

Epidemiological characteristics of 139,492 pediatric fractures over 12 years at a national orthopaedic center in Beijing, China: a retrospective study

Tao Zhang¹

Capital Medical University

Hao Yang¹

Capital Medical University

Wenyu Liao

Capital Medical University

Zhiwei Liu

Capital Medical University

Yanwei Lyu

Capital Medical University

Zheng Yang

Capital Medical University

Xuemin Lyu

1xuemin98@outlook.com

Capital Medical University

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Abstract

Background

Pediatric fractures are among the most common childhood injuries, yet large-scale, long-term epidemiological data from China remain scarce. We characterized the demographic, temporal, anatomical, and mechanistic patterns of pediatric fractures at a national orthopaedic center in northern China.

Methods

In this retrospective descriptive study, children aged ≤ 14 years presenting within 72 hours of injury with radiographically confirmed limb or spine fractures to Beijing Jishuitan Hospital between 1 January 2009 and 31 December 2020 were identified from a prospectively maintained emergency registry. Categorical variables were summarized as counts and percentages; linear trends were assessed using the Cochran–Armitage trend chi-square test.

Results

A total of 131,697 children sustained 139,492 fractures (male:female ratio, 1.83:1; 85,216 boys [64.71%]). The age distribution was bimodal, peaking at 6 years in girls and 13 years in boys; the male:female ratio increased progressively to 4.02:1 at 14 years (trend $\chi^2 = 288.093$, $P < 0.001$). Annual caseload rose from 5,156 (2009) to 14,516 (2019), followed by a marked decline in 2020 during the COVID-19 pandemic. April–October accounted for 70.4% of cases (peak month, May). Among 58 fracture types, distal radius (24,465; 17.54%) and supracondylar humerus fractures (23,304; 16.71%) predominated. Physeal injuries comprised 19 types (41,115; 29.47%). Falls (60.45%), sports injuries (15.08%), and crush injuries (9.52%) were the leading mechanisms.

Conclusions

Pediatric fractures in northern China show a bimodal, sex-specific age distribution, warm-season predominance, and a spectrum led by distal radius and supracondylar humerus fractures. Falls and sports injuries—largely preventable—warrant priority in age-, sex-, and season-targeted prevention programs.

Background

Fractures are one of the most common reasons for children to seek emergency medical care and account for a substantial share of unintentional childhood injuries worldwide^{1,2}. Population-based studies from Europe and North America have reported annual pediatric fracture incidences of

approximately 128–361 per 10,000 children, with fractures of the distal forearm consistently the most frequent type and falls the leading mechanism³. The epidemiological pattern of pediatric fractures is known to vary with age, sex, season, culture, climate, and patterns of physical activity^{4,5}. A summary of major international studies is presented in Table 1.

Despite this substantial international literature, large-scale data from China remain comparatively scarce. A national retrospective survey estimated the incidence of traumatic fractures in the general Chinese population, and hospital-based series from Hong Kong and Shenzhen have described pediatric fracture patterns in southern China^{6,7}. However, published data from northern China are limited, and no previous study has characterized pediatric fractures over a long time span in a large metropolitan referral population. This gap is noteworthy because Beijing had a resident population of 1.687 million children aged 0–14 years in 2010, which grew to 2.591 million by 2020, and fracture care for this population is concentrated in a small number of tertiary centers⁸. The combination of a large pediatric population, centralized referral patterns, and the absence of a population fracture registry means that hospital-based series from major referral centers currently provide the best available proxy for the epidemiology of pediatric fractures in northern China⁹.

Beijing Jishuitan Hospital is the National Center for Orthopaedics and operates one of the largest pediatric orthopaedic emergency services in China. Using a prospectively maintained emergency registry, we analyzed 139,492 fractures in 131,697 children treated over 12 years (2009–2020). The aims of this study were: (i) to describe the demographic, temporal, anatomical, and mechanistic characteristics of pediatric fractures in this population; (ii) to compare these patterns with those reported in international studies; and (iii) to provide an evidence base for age-, sex-, and season-targeted prevention strategies.

Methods

Study design and setting

This was a retrospective descriptive study conducted at the pediatric orthopaedic emergency department of Beijing Jishuitan Hospital, Capital Medical University (Beijing, China), a tertiary referral center and the National Center for Orthopaedics. The hospital serves as a major referral destination for pediatric musculoskeletal injuries in northern China and operates a dedicated pediatric orthopaedic emergency service staffed by senior subspecialists. The study protocol was approved by the institutional ethics committee of Beijing Jishuitan Hospital [Approval No.: (K2023-141-00)], which waived the requirement for individual informed consent because of the retrospective use of anonymized registry data.

Participants

All children who presented to the pediatric orthopaedic emergency department between 1 January 2009 and 31 December 2020 with an acute fracture were screened. The inclusion criteria were: (i) age 14 years or younger at the time of injury; and (ii) a radiographically confirmed fracture of the limbs or spine. The exclusion criteria were: (i) presentation more than 72 hours after injury (to minimize misclassification of referral patterns and to focus on acute epidemiology); and (ii) fractures of the head or ribs, which are managed by other services (neurosurgery, thoracic surgery, or general surgery) and are therefore not captured by the pediatric orthopaedic registry.

Data collection

Senior pediatric orthopaedic surgeons collected patient data through the Hospital Information Support System (HISS), a prospectively maintained electronic registry that records every emergency department encounter. The following variables were extracted for each patient: age (in completed years), sex, date of injury, mechanism of injury, fracture diagnosis, and anatomical site. Fracture type was confirmed by review of radiographs and classified according to anatomical site and injury pattern; physeal injuries were recorded as a distinct category and further subtyped according to the Salter–Harris classification when applicable. Mechanism of injury was recorded from caregiver reports at the time of presentation and categorized as fall (same level, including playground falls), sports injury, crush injury, traffic accident, poke/stub injury (typically finger injuries from doors or drawers), fall from bed, struck by object, bicycle spoke injury, fall from height, or other.

