ARTICLE

Bruises in Infants and Toddlers

Those Who Don't Cruise Rarely Bruise

Naomi F. Sugar, MD; James A. Taylor, MD; Kenneth W. Feldman, MD; and the Puget Sound Pediatric Research Network

Objectives: To determine the frequency and location of bruises in normal infants and toddlers, and to determine the relationship of age and developmental stage to bruising.

Design: Cross-sectional survey.

Setting: Community primary care pediatric offices.

Subjects: Children younger than 36 months attending well-child care visits.

Methods: Prospective data collection of demographics, developmental stage, and presence and location of bruises. Any medical condition that causes bruises as well as known or suspected abuse was also recorded. A χ^2 test or Fisher exact test was used to determine the significance of differences.

Main Outcome Measures: Presence and location of bruises as related to age and developmental stage.

Results: Bruises were found in 203 (20.9%) of 973 children who had no known medical cause for bruising and in whom abuse was not suspected. Only 2 (0.6%) of 366 children who were younger than 6 months and 8 (1.7%) of 473 children younger than 9 months had any bruises. Bruises were noted in only 11 (2.2%) of 511 children who were not yet walking with support (cruising). However, 17.8% of cruisers and 51.9% of walkers had bruises ($P<.001$). Mean bruise frequency ranged from 1.3 bruises per injured child among precruisers (range, 1-2 bruises) to 2.4 per injured child among walkers (range, 1-11). The most frequent site of bruises was over the anterior tibia and knee. Bruises on the forehead and upper leg were common among walkers, but bruises on the face and trunk were rare, and bruises on the hands and buttocks were not observed at any age. There were no differences in bruise frequency by sex. African American children were observed to have bruises much less frequently than white children ($P<.007$).

Conclusions: Bruises are rare in normal infants and precruisers and become common among cruisers and walkers. Bruises in infants younger than 9 months and who are not yet beginning to ambulate should lead to consideration of abuse or illness as causative. Bruises in toddlers that are located in atypical areas, such as the trunk, hands, or buttocks, should prompt similar concerns.

Arch Pediatr Adolesc Med. 1999;153:399-403

Editor's Note: I don't understand why African American children appeared to have fewer bruises than white children. Surely it can't be simply because the high melanin concentration makes them less obvious (the bruises, not the children).

Catherine D. DeAngelis, MD

From the Department of Pediatrics, Division of General Pediatrics, University of Washington School of Medicine, Seattle. The members of the Puget Sound Pediatric Research Network are listed in the acknowledgment.

CHILDREN COMMONLY sustain minor injuries during the course of normal activity and play. The physician who examines infants and toddlers must routinely evaluate whether injuries, such as bruises and abrasions, are consistent with normal activity or raise concern that a child has been physically abused.

Current medical literature asserts that "in children who are nine months of age or less, any soft tissue injury indicates possible abuse."[1] However, the studies on which this assertion is based either evaluated small cohorts of infants[2,3] or failed to evaluate bruising apart from other skin injuries, such as lacerations, abrasions, or burns.[1,3,4] Wedgewood[2] found that 24% of infants who were walking with support (cruising), but none of the infants who were not yet cruising had bruises. This study included only 19 patients in these 2 developmental groups combined. Pascoe et al[3] compared patterns of skin injury in abused, accidentally injured, and consecutive pediatric patients in an ambulatory clinic. However, of 538 patients

METHODS

OVERVIEW

The study was conducted by the Puget Sound Pediatric Research Network, a practice-based research organization in the Seattle, Wash, area. For the current project, data were collected in 6 private practice offices and 1 inner-city, university-affiliated health center. Efforts were made to include practices that had different ethnic and racial representation in their patient populations.

STUDY DESIGN AND SAMPLE

Participating clinicians were asked to sequentially enroll patients aged between 0 and 35 months who presented for well-child visits. For each enrolled child, the clinician completed a brief study form during or after the medical visit. Demographic information, such as the date of the visit, the patient's birth date, sex, and ethnicity, was recorded. The clinician noted the presence of bruises and, if bruises were present, marked the location of each bruise on a printed body diagram. Clinicians documented whether the patient had a known or suspected medical condition that predisposed the child to bruising or if nonaccidental or abusive injury was suspected.

