Ability of parents to recall the injuries of their young children

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Objective: To estimate the ability of parents to recall the injuries of their children.
Design: Comparison of parent recall with computerized medical records.
Setting: A health maintenance organization in Washington State during 2003.
Subjects: Parents of children younger than 6 years.
Main outcome measures: The ratio of recalled injuries to injuries in computerized data.
Results: Telephone interviews were completed with a parent of 1672 young children who had computerized medical data for at least one injury in the last year. Counting the three most recent treated injuries, the 1672 children had 1896 separate new injuries in the year before interview and parents recalled 1150 of these: recall ratio 0.61 (95% confidence interval (CI) 0.58 to 0.63). The recall ratio decreased from 0.82 (95% CI 0.79 to 0.85) for injuries one day before interview to 0.37 (95% CI 0.32 to 0.40) at 365 days before interview. For 341 major injuries the recall ratio was 0.80 (95% CI 0.76 to 0.84), for 202 minor injuries treated in an emergency department or hospital it was 0.77 (95% CI 0.71 to 0.82), for 597 minor injuries treated in urgent care it was 0.70 (95% CI 0.65 to 0.73), and for 756 minor injuries treated in a clinic it was 0.43 (95% CI 0.39 to 0.47).
Conclusions: Recall decreased with time. Recall was best for major injuries, intermediate for minor injuries treated in a hospital, emergency department, or urgent care center, and worst for minor injuries treated in a clinic.

I n some studies it may be useful to ask parents to recall the injuries of their children. The National Children's Study is being planned with the goal of following 100 000 children from birth to age 21 years.[1] In that study parents will be asked periodically about the health of their children. Estimates of injury occurrence may be biased if recall is not accurate. Estimates of association between an exposure and injuries may be biased if recall varies with time since injury or with other factors.

To study the ability of parents to recall the injuries of their children younger than 6 years, we sampled children who had computerized information for a medical visit for a new injury within the last year. A parent was interviewed by telephone and asked about the child's medical visits for injuries in the last year. We estimated how recall of treated injuries varied by time since the injury and other factors.

SUBJECTS AND METHODS
Study population
We studied members of Group Health Cooperative, a non-profit health maintenance organization in Washington. Nearly all medical care utilization can be tracked in computerized records. Even if members use services outside of Group Health, information from submitted bills is entered into computerized data.

Study sampling criteria
Children were randomly sampled from Group Health computerized utilization data if they: (1) were Group Health members for at least a year or since birth; (2) were members when sampled; (3) were alive; (4) had medical care for an injury in the 365 days before sampling; (5) were younger than 5 years plus 340 days, so they would be younger than 6 years when the parent was interviewed. An injury was defined as a diagnosis code from the *International Classification of Diseases, 9th revision, clinical modification*[2] in one of the following ranges: (1) 800–904; (2) 910–929; (3) 940–957. External cause of injury codes were not used to select records.

Survey questions
For each selected child, our goal was to interview the parent or other adult caregiver and ask them to recall all new injuries in the past year that involved a medical visit. Injury was defined as cuts, punctures, scrapes, bruises, fractures, burns, but not poisonings. Caregivers were asked about the date of the three most recent treated injuries.

Participation
A letter was sent to tell parents about the study and allow them to decline further contact. After 10 days, attempts were made to reach the parents by telephone. Up to 12 calls were made over 14 days.

Starting in February 2003, children were randomly sampled weekly without replacement for 21 weeks. For the last three weeks we sampled all children who were still eligible. Interviews stopped on August 11.

Of 2807 children sampled, interviews were not completed because of sampling errors (85), death (1), serious illness (1), language barriers (45), refusals (494), the family was located but never completed the interview (188), the family could not be located (185), and the interviewing window had passed (12). There were 1796 completed interviews, 66% of all subjects who were or may have been eligible.[3]

Interviewed parents gave us verbal consent. Study procedures were approved by the Human Subjects Review Committee of the Group Health Cooperative Center for Health Studies.

Definition of a new injury
Each child's computerized records were sorted by visit date for the two years before parent interview. For each visit we identified the first diagnosis code that fit our injury definition; records may have 15 codes. We considered a visit to not be for a new injury if (1) a code was present for late effects of injury (905–909); (2) a code indicated aftercare (V50–V59); (3) the time from the previous visit was less than 41 days and the first injury code had the same first three

digits on both visits; or (4) the time from the previous visit with any injury code was less than 10 days. If the time between injury visits was shorter than 41 days, we reviewed all the injury codes by date and made further decisions. For example, if a child had a code for a sprained ankle, and returned three days later with a code for a fractured ankle, we considered these to represent the same injury.