Because some children sustained more than one fracture, results are reported at two levels: at the patient level for demographic and temporal distributions ($n = 131,697$), and at the fracture level for fracture type, anatomical site, and physeal injury distributions ($n = 139,492$). This distinction is stated explicitly wherever relevant.

Statistical analysis

Categorical variables are summarized as counts and percentages. The male-to-female ratio was calculated for each year of age. Linear trends in proportions across ordered age groups (0–14 years) were assessed using the trend chi-square test (Cochran–Armitage trend test), with the male-to-female ratio as the outcome of primary interest. A two-sided P value < 0.05 was considered statistically significant. No imputation was performed for missing data, as the registry completeness for the variables analyzed exceeded 99%. Analyses were performed with SPSS version 25.0 (IBM Corp., Armonk, NY, USA).

Results

Patient characteristics

Between January 2009 and December 2020, a total of 131,697 pediatric fracture patients were treated at the pediatric orthopaedic emergency department, accounting for 139,492 fractures (i.e., 7,795 patients

[5.91%] sustained more than one fracture). There were 85,216 boys (64.71%) and 46,481 girls (35.29%), giving an overall male-to-female ratio of 1.83:1. The mean annual caseload was 10,975 patients (range 5,156–14,516).

Age and sex distribution

The age distribution showed a bimodal pattern, with a major peak at 6 years and a secondary peak at 13 years (Fig. 1). The peak age differed markedly by sex: fractures in girls peaked at 6 years, whereas fractures in boys peaked at 13 years (Fig. 2A). The male-to-female ratio rose progressively with age, from approximately 1.1:1 in toddlers to 4.02:1 at 14 years (trend $\chi^2 = 288.093$, $P < 0.001$; Fig. 2B). This divergence indicates that the overall bimodal pattern is driven by the superimposition of an early peak dominated by girls and a later peak dominated by boys.

Temporal distribution

The annual number of patients increased steadily from 5,156 in 2009 to a maximum of 14,516 in 2019 (annual mean 10,975), an increase of approximately 2.8-fold over the 11-year pre-pandemic period. A marked decline was observed in 2020, coinciding with the COVID-19 pandemic and associated public health measures (Fig. 3). Fractures showed a clear seasonal pattern: 70.4% of cases occurred between April and October, and May was the peak month (Fig. 4). The warm-season concentration was consistent across all 12 study years (data not shown).

Fracture types and anatomical distribution

Fifty-eight distinct fracture types were identified. The ten most common types accounted for 72.1% of all fractures (Fig. 5A, Table 2). Distal radius fractures were the most frequent (24,465 cases, 17.54%), followed by supracondylar humerus fractures (23,304 cases, 16.71%); together these two types accounted for more than one-third (34.25%) of all pediatric fractures. The remaining eight of the top ten types were distal fibular physeal injury (9,842; 7.06%), clavicle fracture (9,376; 6.72%), finger phalangeal physeal injury (6,413; 4.60%), radial-ulnar shaft fracture (6,151; 4.41%), lateral humeral condyle fracture (5,781; 4.14%), Monteggia fracture (5,704; 4.09%), finger phalangeal fracture (4,932; 3.54%), and radial neck fracture (4,609; 3.30%). The complete distribution of all 58 fracture types is provided in Table 3.

Physeal injuries comprised 19 types and 41,115 cases, representing 29.47% of all fractures (Table 4). The most common physeal injury was distal fibular physeal injury (9,842 cases, 23.94% of all physeal injuries), followed by finger phalangeal physeal injury (6,413; 15.60%), lateral humeral condyle fracture (5,781; 14.06%), distal radial physeal injury (5,254; 12.78%), and radial head/neck physeal injury (4,609; 11.21%). These five types together accounted for 77.59% of all physeal injuries.

By anatomical region, the elbow was the most frequently involved site (27.86%), followed by the distal forearm (18.41%), forearm shaft (10.53%), hand (9.89%), ankle (9.50%), shoulder (9.00%), leg (6.43%), and foot (5.14%). Fractures of the femur (1.39%), knee region (1.00%), upper arm (0.50%), pelvis and hip

(0.35%), and spine (0.01%) were uncommon (Table 5). The predominance of elbow and distal forearm fractures reflects the high frequency of supracondylar humerus and distal radius fractures, respectively.

Mechanisms of injury

Falls were the leading mechanism of injury (60.45%), followed by sports injuries (15.08%), crush injuries (9.52%), and traffic accidents (6.04%; Fig. 5B, Table 6). Less frequent mechanisms included poke/stub injuries of the fingers (2.63%), falls from bed (2.15%), being struck by objects (2.07%), bicycle spoke injuries (1.08%), and falls from height (0.90%). Falls and sports activities together accounted for 75.53% of all injuries, indicating that the vast majority of pediatric fractures in this population arise from mechanisms that are, in principle, preventable.

Discussion

In this 12-year series of 139,492 fractures from the largest pediatric orthopaedic emergency service in northern China, we observed four principal findings. First, the age distribution was bimodal with peaks at 6 and 13 years, and the peak age differed by sex (6 years in girls, 13 years in boys). Second, the male predominance increased steadily with age, reaching 4.02:1 at 14 years. Third, fractures showed a pronounced warm-season (April–October) concentration, accounting for 70.4% of cases. Fourth, the fracture spectrum was dominated by distal radius (17.54%) and supracondylar humerus (16.71%) fractures, with falls and sports activities together accounting for three-quarters of all injuries.