Finally, the child's developmental stage with respect to ambulation was obtained from the parent or caregiver. Clinicians were not required to validate the parent's report regarding ambulation. Subjects were classified as "precruisers" if they were reported to have no upright ambulation, "cruisers" if they walked holding onto another person's hands or furniture, and as "walkers" if they were able to take 2 or more independent steps.

After the study form was completed, the child's chart was coded with a sticker to ensure that each child was enrolled only once in the study.

DATA ANALYSIS

In the analysis, children with bruises thought to be related to a known medical condition or resulting from reported nonaccidental injury were excluded. Each patient's age was calculated by subtracting the date of birth from the date of the visit. To exclude data that may have been inaccurately recorded, as well as those children who were clearly developmentally delayed, criteria were used to screen the age and developmental stage reports. Age parameters were chosen that represent the outside limits of normal development. Thus, to be eligible for inclusion in the analyses by age and developmental stage, a precruiser was included only if the age was less than 456 days (15 months); a cruiser was included only if the age was between 183 and 547 days (6-18 months); and a walker was included only if the age was greater than 213 days (7 months). The findings in these age- or development-discrepant children were included in all analyses except for those related to age and developmental stage.

The χ^2 test and Fisher exact test were used to evaluate categorical variables; continuous variables were assessed with the Student t test. Logistic regression analysis was performed to determine if race was independently associated with bruising. Differences were considered significant when $P<.05$.

Data forms were anonymous and it was not possible for the researchers to identify individual patients. Because the study procedures were part of the normal well-child examination, no individual consents were obtained. Notices were posted at each office identifying the practice as a participant in the Puget Sound Pediatric Research Network. This study was performed with the approval of the institutional review boards of the Children's Hospital and Medical Center and Virginia Mason Medical Center, Seattle.

in the study, only 6 infants younger than 1 year were in the nonabused group.

The purpose of this study was to establish the prevalence of bruises in infants and toddlers younger than 3 years. We sought, in addition, to determine if a child's gross motor development independently influences the likelihood that a child has bruises. Such normal baseline data are crucial for the clinician who is attempting to assess the possibility of physical abuse when evaluating an infant or toddler with bruises.

RESULTS

SAMPLE

Clinicians completed data collection forms on 1001 children attending well-child visits at 7 different practice sites. In 14 patients, no data were recorded regarding the presence or absence of bruises, and, in 8 patients, the patient's age was more than 36 months; these cases were deleted from the study. Five infants had bruising related to a known medical condition. These included 2 infants who sustained bruises in the birth process: a 2-day-old newborn had facial bruises related to rapid delivery, and an 8-day-old newborn had scalp bruises related to vacuum extraction. Two other infants had bruises related to intravenous infusions administered during recent hospitalizations. One 27-month-old child was diagnosed as having von Willebrand disease and had multiple bruises. Only 1 child had bruises that were known or suspected to have been inflicted; this 16-month-old infant sustained bites from another child at day care. These children were excluded from the analysis.

The final sample consisted of 973 infants and toddlers ranging in age from 1 day through 1095 days (35 months). Bruises were noted in 203 (20.9%) of the total sample of children (95% confidence interval, 18.8%-24.1%).

SEX AND RACE

Sex was not recorded for 31 children; the final sample consisted of 463 boys and 479 girls. Bruises were present with equal frequency in boys (93 [20.1%]) and girls (105 [21.9%]) of all ages ($P = .49$). When toddlers aged 18 through 35 months were analyzed separately, there was again no significant sex difference in the frequency of bruises (boys, 50 [53.2%] of 94; girls, 58 [56.3%] of 103; $P = .66$). Boys and girls aged 18 through 35 months also had a similar number of bruises; considering only

