severe injuries		All injuries	Severe injuries		All injuries	Severe injuries	
Professional, technical, managerial	276. 9	41. 4	2, 335	236. 5	27. 8	95	149. 1	20. 5	161	268. 1	39. 7	2, 601
Clerical, sales, skilled labor	260. 0	40. 4	2, 462	181. 6	27. 9	514	168. 0	20. 0	137	244. 7	37. 6	3, 154
Semiskilled and unskilled labor	256. 6	42. 0	696	193. 3	33. 0	1, 018	134. 8	20. 5	72	216. 8	36. 9	1, 861
Other: father deceased, not living with family, retired, occupation unknown	262. 7	39. 2	841	190. 9	28. 2	249	133. 0	8. 1	34	234. 7	35. 3	1, 258
All occupations	267. 6	40. 5	6, 334	189. 7	29. 3	1, 876	149. 4	19. 4	404	246. 1	37. 4	8, 874

[1] At time of the child's enrollment in the Kaiser Plan.
[2] Includes 260 children classified as "Other and unknown."

NOTE: Rates shown are standardized for age.

rate of increase of injuries with age; for girls, to decelerate the rate of decrease. For both sexes, the net result was that children with at least one older sibling had lower injury rates in their preschool years and higher injury rates in their early teens (as compared with children who had no older siblings). In general, the same pattern held for severe injury rates. The data for Negroes, based on fewer children, were less conclusive (data not shown).

Injury frequency and persistency. Accident rates among subgroups of the study population indicate "average" accident experience for each subgroup as a whole, but do not show variations in the accident experience of individuals within each subgroup. Individual differences in accident experience have, of course, been the subject of much study (often under the heading of "accident proneness") and much controversy (*14, 15*). Data on the distribution of number of accidents among groups of children, however, are rare. Consequently, an immediate objective of our study was to answer two questions: How frequently does accident repeatedness occur among any subgroup of children within a single time period? Does the tendency to have repeated accidents persist from one period to another, or is accident repeatedness an essentially transitory phenomenon?

There are indeed wide variations in the number of accidents suffered by children within any given subgroup. As an illustration, the group with the largest number of study children—white boys, ages 4 through 7 years—had an annual injury rate per 1,000 children of 318.4, or an average of 1.27 injuries per child over the whole 4-year period. Yet within this group, more than one-third of the children had no injuries at all, while 16 percent had three or more—more than double the average:

Number of medically attended injuries	*Number of children*	*Percent of children*
0	599	35. 5
1	504	29. 8
2	319	18. 9
3	152	9. 0
4	65	3. 9
5	28	1. 7
6	12	. 7
7	4	. 2
8	2	. 1
9 or more	4	. 2
Total	1, 689	100. 0

Some children appear to have more than their share of accidents. We determined that chance alone was not responsible for this circumstance

by comparing observed distributions of number of injuries with expected (Poisson) distributions for various subgroups (*12*).

Furthermore, our study shows a definite relationship between the number of injuries a child has in one 4-year period of his life and the number he has in a subsequent 4-year period. (Mellinger and co-workers present in reference *16* a more rigorous mathematical approach to the problem of accident persistency based on the same data.) Among white boys in our study with no injuries in the first 4 years of life, the annual rate per 1,000 in their second 4 years was 234.6 (see chart). For those with three or more injuries during the first 4 years, the rate was twice as high (481.0) in the second 4. Similarly, white boys who incurred severe injuries during the first 4 years of life had an injury rate for severe injuries half again as high during the second 4 years as boys having no severe injury in the first period. A similar pattern is found for all age groups, both sexes, and for Negroes as well as whites. (Only the data for white boys are shown. The number of Orientals who had been enrolled in the plan for 8 years was too small to permit analysis of the data in this manner.)

Table 4. Medically attended injuries of white children without and with older siblings by age period within sex category—annual rates per 1,000 children for all injuries and for severe injuries

Sex, age period, and siblings	Rates		Number of children
	All injuries	Severe injuries	
Male			
0–3 years:			
Without older siblings	336. 1	38. 9	328
With older siblings	300. 7	30. 8	868
4–11 years:			
Without older siblings	326. 2	49. 3	668
With older siblings	320. 8	52. 4	961
12–15 years:			
Without older siblings	330. 5	65. 4	413
With older siblings	382. 8	90. 8	303
Female			
0–3 years:			
Without older siblings	246. 3	22. 9	338
With older siblings	223. 0	23. 7	758
4–11 years:			
Without older siblings	212. 0	32. 5	646
With older siblings	204. 3	30. 4	822
12–15 years:			
Without older siblings	154. 7	18. 9	383
With older siblings	180. 9	32. 2	264

NOTE: The rates shown for the 4–11 year age period represent an average of the rates for the 4–7 and 8–11 year periods. The number of children shown as the base for this 8-year period is also the mean of the numbers of children for each of the 4-year periods.