There were 45 children with diagnosis code 839 for other and ill defined dislocations. Most codes had fourth digits for spinal dislocations and were from chiropractor visits. We felt these were not likely to represent new injuries and visits were not considered injury related solely for this code.

Our new injury definition eliminated 124 children with interviews, leaving 1672 children with interviews and utilization data for at least one new injury in the previous 365 days.

Variables that might affect recall

We wished to know if recall might be related to child age, child sex, age of interviewed adult, number of children in the home, household income, and education of the interviewed adult. We did not ask about the sex of the respondent. For analyses we categorized treatment place in a hierarchy from highest service intensity to lowest: emergency department or hospital, urgent care, primary care clinic. If a child went to more than one of these for the same injury, that injury was assigned to the highest level used by that child.

Injury type was categorized in a hierarchy from highest level of seriousness to lowest: (1) brain and internal injuries (codes 800–829); (2) fractures and dislocations (codes 800–829, 830–831, 833–838); (3) burns (codes 940–949); (4) open wounds (codes 870–897); (5) bruises and crushing (codes 910–929, 950–959); (6) sprains, including radial head subluxation (codes 831, 840–848). The first injury diagnosis code was used to categorize injuries. If this code varied between visits the injury was assigned to the highest category. For analyses of recall by injury type, we collapsed these groups into major injuries (groups 1–3) and minor injuries (groups 4–6).

Statistical analysis

We estimated the proportion of new child injuries with a medical visit in the past year that could be recalled by an adult. Logistic regression was used to estimate the change in this proportion with time.[4] This analysis used the time to each of the three most recent new injuries in the year before interview; only four children had more than three separate new injuries in the visit data and only two parents reported a child with more than three new injuries. We used main effects terms and interaction terms to test whether the proportion of injuries recalled varied by other factors; models with additional terms were compared with reduced models using the likelihood ratio test, the Hosmer-Lemeshow test,[4] and Akaike's Information Criteria.[5] Fractional polynomials and generalized additive models were used to search for evidence that a line other than linear on the log odds scale produced a better fit to the data[6–8]; we found no such evidence.

The count of the three most recent reported injuries in the previous 365 days was divided by the count of the most recent three new injuries in the computerized data; we used exact Poisson confidence intervals (CIs) for this rate ratio.

For respondents who recalled up to three injuries, we used a paired t test to compare (1) the days from the interview to the injury date reported by the parent with (2) the days from interview to the first visit for that injury in the utilization data. For 56% of recalled injuries, adults could report the month and year, but not the day; for those records we assigned the day of the month as the 15th, resulting in a

usable date for 93% of recalled injuries. Some injuries close to 365 days in the past might have been remembered as being more than 365 days in the past and therefore were not reported to us at all, as we asked about injuries only in the past year; if this occurred, our analysis would find a shorter time from interview to reported injury date compared with the time from interview to medical visit date, even if there were no actual difference in the two time intervals. Therefore we repeated this analysis using only injury visits that occurred within the most recent 300 days, as even injuries remembered as being somewhat further in the past might still be recalled as being within the past year.

Two adults reported information about more than one child in the same family. There were 193 (12%) children with two or three new injuries with a medical visit. We used a family identifier and a robust (sandwich) variance estimator to relax the assumption that outcomes within the same family were independent.[9] We used Stata statistical software.[10]

Table 1 Characteristics of 1672 study children with a record of an injury in the previous year, adult respondents, and households

	Total (n = 1672) No (column %)	Respondent did not recall injury (n = 579) No (row %)	Respondent did recall injury (n = 1093) No (row %)
Child age (years)			
<1	63 (4)	30 (48)	33 (52)
1–<2	239 (14)	78 (33)	161 (67)
2–<3	372 (22)	116 (31)	256 (69)
3–<4	347 (21)	128 (37)	219 (63)
4–<5	343 (21)	127 (37)	216 (63)
5–<6	308 (18)	100 (32)	208 (68)
Child sex			
Female	736 (44)	258 (35)	478 (65)
Male	936 (56)	321 (34)	615 (66)
Respondent's age (years)			
18–30	497 (30)	179 (36)	318 (64)
31–40	913 (55)	301 (33)	612 (67)
41–67	256 (15)	99 (39)	157 (61)
Respondent's relationship to child			
Birth parent	1615 (97)	557 (34)	1058 (66)
Other	56 (3)	22 (39)	34 (61)
Respondent's education			
High school or less	235 (14)	89 (38)	146 (62)
Some college	689 (41)	243 (35)	446 (65)
College graduate	429 (26)	151 (35)	278 (65)
Postgraduate	317 (19)	95 (30)	222 (70)
Respondent's marital status			
Single	164 (10)	64 (39)	100 (61)
Married	1284 (77)	430 (33)	854 (67)
Living as married	102 (6)	42 (41)	60 (59)
Divorced, separated, or widowed	121 (7)	43 (36)	78 (64)
Number of children in household			
1	468 (28)	171 (37)	297 (63)
2	737 (44)	260 (35)	477 (65)
≥3	467 (28)	148 (32)	319 (68)
Household income (thousands $)			
<50	686 (43)	259 (38)	427 (62)
50–74	457 (28)	140 (31)	317 (69)
≥75	461 (29)	155 (34)	306 (66)