Age and sex distribution

The bimodal age pattern and the divergent sex-specific peaks are notable. European population-based studies have generally reported a single peak at 12–14 years in boys and 10–11 years in girls, coinciding with the pubertal growth spurt and high-risk sports participation¹⁰. In our population, girls peaked distinctly earlier (6 years) than boys (13 years), and the overall distribution showed peaks at both ages. The early peak at around 6 years coincides with the transition from kindergarten to primary school in China, when children begin to play and commute with less direct supervision and encounter new physical environments (playgrounds, sports, and traffic). At this age, elbow fractures predominated, including supracondylar humerus, lateral condyle, and radial neck fractures, consistent with the vulnerability of the immature elbow to hyperextension injuries during falls onto an outstretched hand¹¹. In contrast, distal radius and finger fractures predominated in early adolescence, reflecting the increasing involvement of older children in higher-energy activities and contact sports¹².

The overall male-to-female ratio of 1.83:1, and its rise to 4.02:1 by 14 years, is consistent with previous reports and probably reflects sex differences in activity exposure, risk-taking behavior, and sports participation. The magnitude of this ratio at older ages is striking and has important implications for targeted prevention: boys in early adolescence represent the highest-risk subgroup and should be the primary focus of sports-injury prevention programs^{10,13}.

Fracture spectrum and international comparison

The fracture spectrum in our population differed from that reported in Western populations in two important respects. First, although distal forearm fractures were also the most common type in European studies, typically comprising 20–33% of pediatric fractures, in our series distal radius fractures (17.54%) were closely followed by supracondylar humerus fractures (16.71%). The proportion of supracondylar humerus fractures in our series is far higher than the approximately 3–8% reported in European series¹⁴. Second, the elbow region accounted for 27.86% of all fractures in our series, a proportion substantially higher than that reported in most Western populations. A similarly high proportion of elbow fractures has been described in hospital-based series from Hong Kong and Shenzhen, suggesting that elbow-region injuries are genuinely more prominent in Chinese pediatric populations, possibly reflecting differences in play environments, playground equipment, supervision patterns, and activity profiles¹⁵.

Direct comparison between studies should nevertheless be made cautiously, because case definitions, age ranges, study settings (population-based versus hospital-based), and fracture classifications differ substantially across studies¹⁶. In particular, our hospital is a national referral center and is therefore likely to receive a disproportionate share of complex elbow injuries that require specialist management; the true population frequency of supracondylar humerus fractures in northern China may be somewhat lower than our figures suggest. Despite these caveats, the consistency of the high elbow-fracture proportion across multiple Chinese series supports the conclusion that this is a real epidemiological feature rather than a referral artifact alone¹⁵.

Physeal injuries

Physeal injuries accounted for 29.47% of fractures in our series, higher than the 18% reported by Mizuta et al. and the approximately 20–30% reported in registry-based studies. As a national referral center, our hospital probably receives a disproportionate share of physeal injuries, which more often require specialist management; this figure should therefore not be extrapolated to the general population. Distal fibular and distal radial physeal injuries were the most frequent, consistent with the vulnerability of the ankle and wrist physes to torsional and compression loading during falls¹⁷. The high proportion of finger phalangeal physeal injuries (15.60% of all physeal injuries) reflects the frequency of poke/stub injuries of the fingers in young children, a mechanism that is largely preventable through door-finger protection devices and caregiver education¹⁸.

Seasonality and annual trends

Seasonality was pronounced, with 70.4% of fractures occurring between April and October and a peak in May. This pattern is in line with reports from Scandinavia and Norway linking fracture incidence to outdoor activity and daylight hours, and corresponds to the warm season in Beijing, when children spend more time outdoors and participate more in wheeled sports (cycling, skating, scootering)¹⁹. The seasonal concentration has practical implications for healthcare resource planning: emergency

department staffing and operating room availability at pediatric orthopaedic services should be increased during the spring and summer months²⁰.

The steady increase in annual caseload between 2009 and 2019 parallels the growth of Beijing's child population (from 1.687 million in 2010 to 2.591 million in 2020) and the increasing centralization of pediatric fracture care at tertiary centers. The marked decline in 2020 most likely reflects reduced outdoor activity, school closures, and restrictions on organized sports during the COVID-19 pandemic, as documented in pediatric fracture series from China and elsewhere²¹. This observation provides a natural experiment demonstrating the substantial contribution of outdoor activity and sports to pediatric fracture incidence, and reinforces the potential for activity modification to reduce fracture burden²².

Implications for prevention

These findings have practical implications for prevention (Table 6). Because falls at playgrounds and sports injuries together account for three-quarters of all fractures, impact-absorbing playground surfaces, protective wrist guards and helmets for skating and cycling, and professional supervision of organized sports are the interventions with the largest potential yield²³. The high frequency of supracondylar humerus fractures in young children suggests that playground safety measures (especially impact-absorbing surfaces under climbing equipment) should be a particular priority²⁴. Traffic-related measures (child safety seats and seat belts, which reduce the risk of ejection and fatal injury by an estimated 75%), wheel guards to prevent bicycle spoke injuries, and window guards to prevent falls from height address less frequent but more severe mechanisms. The seasonal concentration of cases suggests that prevention campaigns and resource allocation should be intensified in the spring¹⁹.

Strengths and limitations

The principal strength of this study is its scale: with 139,492 fractures over 12 years, it is, to our knowledge, the largest single-center series of pediatric fractures reported from China and one of the largest worldwide. The use of a prospectively maintained registry with senior pediatric orthopaedic review of all radiographs ensures high diagnostic accuracy and detailed fracture subtyping. The 12-year span also allows assessment of temporal trends, including the impact of the COVID-19 pandemic.