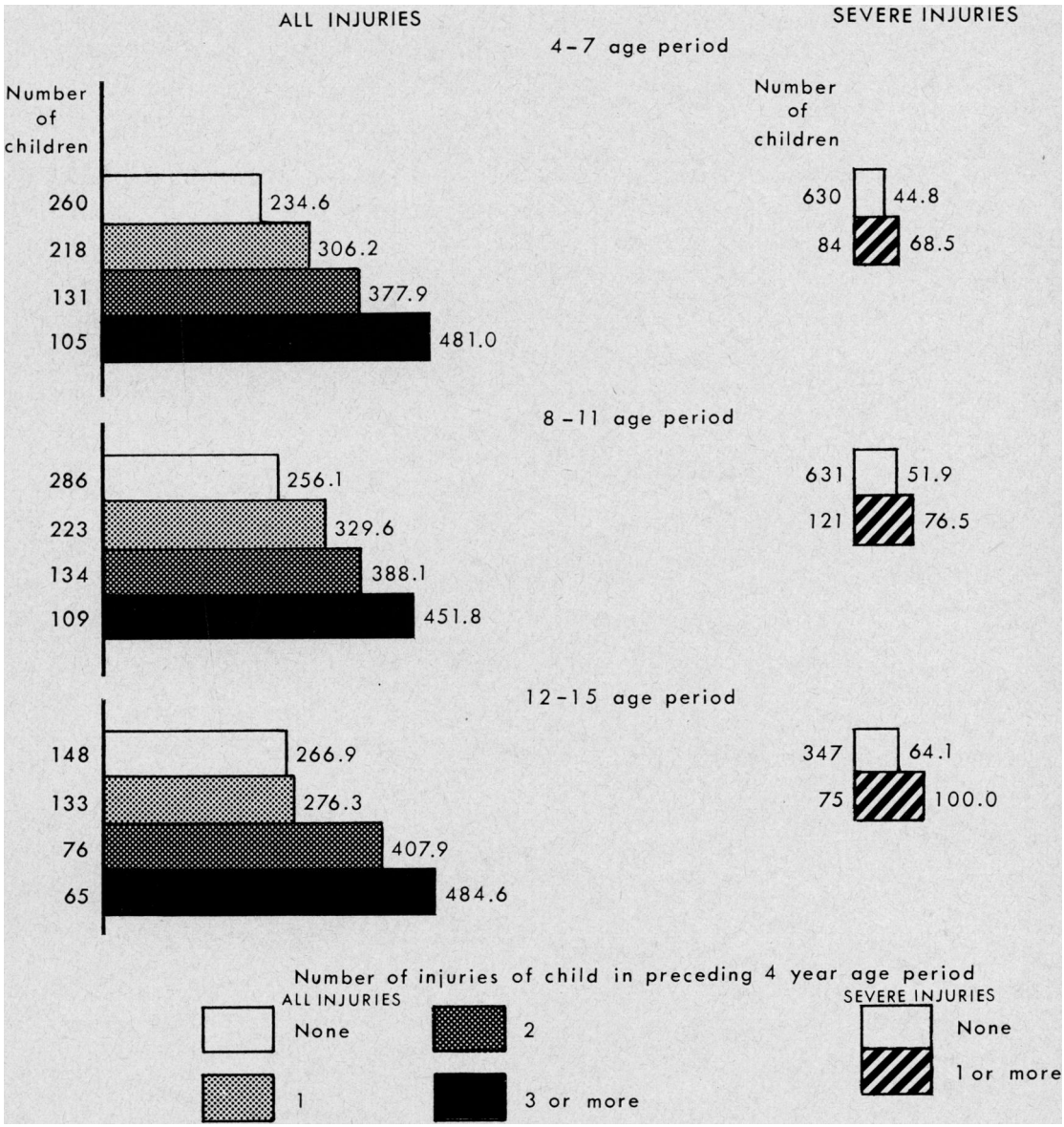
Decision to seek medical care. When an accident occurs, a decision must be made as to whether or not medical attention is necessary. The less severe the injury, presumably the greater the element of discretion as to whether or not medical care is sought. Thus the predispositions of the mother to seek medical care for a child's minor injuries might possibly explain two results already presented: that Negro children had lower rates of medically attended injuries than white children and that some children, whom we have labeled "accident repeaters," appeared to have more than their share of injuries.