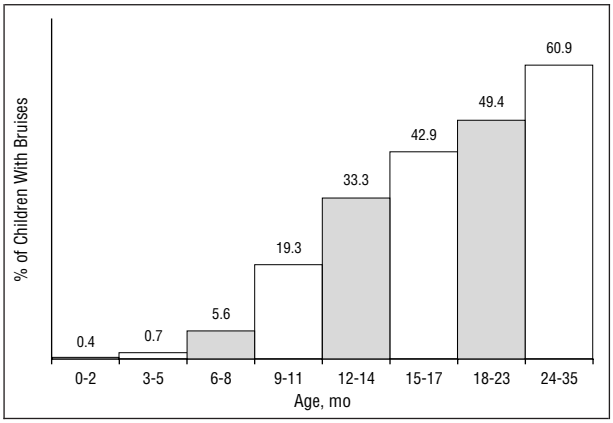

Figure 1. *Percentage of children with bruises by age (N = 930).*

Table 1. Bruises by Age and Developmental Stage of Child*

Age, mo	Precruiser	Cruiser	Walker
0-2	1/225 (0.4)	. . .	. . .
3-5	1/141 (0.7)	. . .	. . .
6-8	4/99 (4.0)	2/8 (25)	. . .
9-11	4/38 (10.5)	12/63 (19.0)	7/18 (38.9)
12-14	1/8 (12.5)	3/24 (12.5)	23/49 (46.9)
15-17	. . .	1/6 (16.7)	26/57 (45.9)
18-23	. . .	. . .	39/79 (49.4)
24-35	. . .	. . .	70/115 (60.9)
Total†	**11/511** (2.2)	**18/101** (17.8)	**165/318** (51.9)

**Data are presented as the number of children with bruises/total number of children (percentage). Precruiser indicates a child who is not walking; cruiser, one who walks with support; walker, one who walks independently; ellipses, not applicable.*
†P<.001.

those children who were 18 months of age and older and had bruises, the mean (±SD) number of bruises was 2.4 (1.9) for boys and 2.4 (1.6) for girls. ($P = .94$).

A majority of the patients enrolled were white. The African American (100 [10.4%] of 973) and Asian/Pacific Islander (92 [9.5%] of 973) representation reflects the urban Seattle-area population. Only 16 Hispanic and 2 Native American patients were enrolled. These 2 groups were combined with patients of mixed race or ethnicity in the "other" category. Race/ethnicity data were missing for 53 patients, and these patients were excluded from the following analysis by race.

Bruises were noted significantly more often in white than in African American children ($P<.007$). Asian/Pacific Islanders occupied an intermediate position, as did children in the "other" category. These 2 groups did not differ significantly from either white or African American children in the frequency of children identified with bruises. The difference in bruise frequency between white and African American children persisted after controlling for age ($P<.001$). The number of children with bruises by race/ethnicity is listed below.

Race/Ethnicity (n)	No. (%) of Patients
White (660)	150 (22.7)
African American (100)	8 (8)
Asian/Pacific Islander (92)	15 (16.3)
Other (68)	11 (7)
Total (973)	203 (20.9)

AGE AND BRUISES

The data sheets for 29 patients were missing information from which to calculate age (18 patients) or had dates that were clearly in error (calculated age <0 days in 11 patients). Fourteen patients had calculated ages that were inconsistent with the developmental stage recorded. This included 6 infants whose development appeared too advanced for their ages and 8 patients who appeared to exhibit developmental delay. (See the criteria in the "Methods" section.) These 43 patients were excluded from the analyses by age and developmental stage, leaving a sample of 930 patients for these analyses.

The presence of any bruises was clearly associated with patient age (**Figure 1**). In infants younger than 6 months, bruises were rare, present in only 2 (0.6%) of 366 patients. Each of these infants had 1 bruise on the head; a 9-day-old boy had a bruise on the occipital scalp, and a 3-month-old girl had a bruise on the parietal scalp.

In the group aged 6 through 8 months, a significantly higher proportion of infants had bruises (6 [5.6%] of 107 vs 2 [0.6%] of 366; $P = .002$), but bruises remained distinctly uncommon. The frequency of bruises rose rapidly after 9 months of age, so that between the ages of 18 and 23 months nearly half (39 [49.4%] of 79) of the patients had at least 1 bruise and a majority (70 [60.9%] of 115) of patients aged 24 through 35 months had visible bruises.