The study has several limitations that should be acknowledged. First, it is a single-center hospital-based study; because Beijing Jishuitan Hospital is a national referral center, severe and physeal injuries are likely over-represented, and population-based incidence rates cannot be calculated. The demographic and fracture-type distributions may therefore not be representative of the general pediatric population of northern China. Second, the retrospective design relied on routinely collected registry data, and injury mechanisms were recorded from caregiver reports without standardized coding; some misclassification of mechanism is likely, particularly for the less frequent categories. Third, we did not capture injury severity, treatment, or outcomes, which limits clinical inferences beyond descriptive epidemiology. Fourth, the absence of a population denominator precludes calculation of age- and sex-specific

incidence rates, which would have allowed more direct comparison with international studies. Finally, direct comparison with international studies is constrained by differences in age ranges, fracture classifications, and study settings. Despite these limitations, the consistency of our key findings with those of previous Chinese series supports the validity of the observed patterns.

Conclusions

Over a 12-year period, pediatric fractures at this national orthopaedic center in northern China showed a bimodal age distribution with sex-specific peaks (6 years in girls, 13 years in boys), an increasing male predominance with age, a clear April–October seasonality, and a fracture spectrum led by distal radius and supracondylar humerus fractures. Falls and sports injuries were the predominant preventable mechanisms, together accounting for three-quarters of all injuries. These data provide a baseline for injury surveillance in northern China and support age-, sex-, and season-targeted prevention programs, with particular attention to playground safety for young children and sports-injury prevention for adolescent boys.

Abbreviations

HISS: Hospital Information Support System; COVID-19: coronavirus disease 2019; SPSS: Statistical Package for the Social Sciences.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of Beijing Jishuitan Hospital [Approval No.: (K2023-141-00)]. The requirement for individual informed consent was waived because of the retrospective design and use of anonymized data.

Clinical trial number: not applicable.

Consent for publication

Not applicable.

Availability of data and materials

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Tao Zhang, designed the study, collected and analyzed data, and drafted the manuscript. Hao Yang, Wenyu Liao, data collection, performed measurements. Zhiwei Liu, Yanwei Lyu, data collection, performed measurements, statistical analysis. Zheng Yang, Xuemin Lyu: study design, manuscript preparation. All authors read and approved the final manuscript.

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Tables

Table 1. Major international epidemiological studies of pediatric fractures

Author	Age range (y)	Study period	Location	Incidence (/10 ⁴ /y)	Most common fracture site (%)	Leading mechanism
Landin	0–16	1950–1979	Sweden	212	Distal forearm, 23%	Fall
Cooper	0–17	1988–1998	UK	133	Forearm, 30%	—
Kopjar	0–12	1992–1995	Norway	128	Distal radius, 27%	Fall (71%)
Tiderius	0–16	1993–1994	Sweden	193	Distal forearm, 26%	Fall (40%)
Lyons (a)	0–14	1996	Scandinavia	156–178	Forearm, 20%	Fall
Lyons (b)	0–14	1996	Wales	361	Forearm, 36%	Fall
Brudvik	0–15	1998	Norway	245	Distal forearm, 27%	—
Rennie	0–15	2000	Scotland	202	Distal forearm, 33%	Fall (37%)
Hedström	0–19	1993–2007	Sweden	201	Distal forearm, 26%	Fall (24%)
Current study	0–14	2009–2020	Beijing, China	—	Distal radius, 17.54%	Fall (60.45%)

Incidence rates are population-based estimates from the cited studies; the current study is hospital-based and does not provide a directly comparable incidence rate. "—" indicates that the corresponding information was not reported in the original study.

Table 2. The ten most common fracture types: frequency, peak age, sex ratio, and leading mechanism

Fracture type	n	Proportion (%)	Peak age (y)	Male:female ratio	Leading mechanism
Distal radius fracture	24,465	17.54	13	2.69:1	Fall
Supracondylar humerus fracture	23,304	16.71	6	1.50:1	Fall
Distal fibular physeal injury	9,842	7.06	9	1.17:1	Twisting/sprain
Clavicle fracture	9,376	6.72	4	1.40:1	Fall
Finger phalangeal physeal injury	6,413	4.60	13	2.15:1	Poke/stub
Radial-ulnar shaft fracture	6,151	4.41	5	2.47:1	Fall
Lateral humeral condyle fracture	5,781	4.14	6	2.10:1	Fall
Monteggia fracture	5,704	4.09	6	1.84:1	Fall
Finger phalangeal fracture	4,932	3.54	13	2.05:1	Poke/stub
Radial neck fracture	4,609	3.30	6	1.24:1	Fall

The ten fracture types listed together account for 72.1% of all 139,492 fractures.

Table 3. Complete distribution of all 58 fracture types (n = 139,492)

Fracture type	n	%	Fracture type	n	%
Distal radius fracture	24,465	17.54	Tibial fracture	4,282	3.07
Supracondylar humerus fracture	23,304	16.71	Distal tibial physeal injury	3,410	2.44
Distal fibular physeal injury	9,842	7.06	Metatarsal fracture	2,760	1.98
Clavicle fracture	9,376	6.72	Proximal humeral fracture	2,748	1.97
Finger phalangeal physeal injury	6,413	4.60	Olecranon fracture	2,608	1.87
Radial-ulnar shaft fracture	6,151	4.41	Fibular fracture	2,638	1.89
Lateral humeral condyle fracture	5,781	4.14	Tibiofibular fracture	2,030	1.46
Monteggia fracture	5,704	4.09	Toe phalangeal fracture	1,786	1.28
Finger phalangeal fracture	4,932	3.54	Ulnar fracture	1,671	1.20
Radial neck fracture	4,609	3.30	Metacarpal fracture	1,571	1.13
Femoral shaft fracture	1,362	0.98	Metacarpal physeal injury	478	0.34
Radial fracture	1,161	0.83	Calcaneal fracture	345	0.25
Metatarsal physeal injury	1,031	0.74	Total distal humeral physeal separation	412	0.30
Toe phalangeal physeal injury	926	0.66	Carpal fracture	404	0.29
Medial humeral epicondyle fracture	798	0.57	Proximal humeral physeal injury	400	0.29
Distal ulnar physeal injury	795	0.57	Proximal tibial physeal injury	389	0.28
Patellar fracture	430	0.31	Distal femoral fracture	356	0.26
Humeral shaft fracture	609	0.44	Ulnar styloid fracture	339	0.24
Proximal ulnar fracture	550	0.39	Distal femoral physeal injury	262	0.19
Ulnar coronoid fracture	498	0.36	Femoral neck fracture	222	0.16
Subtrochanteric femoral fracture	215	0.15	Medial humeral condyle fracture	70	0.05
Talar fracture	214	0.15	Lateral humeral epicondyle fracture	50	0.04
Tibial intercondylar eminence fracture	213	0.15	Distal ulnar fracture	39	0.03
Pelvic fracture	152	0.11	Intertrochanteric femoral fracture	36	0.03