It is conceivable that Negro mothers were less predisposed to seek medical attention for minor injuries sustained by their children than white mothers. If this were true, Negro children could have lower rates of medically attended injuries than white children, even if they had more accidents. This explanation would also be compatible with the relatively higher accident mortality of Negro children. We can test this possibility by means of the index of injury severity described earlier. If minor injuries comprised a smaller proportion of the injuries recorded for Negro children than of those recorded for white children, we might reasonably conclude that the predisposition to seek medical attention for minor injuries was lower among Negro mothers than among white mothers.

The 1,876 Negro children in the study, however, differed little from the 6,334 white children in the proportion of injuries which were minor, as shown by the following percentages standardized for age:

Injury category	*Whites*	*Negroes*
Severe injuries	15. 2	15. 4
Requiring hospitalization	2. 6	2. 7
Not requiring hospitalization	12. 6	12. 7
Minor injuries	84. 8	84. 6
Total	100. 0	100. 0

Medically attended injuries of white boys, annual rates per 1,000 children, by number of injuries incurred in preceding age period—for all injuries and for severe injuries within each age period



It is possible, however, that Negro mothers were less likely than white mothers to complete the series of outpatient visits recommended by the physician at the time of injury. If this happened to any great extent it would mean that our measure of injury severity underestimates the actual proportion of "severe" injuries among Negro children and that the proportions for Negro and white children may not be as similar as the figures just given indicate.

Since the physician probably has greater control over whether or not the child is hospitalized than he does over completion of office visits, the proportion of injuries resulting in hospitalization is less subject to bias caused by the mother's predisposition to seek medical care. Ac-

cordingly, the data on hospitalization provide more convincing evidence that the differences in Negro and white accident rates cannot be explained by differences in the mother's predisposition to seek medical care.

Similarly, the proportion of injuries that were minor may be used to test the possibility that accident repeatedness reflects the predispositions of some mothers to seek medical care for minor injuries sustained by their children. Table 5 shows the proportion of injuries of white boys that were minor according to the total number of injuries recorded for the child in each 4-year period. In all but the oldest age period (12–15 years), the proportion of total injuries that were minor was only slightly higher among boys with three or more injuries than among those with only one injury. In the period 12–15 years, this small difference actually disappeared. These data thus suggest that the predisposition of mothers to seek medical care contributes little, if at all, to accident repeatedness.

Specific injuries. Besides examining rates for all medically treated injuries together, we classified each injury according to the medical diagnosis (nature of injury), part (or parts) of body affected, type of accident leading to injury, and severity of injury.

The highest rate for any single type of injury was for lacerations—63.8 per 1,000 children per year (table 6). The next highest was for con-

Table 5. Minor injuries as a percent of all injuries for white boys—by total number of medically attended injuries incurred within each of four age periods

Age period	1 injury		2 injuries		3 or more injuries	
	Percent of injuries minor	Number of children	Percent of injuries minor	Number of children	Percent of injuries minor	Number of children
0–3 years	87. 8	378	89. 3	214	90. 3	185
4–7 years	84. 7	504	84. 5	319	87. 0	267
8–11 years	81. 4	511	81. 0	271	85. 0	267
12–15 years	79. 6	201	75. 9	147	79. 4	136

Table 6. Nature of medically attended injuries—annual rates per 1,000 children for all injuries and for severe injuries, and three measures of severity for each kind of injury

Nature of injury	Rates [1]		Percent severe in category	Average number of physician visits	Percent in category resulting in hospitalization
	All injuries	Severe injuries			
Laceration	63. 8	9. 2	14. 5	1. 8	1. 3
Contusion	45. 5	4. 7	10. 4	1. 4	2. 4
Sprain or strain	30. 8	2. 6	8. 4	1. 3	. 9
Abrasion	27. 9	3. 1	11. 2	1. 4	1. 9
Perforation	21. 6	. 8	3. 9	1. 2	. 5
Fracture	21. 4	15. 7	73. 5	3. 4	14. 4
Burn	9. 5	2. 6	27. 3	2. 1	4. 1
Poisoning [2]	4. 8	. 5	9. 4	1. 1	7. 6
Concussion	2. 2	. 9	40. 3	1. 7	34. 8
All injuries [3]	246. 1	37. 4	15. 2	1. 6	2. 6