When the group of precruisers was considered alone, increased age was associated with increased bruises (**Table 1**). Only 2 (0.6%) of 366 precruisers younger than 6 months had bruises, while 4 (4%) of 99 precruisers aged 6 to 8 months, 4 (10.5%) of 38 of those aged 9 to 11 months, and 1 (12.5%) of 8 of those aged 12 to 14 months had bruises ($P<.004$).

DEVELOPMENTAL STAGE AND BRUISES

Bruising was also directly correlated with developmental stage (Table 1). Only 2.2% of precruisers had any bruises, while 17.8% of cruisers had bruises and 51.9% of walkers had bruises ($P<.001$).

Within every chronological age group, infants who were ambulating upright had bruises more frequently than those who were crawling (**Figure 2**). All the infants who were younger than 6 months were precruisers. In the group aged 6 to 8 months, more cruisers than precruisers had bruises, although, since only a few infants in this group were cruisers, this difference did not reach statistical significance ($P = .06$). In the group aged 9 through 11 months, significantly more walkers (38.9%) had bruises than cruisers (19%), who in turn were significantly more likely to have bruises than precruisers (10.9%; $P<.05$). In the group aged 12 through 14 months as well, significantly more walkers than cruisers had bruises (46.9% vs 12.5%; $P<.05$). In the group aged 15 to 17 months, once again more walkers than cruisers had bruises (45.9% vs 16.7%), but this was not statistically significant due to the small numbers of cruisers in this age group ($P = .23$).

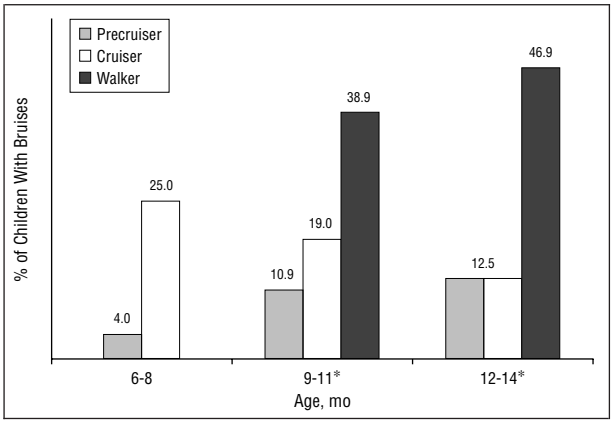

Figure 2. *Prevalence of children with bruises by age and developmental stage (N = 930). Precruiser indicates a child who is not walking; cruiser, one who walks with support; walker, one who walks independently; and the asterisk,* P<*.05.*

Table 2. More Common Sites of Bruises by Location and Developmental Stage*

Location	No. (%) of Children		
	Precruiser (n = 511)	Cruiser (n = 101)	Walker (n = 318)
Anterior tibia or knee	3 (0.6)	12 (11.9)	142 (44.7)
Forehead	3 (0.6)	3 (3.0)	18 (5.7)
Scalp	3 (0.6)	5 (5.0)	2 (0.6)
Upper leg	1 (0.2)	1 (1.0)	13 (4.4)

**Precruiser indicates a child who is not walking; cruiser, one who walks with support; and walker, one who walks independently.*

NUMBERS AND SITES OF BRUISES

In the study population, 973 patients had a total of 466 bruises. Considering only those infants and toddlers who had bruises, the mean number of bruises ranged from 1.3 per child in precruisers to 2.4 per child in walkers (range: precruisers, 1-2; cruisers, 1-5; and walkers, 1-11).

Certain sites of bruises were relatively common in all developmental groups. While few precruisers had any bruises, in those infants who had bruises, the most common sites were the anterior tibia or knee, forehead, and scalp (**Table 2**). In cruisers and walkers, the most common site of bruises was the anterior tibia or knee; nearly half of all walkers (142 [44.7%] of 318) and one eighth of all cruisers (12 [11.9%] of 101) had one or more bruises at this site. The forehead was the second most common site. Forehead bruises were noted in 18 (5.7%) of 311 walkers and 3 (3%) of 101 cruisers.

For cruisers, the scalp was the third most common site, while for walkers the upper leg ranked third. In all ages combined, bruises were more commonly noted on the anterior thigh (13) than on either the posterior (4) or lateral (3) surfaces.