Table 2 Characteristics of the most recent three injuries (n = 1896) in the year before interview for the 1672 children with a computerized record of an injury

Characteristic	Total (n = 1896) No (column %)	Respondent did not recall injury (n = 746) No (row %)	Respondent did recall injury (n = 1150) No (row %)
Place of treatment			
Clinic	885 (47)	455 (51)	430 (49)
Urgent care	715 (38)	210 (29)	505 (71)
Emergency department	232 (12)	58 (25)	174 (75)
Hospital outpatient	41 (2)	12 (29)	29 (71)
Hospital inpatient	23 (1)	11 (48)	12 (52)
Type of injury			
Brain, internal	24 (1)	11 (46)	13 (54)
Fracture	216 (11)	35 (16)	181 (84)
Burn	101 (5)	30 (30)	71 (70)
Total, major	*341 (18)*	*76 (22)*	*265 (78)*
Open wound	565 (30)	143 (25)	422 (75)
Bruise, crush	778 (41)	449 (58)	329 (42)
Sprain	212 (11)	78 (37)	134 (63)
Total, minor	*1555 (82)*	*670 (43)*	*885 (57)*

Table 3 Counts for 1672 children according to the number of injuries in the previous year: reported number of injuries with a medical visit and new injuries from medical utilization data

No of injuries	Reported medical visit	Injury visit in utilization data
0	577	0
1	983	1477
2	99	166
3	13	25
4	*	2
5	*	2
6	*	0
Total children	1672	1672
Total injuries	1220	1902

*Questions were not asked about more than three new injuries with a medical visit.

Figure 1 Plot of the proportion of child injuries with a medical visit recalled by a parent according to days since the first visit for each injury. The line is from logistic regression with shaded pointwise confidence intervals. The X symbols are the actual proportions for each month of the data.

RESULTS

Description

Mean age of the 1672 injured children was 3.5 years and 56% were male (table 1). For 97% of the children the respondent was a birth parent. Mean adult respondent age was 34 years, 45% finished college, and 77% were married. Households had from one to nine children with a mean of 2.2. Most households (57%) earned over $50 thousand dollars a year.

The count of the three most recent injuries for the 1672 children was 1896. Nearly half of these injuries involved only a clinic visit, 38% were treated in urgent care, 12% were treated in an emergency department, and 3% had a hospital outpatient visit or inpatient stay (table 2). Most injuries (82%) were classified as minor.

Recall of any new injury

Almost two thirds of the respondents reported at least one child injury with a medical visit in the past year: 1093/1672 = 0.65 (95% CI 0.63 to 0.68). Using information about the three most recent injuries, adults reported 1220 separate child injuries with a medical visit in the year before interview (table 3). In the utilization data there were 1477 children with one injury in the previous year, 166 with two injuries, and 29 with three or more injuries, for a total of 1896 new first, second, or third injuries. The rate ratio of reported to observed injuries was 1220/1896 = 0.64 (95% CI 0.61 to 0.68).
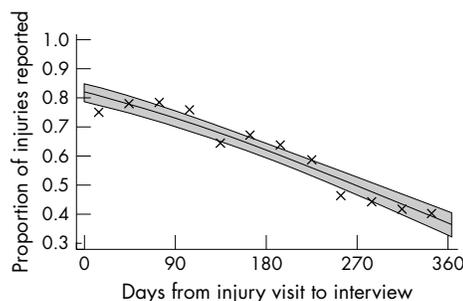
Variation in recall with time

Using information about up to three new injuries in the year before the interview, the proportion of injuries recalled was 1150/1896 = 0.61; this was less than the rate ratio of 1220/1896 = 0.64 for injury counts in table 3, because table 3 included 70 reported second or third injuries that had no corresponding new second or third injury in the utilization data. The smoothed plot (fig 1) of recall by time since injury visit estimated the proportion recalled as 0.82 (95% CI 0.79 to 0.85) at time 0 and 0.37 (95% CI 0.32 to 0.41) at time 365 days.