[1] Rates are standardized for age for the 8,874 study children.
[2] Includes only cases in which the patient was lavaged or showed ill effects from poisoning.
[3] The sum of the rates for the 9 injuries does not equal that for "All injuries" because "All injuries" includes some relatively rare ones as well as cases in which the medical record indicated no evident symptom of injury or contained no entry about kind of injury. Also, in a few instances, a child's accident was classified in 2 or more injury categories.

tusions 45.5, followed by sprains and strains 30.8, abrasions 27.9, perforations 21.6, and fractures 21.4. Lower rates were found for burns 9.5, poisonings 4.8, and concussions 2.2.

About one injury in seven (15.2 percent) was severe—that is, required three or more visits to a physician or hospitalization. The pattern for severe injury rates does not parallel that for all injuries because some kinds of injuries are more likely to be serious than others. Thus fractures, which were severe about three times out of four, had the highest rate of any severe injury, 15.7 per 1,000 per year, although the overall fracture rate ranked only sixth in frequency. Lacerations, which were severe only about one time in seven, ranked after fractures with a rate of severe injuries of 9.2. All other rates for severe injuries were less than 5.0 (table 6).

The head was the part of the body injured most frequently (table 7). The accident rate for head injuries was 83.8 per 1,000 per year, followed by hand injuries 46.5, leg 36.9, foot 28.3, and arm 26.7. Rates for internal, lower and upper trunk, and neck injuries were each less than 12.0. Among severe injuries, the highest rate was for those affecting the arm 9.3, followed closely by those affecting the head 8.4, the hand 8.3, and the leg 7.4.

Unfortunately, the medical records were not as complete on the type of accident as on diagnosis of the injury itself. For one-fifth of the injuries, there was no entry at all about the accident that caused the injury. The rates in table 8 are based on those injuries for which we had information, and therefore they underestimate the actual incidence of the various accidents in the population.

Falls ranked first as a cause of accidental injuries, with a rate of 56.8 per 1,000 per year, followed by accidents resulting from contact with sharp or rough objects, 29.2. Collisions with persons or objects (other than vehicles in motion), dog bites, being struck by a falling, flying, or thrown object, and accidents involving bicycles or other pedal vehicles ranked next in that order. For severe injuries, falls again ranked highest with a rate of 11.9. Rates for severe injuries from all other types of accidents were each less than 4.0.

Excluding physician care while children were hospitalized, all medically treated injuries required an average of 1.6 visits to physicians, varying from a high of 3.4 visits for fractures to a low of 1.1 for poisonings. Variations in number of visits according to specific parts of the body injured and by type of accident were not as great (tables 6, 7, and 8).

Although only 2.6 percent of all nonfatal accidents resulted in hospitalization (an annual

Table 7. Part of body affected in medically attended injuries—annual rates per 1,000 children for all injuries and for severe injuries, and three measures of severity for each part of body affected

Part of body	Rates [1]		Percent severe in category	Average number of physician visits	Percent in category resulting in hospitalization
	All injuries	Severe injuries			
Head	83.8	8.4	10.1	1.5	2.6
Hand	46.5	8.3	17.8	1.6	1.5
Leg	36.9	7.4	19.9	1.8	3.6
Foot	28.3	3.1	11.1	1.4	1.0
Arm	26.7	9.3	34.6	2.2	7.1
Internal	11.9	.9	7.4	1.1	6.7
Lower trunk	10.6	1.3	12.5	1.4	4.6
Upper trunk	9.8	2.4	24.7	1.8	5.2
Neck	2.9	.5	18.8	1.6	7.6
All injuries [2]	246.1	37.4	15.2	1.6	2.6

[1] Rates are standardized for age for the 8,874 study children.

[2] Rates for the 9 parts of body add to more than the rate for "All injuries" since injuries affecting more than 1 part of the body are entered in all appropriate categories. Also, those few cases for which part of body affected was not ascertained are included in the "All injuries" figures.

rate of 6.4 per 1,000 children), the proportion of children hospitalized varied from 34.8 percent for concussions, 16.7 percent for pedestrian-motor vehicle accidents, and 14.4 percent for fractures to a low of less than 1 percent each for sprains or strains, perforation injuries, accidents involving contact with sharp objects, and for dog bites. Victims of poisonings, events which rarely entailed more than one visit to a physician, were hospitalized in 7.6 percent of the occurrences (tables 6, 7, and 8).