Bruises on the back, forearm, or face (excluding the forehead) were noted in less than 2% of walkers but were extremely rare in precruisers or cruisers (**Table 3**). Of facial bruises, 6 were on the cheek and 1 was on the nose. No bruises were noted on the chin.

Table 3. Less Common Sites of Bruises by Location and Developmental Stage*

Location	No (%) of Children		
	Precruiser (n = 511)	Cruiser (n = 101)	Walker (n = 318)
Back	0 (0)	1 (1.0)	6 (1.9)
Chest	0 (0)	0 (0)	4 (1.3)
Forearm	0 (0)	0 (0)	5 (1.6)
Face (cheek or nose)	1 (0.2)	1 (1.0)	5 (1.6)

**Precruiser indicates a child who is not walking; cruiser, one who walks with support; and walker, one who walks independently.*

Several sites were uncommon locations of bruises in all age groups. Three walkers (0.9%) had bruises on the abdomen or hip, and 2 precruisers (0.4%) and 2 walkers (0.6%) had bruises on the upper arm. Only 1 walker (0.3%) was noted to have a bruise on the either the posterior lower leg or foot. No children were noted to have bruises on the buttocks or the hands.

Overall, 434 (93.1%) of 466 bruises were located over bony prominences.

COMMENT

In this large study of healthy children, we found that preambulatory infants who are younger than 9 months rarely have bruises that are not related to known medical conditions. Infants younger than 6 months, in particular, did not have any bruises on the face, trunk, or extremities, and bruises on the scalp were extremely rare. These findings confirm the conclusions of previous investigators.[2,5]

However, we found that infants who are beginning to cruise begin to have visible bruises, even when they are younger than 9 months. In addition, we found that precruisers who are older than 6 months have increasingly frequent bruises. This finding is in contrast to the study by Wedgewood,[2] in which no bruises were found in infants who were not yet cruising. This difference may be due to the larger number of children in this age group in our study. It is not surprising that as infants grow larger and begin pulling to stand and to stand (and fall) alone, these minor injuries occur with greater frequency.

In concordance with previous studies,[2,3,5] the predominant site for bruises in our patients was the anterior tibia and knee. As in these studies, we found that the upper leg was also a relatively frequent site for bruises in children who were walkers. In contrast to Robertson et al,[5] we identified no bruises on the hands or buttocks and only 1 child with a bruise on the foot. This may be due to cultural differences in dress, play, or disciplinary practices between Nottingham, England, in 1982, where the data were collected, and Seattle in the late 1990s.

Although bruises on the back may be caused by abusive discipline, in this study we found that a few walkers had bruises on the back that were interpreted as accidental. Bruises on the anterior chest were also noted in a small number of walkers. Both the chest and back

are unpadded areas that might be bruised in the course of normal toddler climbing.

Other authors noted frequent injuries of the head and face in children who are victims of abuse. In one large retrospective case review,[6] 385 (75.5%) of 511 physically abused children had injuries of the head, face, neck, or mouth. Another case review[7] found that facial and intraoral trauma was present in 128 (49%) of 260 documented cases of child abuse. In a more recent study,[1] which included 105 abused infants and toddlers, 49% of the soft tissue injuries in infants and 38% of the soft tissue injuries in toddlers involved the head or face. In our study of children attending well-child visits, in whom abuse was not suspected, bruises on the forehead were relatively common in cruisers and walkers but other facial bruises were rare.

The marked difference in frequency of bruises in African American vs white children was not surprising. It is possible that African American children have bruises less frequently than white children, but it is more likely that children with more darkly pigmented skin have bruises that are more difficult to recognize than bruises on children with lighter pigmentation.

This study has some limitations. The children's ambulatory stage was determined by parental report, and no validation was required. In addition, the clinician's ascertainment of bruises is dependent on visual diagnosis, and there is no reasonable confirmatory test. In this study, several examiners (see list of the members of the Puget Sound Pediatric Research Network in the acknowledgment) gathered and recorded the data, and interobserver reliability was not evaluated. Because the study was anonymous, the authors were not able to clarify possible errors in recording data nor was it possible to return to define missing data.