Tarsal fracture	109	0.08	Galeazzi fracture	36	0.03
Intercondylar humeral fracture	98	0.07	Scapular fracture	25	0.02
Tibial tubercle fracture	107	0.08	Spinal fracture	16	0.01
Distal humeral fracture	95	0.07	Radial styloid fracture	9	0.01
Capitellar (half-humeral) fracture	88	0.06	—	—	—
Sacrococcygeal fracture	72	0.05	—	—	—

Percentages are calculated from the total of 139,492 fractures. "—" indicates no additional fracture type in that row.

Table 4. Distribution of 41,115 physeal injuries (29.47% of all fractures)

Physeal injury type	n	Proportion of physeal injuries (%)
Distal fibular physeal injury	9,842	23.94
Finger phalangeal physeal injury	6,413	15.60
Lateral humeral condyle fracture	5,781	14.06
Distal radial physeal injury	5,254	12.78
Radial head/neck physeal injury	4,609	11.21
Distal tibial physeal injury	3,410	8.29
Metatarsal physeal injury	1,031	2.51
Toe phalangeal physeal injury	926	2.25
Medial humeral epicondyle fracture	798	1.94
Distal ulnar physeal injury	795	1.93
Metacarpal physeal injury	478	1.16
Total distal humeral physeal separation	412	1.00
Proximal humeral physeal injury	400	0.97
Proximal tibial physeal injury	389	0.95
Distal femoral physeal injury	262	0.64
Tibial tubercle fracture	107	0.26
Capitellar fracture	88	0.21
Medial humeral condyle fracture	70	0.17
Lateral humeral epicondyle fracture	50	0.12

Physeal injuries comprised 19 distinct types and 41,115 cases, representing 29.47% of all 139,492 fractures. The five most common types together accounted for 77.59% of all physeal injuries.

Table 5. Anatomical distribution of pediatric fractures by body region

Anatomical region	n	Proportion (%)
Elbow	38,856	27.86
Distal forearm	25,675	18.41
Forearm shaft	14,690	10.53
Hand	13,794	9.89
Ankle	13,252	9.50
Shoulder	12,554	9.00
Leg	8,969	6.43
Foot	7,170	5.14
Femur	1,939	1.39
Knee	1,394	1.00
Upper arm	697	0.50
Pelvis and hip	488	0.35
Spine	14	0.01

Anatomical regions are ordered by descending frequency. Percentages are calculated from the total of 139,492 fractures.

Table 6. Leading injury mechanisms and corresponding prevention measures

Injury mechanism	Proportion (%)	Recommended prevention measures
Fall (playground, same level)	60.45	Impact-absorbing playground surfacing; supervision of young children; caregiver education on fall hazards
Sports injury (skating, skiing, scootering, contact sports)	15.08	Protective gear (helmet, wrist guards, knee/elbow pads); professional supervision; pre-participation conditioning; age-appropriate activity design
Crush injury	9.52	Adult supervision; door-finger protection devices; safe furniture and appliance design; caregiver education
Traffic accident	6.04	Child safety seats and seat belts (estimated 75% reduction in fatal risk); pedestrian safety education; speed enforcement near schools
Poke/stub injury (finger)	2.63	Finger-protection education; safe door and drawer design; door stoppers and hinge guards
Fall from bed	2.15	Bed rails; caregiver supervision of infants and toddlers; age-appropriate bed selection
Struck by object	2.07	Safe storage of household objects; supervision during play; protective equipment in organized sports
Bicycle spoke injury	1.08	Bicycle wheel guards; spoke guards; child carrier seats with foot protection; caregiver education
Fall from height	0.90	Window guards and balcony railings; stair gates; supervision of young children near windows and balconies
Other	0.08	General caregiver education and supervision

Falls and sports injuries together account for 75.53% of all fractures and represent the principal preventable mechanisms. Prevention measures are evidence-based recommendations adapted from the cited literature [2, 10, 24].

Figures

Age distribution of pediatric fracture patients (2009–2020)