Specific injuries by age and sex. To some extent, age and sex are related to rates for specific injuries in the same way that they are related to overall injury rates. As documented previously, overall injury rates were higher for boys than for girls; the rates for boys increased with age, and those for girls decreased. These general trends, however, did not always hold true for certain specific types of injury, injuries to particular parts of the body, and certain types of accidents.

The age of the child strongly influenced the type of injury he experienced (table 9). For boys and girls combined, the rate of burns declined sharply after the first 4 years of life, and that of poisonings declined even more. The rate of lacerations remained relatively constant through the first 8 years and then decreased rapidly, so the rate of the 12–15 group was about half of what it was before age 8. On the other hand, the rate of fractures quadrupled from the first to the fourth period of life, and that of sprains and strains went up nearly seven times. In fact, by the age period 12–15 years, sprains and strains became the most frequent injury sustained, while lacerations dropped from first to third place.

When only rates for severe injuries are considered, relationships between age and type of injury are essentially similar to those reported for all injuries. An exception is that the rates for severe lacerations did not decrease sharply with age (data for severe injuries not shown).

Sex, unlike age, had little bearing on the type of injury. The major deviation from the overall rate pattern was that, up to the age of 12, the sprain and strain rate for girls was about the same as that for boys, despite the lower overall injury rate for girls compared to boys.

Table 8. Type of accident resulting in medically attended injuries—annual rates per 1,000 children for all injuries and for severe injuries, and three measures of severity for each type of accident

Type of accident	Rates [1]		Percent of type severe	Average number of physician visits	Percent of type resulting in hospitalization
	All injuries	Severe injuries			
Fall	56.8	11.9	21.0	1.8	4.5
Contact with sharp or rough object	29.2	2.6	8.8	1.4	.7
Collision with person or object except vehicle in motion	22.7	3.6	16.0	1.6	2.2
Dog bite	13.4	.6	4.8	1.2	.2
Struck by falling, flying, or thrown object	10.2	2.1	20.2	1.7	2.7
Bicycle or other pedal vehicle	9.5	2.7	28.7	2.0	6.5
Caught in, pinched, crushed	8.2	1.3	15.2	1.6	1.3
Contact with hot object or substance	6.7	2.0	29.8	2.1	3.5
Motor vehicle	6.2	1.2	19.5	1.7	9.7
Occupant	4.4	.7	15.9	1.5	6.4
Pedestrian	1.8	.5	28.6	2.1	16.7
Ingestion of poison [2]	6.2	.5	7.3	1.1	6.8
Suffocation	5.8	.4	6.6	1.2	5.2
All injuries [3]	246.1	37.4	15.2	1.6	2.6

[1] Based on only those injuries with information as to type of accident. Since for fully one-fifth of the injuries the accident type was unknown, rates underestimate actual incidence of accidents in the study population. Rates are standardized for age for the 8,874 study children.

[2] Includes all cases of actual or suspected aspiration or ingestion of poisonous substances.

[3] The data presented for "All injuries" include miscellaneous accidents as well as those for which information was not obtained.

Table 9. Nature of medically attended injuries by sex for each age period—annual rates per 1,000 children

Nature of injury and sex	Age period (years)			
	0–3	4–7	8–11	12–15
Laceration				
Both sexes	76.4	82.8	55.7	39.9
Boys	92.4	105.8	74.9	59.9
Girls	58.6	57.6	34.7	18.5
Contusion				
Both sexes	45.2	43.8	46.5	46.1
Boys	52.3	53.2	55.8	62.8
Girls	37.3	33.5	36.3	28.4
Sprain or strain				
Both sexes	9.4	14.4	36.8	62.2
Boys	9.9	14.5	36.8	79.4
Girls	8.9	14.3	37.0	43.8
Abrasion				
Both sexes	23.8	32.8	31.1	23.8
Boys	25.8	36.9	37.4	33.8
Girls	21.5	28.4	24.2	13.2
Perforation				
Both sexes	9.8	24.1	29.1	23.5
Boys	9.7	29.8	39.8	28.0
Girls	9.9	17.8	17.4	18.8