Recall varied by place of treatment and whether the injury was minor or not (fig 2). Both variables were related to recall: $p < 0.001$ for tests of main effects terms. However there was little evidence that the change in recall with time varied with these terms. Model fit was best when interactions were

allowed between treatment place and injury severity, and major injuries were grouped together, regardless of treatment place.

There was little evidence that recall varied by child age, child sex, respondent's age, respondent's marital status, number of children in the home, or yearly household income. There was evidence that recall was better if the adult respondent had more years of education ($p = 0.02$), but that association made so little difference to the plots in fig 2 that we do not present those results.

Using the plots of fig 2, we created estimates of the proportion of injuries recalled for time from injury to interview of 0, 15, 46, 91, 137, 183, and 365 days. The estimates for 0 and 365 days are for the ends of the plotted curves. The other times correspond to points on the curves that estimate the recalled proportions if respondents were asked about injuries in the previous one, three, six, nine, or 12 months (table 4).

Recall of injury date

Among the 1068 recalled injuries with a reported injury date, the mean reported time from interview to injury was 154 days and the mean time from interview to visit in the utilization data was 157 days: mean difference −4 days (95% CI −8 to +1). Limiting this analysis to 935 injuries within 300 days of interview in the utilization data, the respective mean times were 135 days and 132 days: mean difference +2 days (95% CI −2 to +6).

DISCUSSION

Parents could recall 61% of the injuries to their young child that were in computerized medical records in the previous
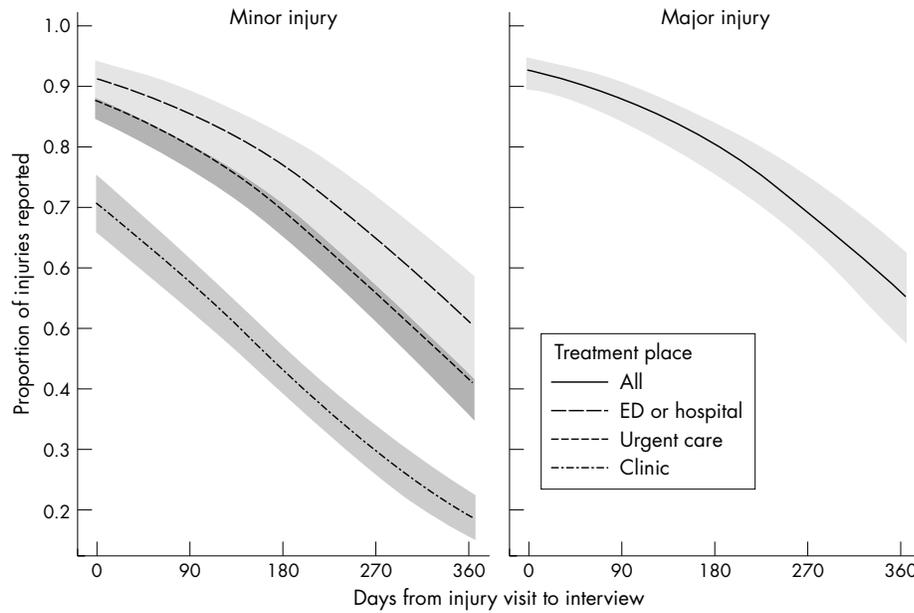
Figure 2 Plot of the proportion of child injuries with a medical visit recalled by a parent according to the days since the first visit for each injury, the place of treatment, and whether the injury was major or minor. Proportions are from logistic regression. Shaded areas cover the pointwise confidence intervals for each line (ED, emergency department).

year. About 80% of all major injuries treated in the previous year were recalled. Recall was intermediate, 70% to 77%, for minor injuries treated in urgent care, an emergency department, or a hospital. Recall was worst, 43%, for minor injuries treated only in a clinic.

A limitation of our study is that there could be errors in the computerized utilization data. Some children might have visit codes for an injury when the actual visit was for a non-injury problem. Studies of Group Health automated data, compared with written medical records, reveal some errors, but a generally high degree of accuracy.[11–13]

There might also be errors in our method of determining which visits represented a new injury. However, 71% of the children had only one injury with a medical visit in the previous year and 87% had only one or two such injuries. Therefore misclassification regarding a new injury date or the presence of a new injury would affect only a small portion of our data.

Reporting an injury and recall of an injury are not the same. Some parents may have recalled an injury, but chose not to report it in the telephone interview. It is possible that different questions might have revealed additional injuries.

Only 66% of eligible parents agreed to participate in the study. Our results best reflect what cooperative parents voluntarily reported after consent using our study questions.