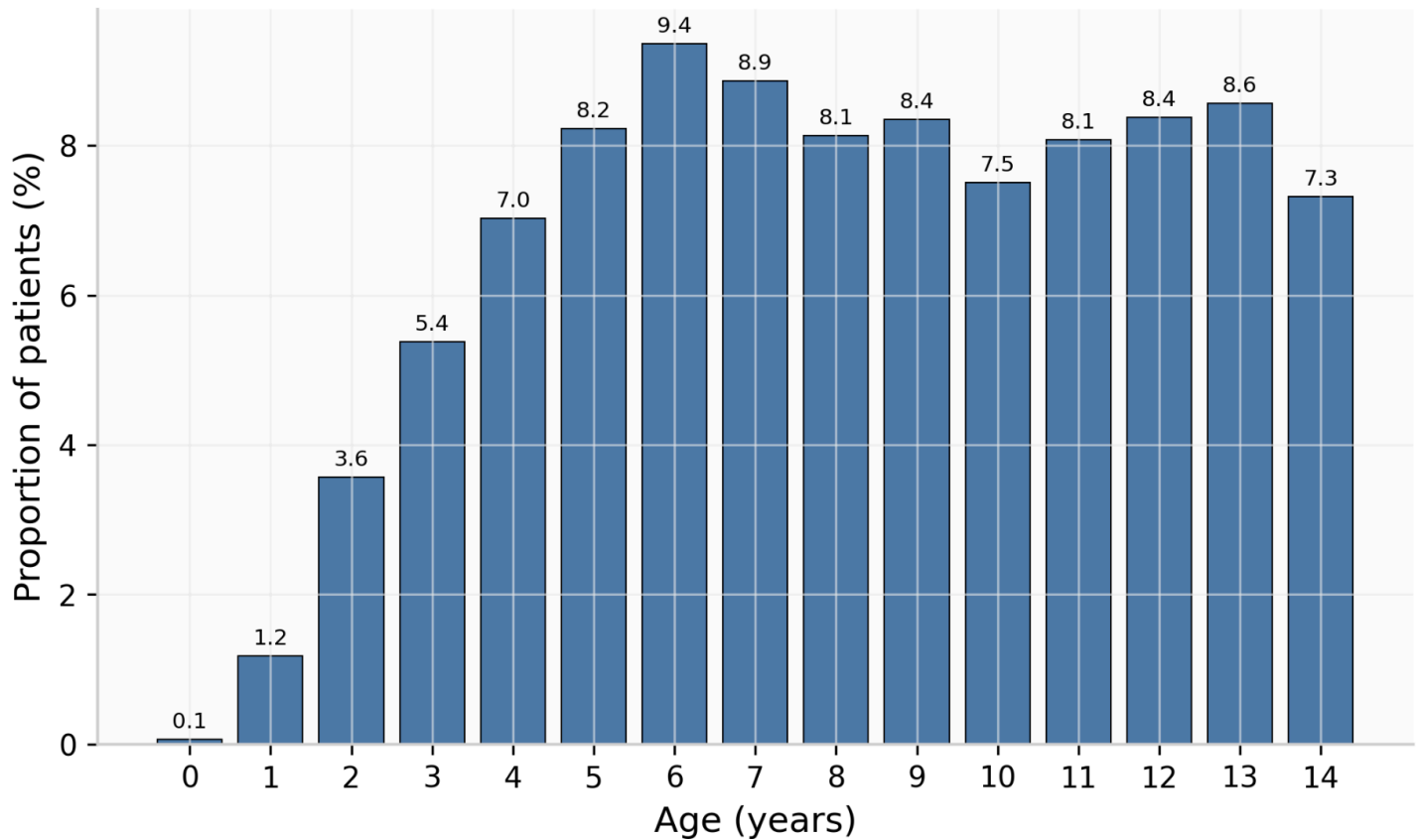


Figure 1

Age distribution of pediatric fracture patients, 2009–2020. The distribution is bimodal, with a major peak at 6 years and a secondary peak at 13 years.

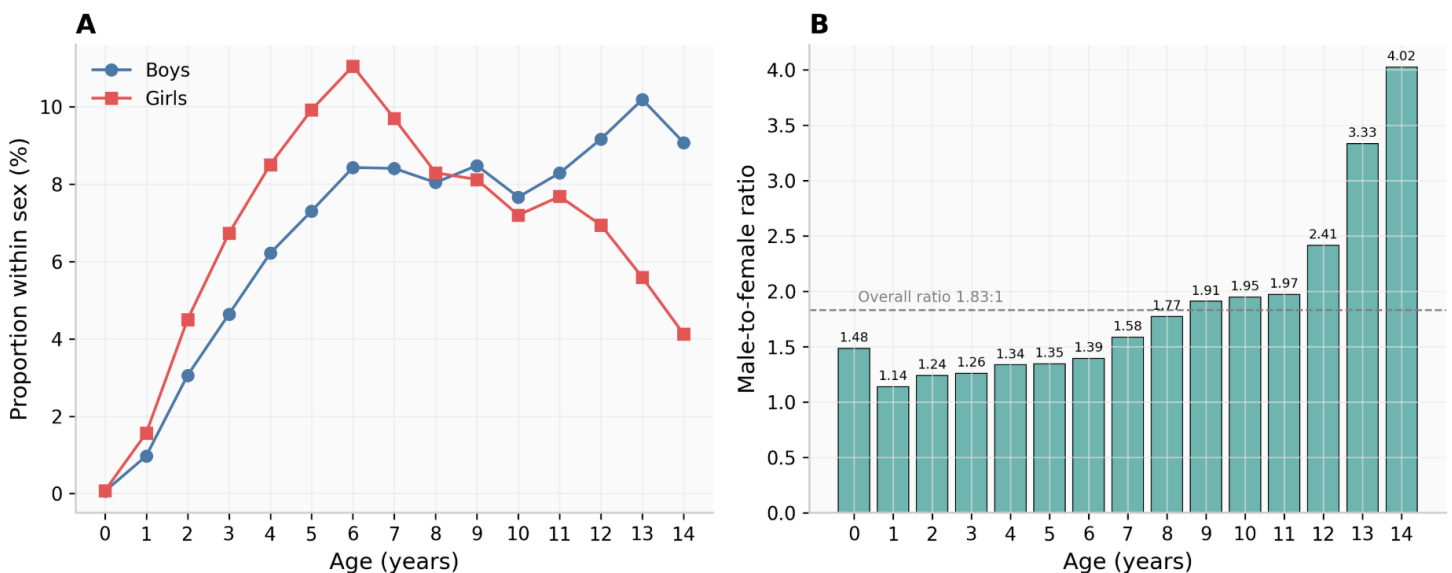


Figure 2

Age distribution by sex and male-to-female ratio by age. (A) Age distribution within each sex: fractures in girls peak at 6 years, whereas fractures in boys peak at 13 years. (B) The male-to-female ratio increases with age, reaching 4.02:1 at 14 years (trend $\chi^2 = 288.093$, $P < 0.001$). The dashed line indicates the overall ratio of 1.83:1.