Nature of injury and sex	Age period (years)			
	0–3	4–7	8–11	12–15
Fracture				
Both sexes	8.5	16.6	26.1	34.3
Boys	9.0	18.9	30.1	52.7
Girls	7.9	14.1	21.0	14.6
Burn				
Both sexes	22.4	6.0	5.1	4.4
Boys	25.0	6.9	5.9	5.5
Girls	19.5	4.9	4.3	3.1
Poisoning				
Both sexes	16.7	1.6	.8	.3
Boys	20.0	1.7	1.0	.3
Girls	12.9	1.5	.5	.3
Concussion				
Both sexes	1.2	3.0	2.5	2.0
Boys	1.4	3.8	4.0	3.2
Girls	1.0	2.0	.9	.8
All injuries				
Both sexes	252.0	243.1	247.5	242.0
Boys	287.8	288.7	302.5	328.6
Girls	212.5	192.9	187.0	146.6

NOTE: Rates are based on the 8,874 study children. See table 2 for number in each age group. The sum of the rates for the 9 injuries does not equal that for "All injuries" because "All injuries" includes some relatively rare ones as well as cases in which the medical record indicated no evident symptom of injury or contained no entry about kind of injury. Also, in a few instances, a child's accident was classified in 2 or more injury categories.

The age of the child also was a factor in determining the site of the injury (table 10). Rates for head injuries dropped sharply between the first 4 years of life and ages 12 through 15. Rates for internal injuries, usually the result of poisonings, also decreased with age but showed the sharpest decline after the first 4 years of life. By contrast, rates for leg injuries and, to a lesser extent, rates for foot, hand, and arm injuries increased with age. Rates for severe injuries generally showed similar trends, except that the rate for severe head injuries showed a less drastic decrease with age than did the overall head injury rate (data for severe injuries not shown).

As age increased, the rates of injuries affecting the lower half of the body (below the waist) increased sharply for both boys and girls. The rates for injuries affecting the upper part of the body remained relatively constant over time for boys but declined markedly for girls. Thus, by the age period 12–15 years, boys had a rate for below-the-waist injuries only 60 percent as high as that for above-the-waist injuries. By contrast, the girls' rate for below-the-waist injuries in the same age period was actually slightly higher than that for above-the-waist injuries. In early adolescence, the injury rate for boys compared with girls was about three times as high for upper trunk, head, and hand injuries (all above the waist), while girls had nearly the same rate as boys for foot injuries.

Rates by type of accident also showed several differences from the general injury rate pattern. As children grew older, accidents caused by falls,

suffocation, ingestion of poison, and contact with hot objects decreased, while those resulting from collisions, contact with sharp objects, and being struck by flying, falling, or thrown objects increased. Bicycle accidents and dog bites happened more frequently in the age groups 4–11 years than at other ages. Few differences from the overall pattern were noted by sex, except that boys had more than their share of bicycle accidents (data not shown).

Discussion

Our study data provide a comprehensive picture of the medically attended injuries sustained over long periods of time by children enrolled in a prepaid medical health plan. Thus, our results should be useful to staffs of the growing number of similar health plans throughout the country.

The data, however, may have even broader relevance and application, for they correspond closely to cross-section data for the United States as a whole, published by the National Health Survey (*8a*). The annual medically attended injury rates per 1,000 children for the Kaiser Health Plan children (birth–15 years) and for children in the National Health Survey (birth–16 years) are as follows:

Sex	*Kaiser children*	*National Health Survey children*
Both sexes	246. 1	258. 5
Boys	301. 9	301. 9
Girls	184. 8	213. 3

(These Kaiser plan rates were standardized for age for the 8,874 study children. We calculated weighted averages of the National Health Survey rates for the two age groups that it uses (0–5 and 6–16 years) to make its survey data as comparable as possible to the data from our study.)

The two sets of data are also very similar when compared according to demographic variables. In the National Health Survey, as in our study, boys showed the lowest rates of injury during the first years of life, while girls showed their lowest injury rates during their teens (personal communication dated March 9, 1965, from G. A. Gleeson, chief, Analysis and Reports Branch, Division of Health Interview Statistics, National Center for Health Statistics, Public Health Service).

The reason why our rates are lower among Negro children, both for all and for severe injuries, is not clear. The result is the more perplexing because Negro children have higher death rates due to accidents than white children (*13*). Our data did not support the hypothesis that the morbidity rates for Negro children were lower because their parents were less disposed to take them to the physician for minor injuries than parents of white children. It is, of course, possible that Negroes in our sample were not typical of Negroes in general. Those in our sample belonged to a prepaid medical plan and probably came from higher socioeconomic groups than a cross-section of United States Negroes. Yet the National Health Survey cross-section data also reflect generally lower injury rates for nonwhite children according to Gleeson. Clearly, further research is needed on the environmental, psychological, and sociological factors which might reconcile the apparently incompatible data on morbidity and mortality.