Cash and Moss studied the recall of 377 persons who were in a motor vehicle crash in 1966–67 in North Carolina and were classified as injured on the police report.[14] If the crash

was within three months of the interview, 99% of subjects recalled a crash and 87% (95% CI 77% to 94%) reported an injury. If the crash was nine to 12 months in the past 78% recalled a crash and 63% (95% CI 52% to 73%) reported an injury. Overall recall of an injury for a one year interval was 75% (95% CI 70% to 79%). Injuries with bleeding or limb distortion were more likely to be reported compared with less obvious injuries. The overall reporting of injuries in the study by Cash and Moss was similar to what we found for our intermediate recall group.

Harel *et al* analyzed data from the 1988 National Health Interview Survey regarding injuries to children.[15] Adults were asked to recall the injuries of their children that involved a medical visit. For children 0–4 years, the reported injury rate based on a one month recall period was 27 per 100 child-years and the rate for a 12 month recall period was 12. In Harel's study, as in ours, recall declined less steeply for more severe injuries and injuries involving a hospitalization.

Mock *et al* conducted a survey in Ghana and analyzed 1534 injuries reported by 21 105 respondents.[16] For 2537 children age 0–4 years, the rate based upon a recall period of one month was 24.3 per 100 person-years, compared with 6.1 for a 12 month recall period, a 75% decline in reported incidence.

When rates from one month recall intervals were compared with rates from 12 month intervals, the decline in reported injury incidence was 56% in the National Health Interview Survey[15] and 75% in the survey from Ghana.[16] These declines were steeper than the change in proportion of injuries

Table 4 Proportion (95% CI) of injuries recalled by months since first visit for each new injury, whether injury was minor or major, and place of injury treatment for minor injuries

Months	Minor: clinic (n = 756; 40%)	Minor: urgent care (n = 597; 31%)	Minor: ED* or hospital (n = 202; 11%)	Major: all places (n = 341; 18%)
0	0.71 (0.66 to 0.76)	0.88 (0.85 to 0.91)	0.92 (0.88 to 0.94)	0.93 (0.91 to 0.95)
0.5	0.69 (0.64 to 0.74)	0.87 (0.84 to 0.90)	0.91 (0.87 to 0.94)	0.93 (0.90 to 0.94)
1.5	0.65 (0.60 to 0.69)	0.85 (0.82 to 0.88)	0.89 (0.85 to 0.92)	0.91 (0.88 to 0.93)
3	0.58 (0.53 to 0.62)	0.81 (0.77 to 0.84)	0.86 (0.81 to 0.90)	0.88 (0.85 to 0.91)
4.5	0.50 (0.46 to 0.54)	0.76 (0.72 to 0.79)	0.82 (0.77 to 0.86)	0.85 (0.81 to 0.88)
6	0.43 (0.39 to 0.47)	0.70 (0.65 to 0.73)	0.77 (0.71 to 0.82)	0.80 (0.76 to 0.84)
12	0.19 (0.15 to 0.23)	0.41 (0.35 to 0.47)	0.51 (0.42 to 0.59)	0.56 (0.48 to 0.63)

These estimates are based on the regression model information that is plotted in Figure 2.
*ED, emergency department.

Key points

- It is not known how accurately parents can recall the injuries of their children younger than 6 years.
- We found that parent recall of the injuries of their children decreased with time from injury to interview.
- Recall was best for major injuries: brain or internal injuries, fractures, dislocations, and burns.
- Recall was intermediate for minor injuries treated at a hospital, emergency department, or urgent care clinic.
- Recall was worst for minor injuries treated in a clinic office.

recalled in our data for the same recall periods (19%) (fig 1). They were also steeper than the 12% decline reported by the North Carolina crash study,[14] comparing three month recall with 12 month recall intervals. All four studies offered evidence that recall decays more steeply for less serious injuries. It is possible that the average injury and its surrounding events were more severe and easier to recall in our study and the North Carolina crash study, compared with the other two studies.

Another possible reason for the observed differences between the studies is that the National Health Interview Study[15] and the study from Ghana[16] relied on two pieces of information: recall of an injury and recall of the approximate date for that injury. Recall would appear to decline more quickly if people reported many injuries as occurring more recently than they actually did, a phenomenon called telescoping.[15] However, we found little evidence of telescoping: the mean reported time from interview to injury was similar to the mean time from interview to the first visit for each injury in the computerized utilization data.

Our results suggest that a six month recall period can be used to identify nearly 90% of major injuries. For minor injuries treated in a hospital, emergency department, or urgent care center, a three month recall period can identify almost 90% of the injuries. For minor injuries treated in a clinic, even the shortest recall periods may identify fewer than 70% of the injuries.

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