It is possible that some of the patients in this study had bruises that were actually caused by abuse. Since the study was designed to cause no alteration in usual clinical practice, there was no specific process by which examiners were to exclude or diagnose suspected physical abuse of these infants and toddlers. Clinicians used their usual methods of assessment in determining whether there was a suspicion of abuse. Thus, this study does not unequivocally define the frequency and distribution patterns of accidental bruises. These numbers are likely to represent a maximum possible frequency.

In this large group of infants and toddlers who presented for well-child care, we found that the age of 9 months is a reasonable guideline for judging whether bruises are likely to be developmentally appropriate, accidental injuries. We found that bruises are extremely rare in infants who are younger than 6 months and are distinctly uncommon in preambulatory infants who are younger than 9 months. Infants aged between 6 and 9 months may develop bruises as they begin to cruise. When infants begin to cruise, the frequency of bruises increases and bruises located in certain sites may be an expected finding. Bruises on the anterior lower leg and knee, as well as the upper leg and forehead, are common in cruising and walking toddlers. Bruises on the cheek, back, chest, and upper arm are much less commonly observed but may be seen in infants as they begin to walk independently. Bruises on the abdomen, buttocks, hands, and feet are extremely rare in both infants and toddlers. Bruises that are not over bony prominences are uncommon.

The data from this study suggest that the prudent physician should seriously consider the possibility of medical illness or inflicted injury when evaluating a young infant who has any bruises. Bruises in infants or toddlers that are on atypical sites should prompt similar concerns.

Accepted for publication September 21, 1998.

Presented in part at the San Diego Conference on Child Maltreatment, San Diego, Calif, January 29, 1998; the Ambulatory Pediatrics Association Region IX and X Meeting, Carmel, Calif, February 7, 1998; and the Ambulatory Pediatric Association Annual Meeting, New Orleans, La, May 3, 1998.

Members of the Puget Sound Pediatric Research Network who participated in this study are Ann Champoux, MD; Ruth Conn, MD; Steve Dassel, MD; Kathryn DelBeccaro, MD; Kenneth Feldman, MD; Robert Fukura, MD; Peyton Gaunt, MD; Ourania Malliris, MD; Helen Matthews, MD; Edward M. McMahon, Jr, MD; Jo Montgomery, ARNP; Tracie O'Neill, MD; Connie Patulot, MD; Jeffrey Scott, MD; Stuart Shorr, MD; Donna Smith, MD; Jeffrey Steele, MD; Robert Telzrow, MD; Elizabeth Thomas, ARNP; Nancy Thordarson, MD; Margaret Wheeler, MD; Roberta Winch, MD; Linda Wiseman, MD; Agnes Wong, MD; Dee Woods, ARNP; and Kyle Yasuda, MD.

Corresponding author: Naomi F. Sugar, MD, Harborview Medical Center, Box 359 947, 325 Ninth Ave, Seattle, WA 98122-2499.

REFERENCES

1. McMahon PG, Grossman W, Gaffney M, Stanitski C. Soft-tissue injury as an indication of child abuse. *J Bone Joint Surg Am.* 1995;77:1179-1183.
2. Wedgewood J. Childhood bruising. *Practitioner.* 1990;234:598-601.
3. Pascoe JM, Hildebrandt HM, Tarrier A, Murphy M. Patterns of skin injury in nonaccidental and accidental injury. *Pediatrics.* 1979;64:245-247.
4. Rosenberg NM, Meyers S, Shackleton N. Prediction of child abuse in an ambulatory setting. *Pediatrics.* 1982;70:879-882.
5. Robertson D, Barbor P, Hull D. Unusual injury? recent injury in normal children and children with suspected non-accidental injury. *BMJ.* 1982;285:1399-1401.
6. da Fonseca MA, Feigal RJ, ten Bensel RW. Dental aspects of 1248 cases of child maltreatment on file at a major county hospital. *Pediatr Dent.* 1992;14:152-157.
7. Becker DB, Needleman HL, Kotelchuck M. Child abuse and dentistry: orofacial trauma and its recognition by dentists. *J Am Dent Assoc.* 1978;97:24-28.