A major contribution of the present study is to provide detailed data on the extent of accident repeatedness among children. The theory that some persons are accident prone has been criticized on the ground that there is little consistency in the accident experience of individuals from one period to the next (*14*). Schulzinger, for example, has been widely quoted to the effect that accident repeaters are ". . . essentially a shifting group of individuals with new persons constantly falling in and out of the group" (*17*). If susceptibility to having accidents (accident liability) is an essentially unstable or transitory phenomenon, it clearly is not subject to scientific study. Our data, however, do not support this conclusion. We found that children who had three or more injuries in one 4-year period had an average injury rate 75 to 100 percent higher in the following period than children who were accident free in the first period. This result clearly suggests that accident liability continues to be relatively high among children who were accident repeaters in one period, even though some repeaters turn out to have few or no accidents in a later period. (Inasmuch as accident liability denotes the probability of having accidents, a person could be

Table 10. Part of body affected in medically attended injuries by sex for each age period—annual rates per 1,000 children

Part of body and sex	Age period (years)			
	0–3	4–7	8–11	12–15
Head				
Both sexes	119.8	105.6	66.5	42.9
Boys	138.5	133.1	91.4	63.6
Girls	99.1	75.5	39.3	20.8
Hand				
Both sexes	39.1	37.9	47.9	60.7
Boys	47.2	47.3	59.6	88.6
Girls	30.2	27.5	35.1	30.9
Leg				
Both sexes	15.8	28.8	45.1	57.7
Boys	17.4	30.1	50.6	77.3
Girls	13.9	27.4	39.2	36.8
Foot				
Both sexes	16.4	25.6	35.7	35.4
Boys	18.4	29.7	42.4	38.0
Girls	14.3	21.1	28.3	32.6
Arm				
Both sexes	18.7	24.2	34.1	29.7
Boys	20.5	26.3	37.8	42.2
Girls	16.8	21.9	30.1	16.3
Internal				
Both sexes	35.4	8.1	2.6	1.5
Boys	41.0	8.2	2.6	1.8
Girls	29.2	8.0	2.6	1.1
Lower trunk				
Both sexes	7.9	11.6	11.1	11.7
Boys	7.4	11.9	11.2	15.0
Girls	8.4	11.2	11.0	8.1
Upper trunk				
Both sexes	8.1	7.8	10.8	12.5
Boys	9.1	8.9	13.7	19.3
Girls	6.9	6.7	7.6	5.3
Neck				
Both sexes	2.1	3.1	3.3	3.1
Boys	2.3	3.9	3.4	3.7
Girls	1.8	2.3	3.2	2.5
All injuries				
Both sexes	252.0	243.1	247.5	242.0
Boys	287.8	288.7	302.5	328.6
Girls	212.5	192.9	187.0	146.6
Above waist				
Both sexes	187.8	178.6	162.6	148.9
Boys	217.6	219.5	205.9	217.4
Girls	154.8	133.9	115.3	75.8
Below waist				
Both sexes	40.1	66.0	91.9	104.8
Boys	43.2	71.7	104.2	130.3
Girls	36.6	59.7	78.5	77.5

NOTE: Rates are based on the 8,874 study children. See table 2 for number in each age group. Rates for the 9 parts of body add to more than the rate for "All injuries" since injuries affecting more than 1 part of the body are entered in all appropriate categories. Also, the few injuries for which part of body affected was not ascertained are included in "All injuries."

accident free in a given period even though his liability was relatively high.)

In short, the relationship between the number of accidents incurred in successive periods is sufficiently high to justify selecting groups of children on the basis of their previous accident experience in order to identify factors associated with accident liability.

We also recognized the possibility that our data on accident persistency might be explained by differences among mothers in their predisposition to seek medical care for their children. The hypothesis, however, was not supported by our data.

The relationship of birth order to a child's personality and behavioral characteristics has aroused interest in recent years (*18*, *19*). To our knowledge, no study has investigated this factor in respect to accidents. In relating ordinal position to medically attended injury rates, we found that children with no older siblings had more injuries during the first few years of life than children with older siblings, but that this pattern reversed for the teen years.