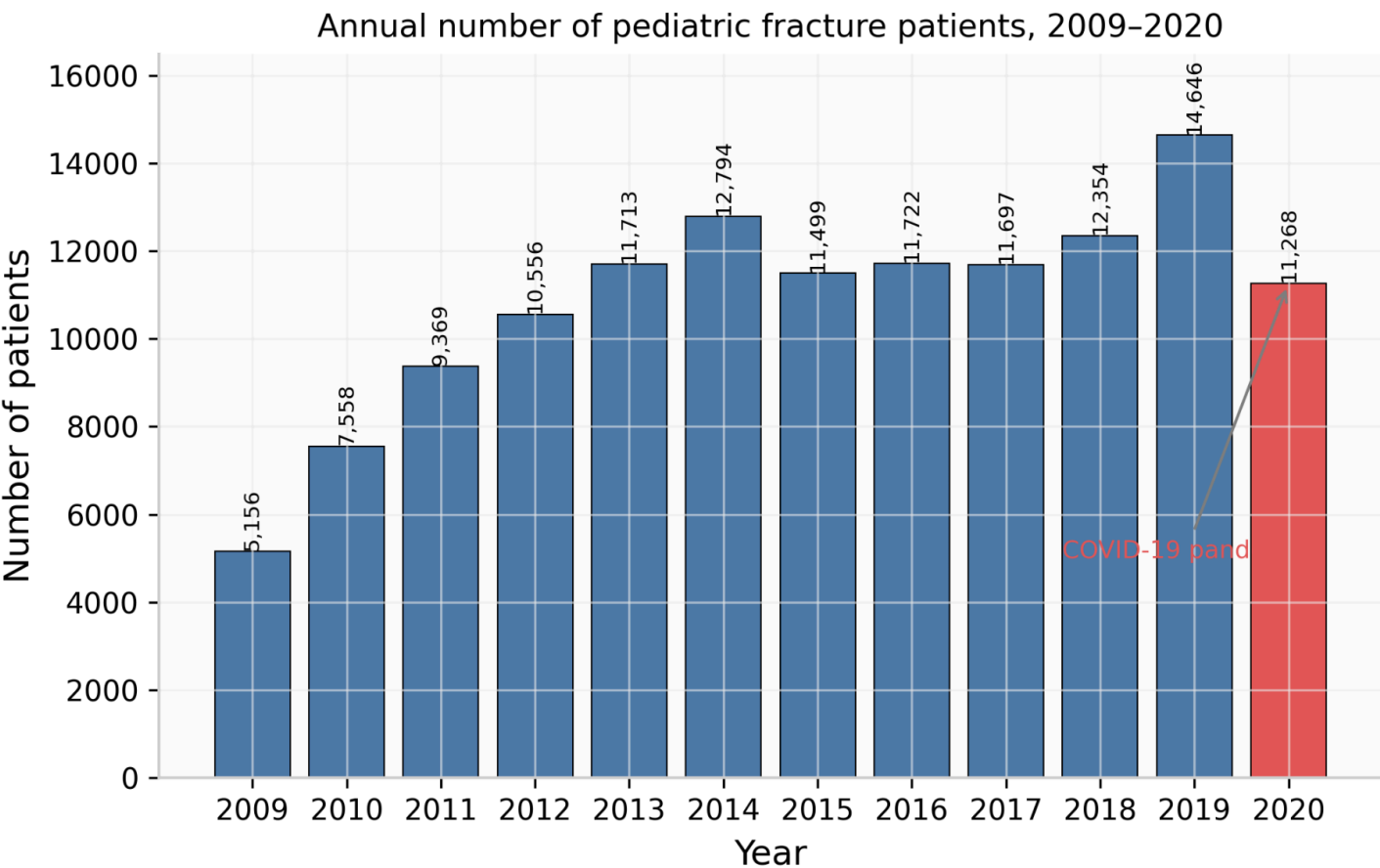


Figure 3

Annual number of pediatric fracture patients, 2009–2020. The caseload increased steadily to a maximum of 14,516 in 2019 (annual mean 10,975) and declined in 2020 during the COVID-19 pandemic.