There is ample reason to believe that parents' behavior and expectations are different with respect to first children than the children born later. There is also evidence that the personality and behavior characteristics of first-born children differ as a consequence. The rela-

tionships reported to date, however, are complex and not always consistent from one study to the next. Thus, our data, although intriguing, are not readily interpretable given the present state of knowledge concerning the psychological implications of birth order.

Our data would be even more useful if they included detailed information on the circumstances leading up to each accident. Unfortunately the available medical records contained only limited information on these circumstances. For certain types of accidents, however, it was possible to retrieve additional data from the medical files. For example, in one small study, we extracted all records of burns suffered by young children so that we could discover the extent to which floor heaters constitute a hazard to the young child (*20*).

Summary

An analysis was made of the medical records of 8,874 children whose families belonged to the Kaiser Foundation Health Plan. For the first 16 years of life, the rate for all medically attended, nonfatal injuries was 246.1 per 1,000 children per year. Excluding the 2.6 percent of nonfatal accidents that resulted in hospitalization, other nonfatal injuries required, on the average, 1.6 physician visits. Boys had more medically attended injuries than girls at all ages, and their injury rate went up with age, whereas for girls the rate went down.

Negro and Oriental children had lower rates for medically attended injuries than white children. Even after we controlled for occupation of the parent, race appeared to be an important indicator of medically attended injuries. The data clearly showed evidence of accident persistency. Children with higher accident rates in one period of their childhood tended to have higher rates in subsequent periods. The data did not support the possibility that differences in mothers' predispositions to seek medical care for their children might explain the differences observed in injury rates between racial groups or in accident persistency.

For the first 4 years of life, children with one or more older siblings had somewhat lower accident rates than children with no older siblings. The pattern reversed in the teen years.

Lacerations were the most common injury. Among severe injuries, however, the most frequent type was fractures. The part of the body most often injured was the head, but arms were the most frequently affected in severe injuries. Falls were the most frequent cause of all injuries, also of severe injuries. Kind of injury, part of body affected, and type of accident were also examined by age and sex. A larger proportion of the injuries to girls than to boys affected the lower half of the body. This difference between the sexes was particularly marked in the teen years.

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Public Health Service Staff Appointments

Dr. Richard A. Prindle has been appointed Assistant Surgeon General of the Public Health Service in charge of the Bureau of State Services. Dr. Prindle has been chief of the Division of Public Health Methods since April 1963.

Born in Mansfield, Ohio, Dr. Prindle was graduated from the Harvard Medical School and the Harvard School of Public Health. He entered the Public Health Service as an epidemic intelligence officer in 1951 after a year's fellowship at Harvard.

From 1954 to 1957, Dr. Prindle was medical officer of a Division of International Health mission to Haiti. He was chief of program services section, Air Pollution Medical Program, 1957–60; and deputy chief of the Division of Air Pollution, 1960–63.

Dr. Prindle has received the Meritorious Service Medal of the Public Health Service and the National Defense Service Medal. He is a member of the American Medical Association, American Public Health Association, American Association for the Advancement of Science, American College of Preventive Medicine, and is a diplomate of the American Board of Preventive Medicine.

John H. Kelso has been appointed executive officer of the Public Health Service. Mr. Kelso has been assistant executive officer of the Bureau of State Services (Environmental Health) since 1962.

Born in Iowa City, Iowa, Mr. Kelso received his M.A. from the University of Iowa. He joined the staff of the Service in 1957.

Mr. Kelso is a member of the American Society for Public Administration and the Society for the Advancement of Management.

Dr. Erwin S. Rabeau has been named chief of the Division of Indian Health, succeeding Assistant Surgeon General Carruth J. Wagner, who became chief of the Bureau of Medical Services.

Born in Madison, S. Dak., Dr. Rabeau received his bachelor's degree and his medical degree from the University of Chicago. Following an internship at Grand Central Hospital in New York City, he was commissioned by the Public Health Service in 1946 and assigned as medical officer in charge of Public Health Service Alaska Native Hospitals in Tanana, Barrow, and Kotzebue. He was clinical director of the Service's Anchorage Medical Center and then deputy area medical officer in charge for Alaska. He has also served as Indian Health area director in the Aberdeen, S. Dak., area.

Dr. Rabeau was certified in hospital administration by the Federal Hospital Interagency Council in 1962 and in management by the American Management Association in 1963. He is a Fellow of the American Public Health Association and a member of the American Medical Association, Association of Military Surgeons, American Management Association, and National Association of Sanitarians.