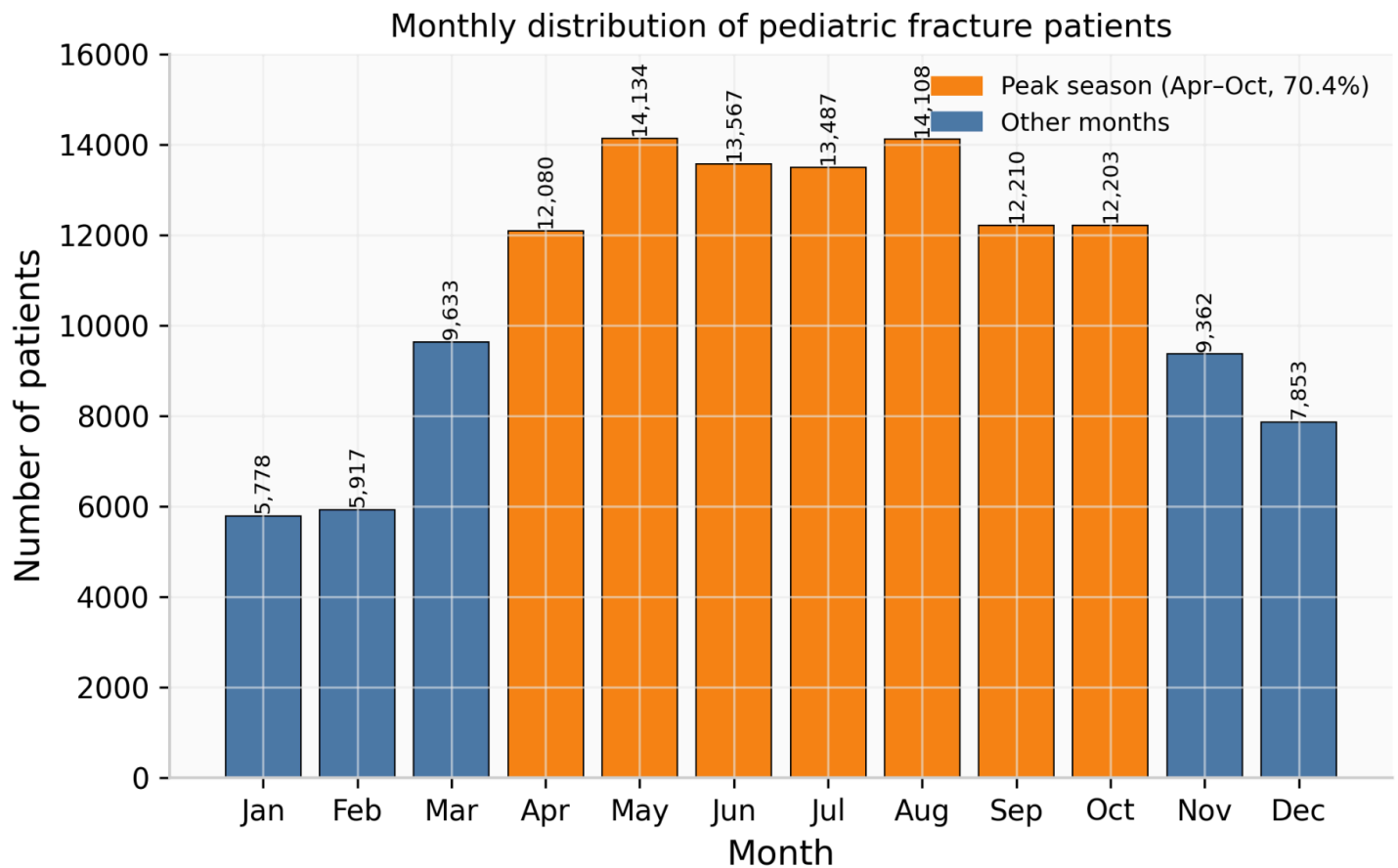


Figure 4

Monthly distribution of pediatric fracture patients. April through October (shaded) is the peak season, accounting for 70.4% of cases; May is the peak month.

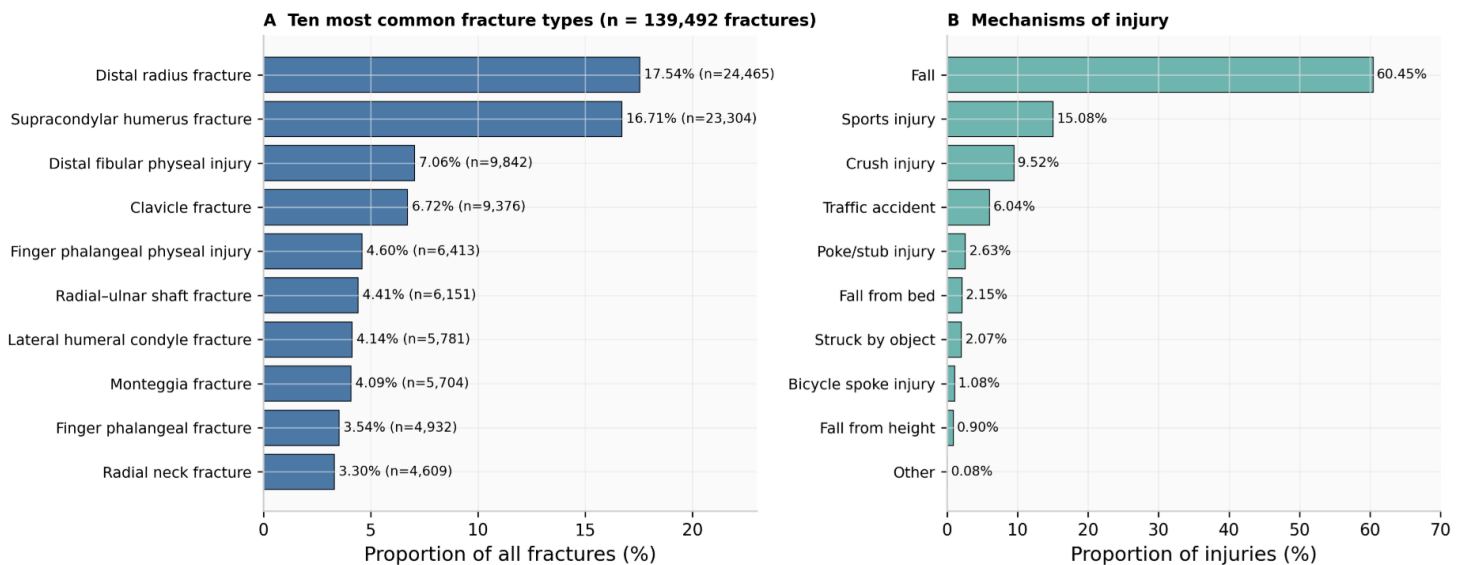


Figure 5

Fracture types and mechanisms of injury. (A) The ten most common fracture types among 139,492 fractures. (B) Distribution of injury mechanisms; falls are the leading mechanism (60.45%).