Patterns and risk factors for vertebral compression fractures in children and adolescents: a 20-year national emergency department study

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INTRODUCTION- Vertebral compression fractures in children and adolescents represent an important but understudied injury pattern. Children are especially active and participate in a wide variety of physical activities, which makes them especially prone to these types of injuries. While spinal fractures in general are well studied, little is known about the specific epidemiology and activity patterns of compression fractures in this population. This study uses a nationally representative dataset to provide a clearer picture of pediatric vertebral compression fractures and to promote increased awareness and preventative efforts.

METHODS- We conducted a retrospective review of the National Electronic Injury Surveillance System (NEISS) from 2005–2025 to identify patients ≤21 years of age with vertebral compression fractures, including burst fractures. Cases were identified through a keyword search of case narratives, followed by manual review to confirm inclusion and to extract additional variables, including spinal level, activity at the time of injury, and mechanism of injury. Standard demographic characteristics were also recorded.

Descriptive statistics were used to summarize patient and injury characteristics, and national estimates were derived using NEISS-provided sample weights. Comparisons were made between younger children (≤13 years) and older adolescents (14–21 years), as well as between hospitalized and non-hospitalized patients. We also evaluated associations between fracture region and mechanism of injury, and compared fracture distribution patterns between burst and non-burst fractures. Categorical variables were analyzed using chi-square or Fisher's exact tests for expected counts < 5. False discovery rate (FDR) correction was applied to account for multiple hypothesis testing. Annual trends were evaluated with simple linear regression.

RESULTS- We identified 1,217 cases, corresponding to a national estimate of 32,458 injuries. The mean age was 13.0 years (range 1 month – 21 years), and 734 patients (60.3%) were male. Injuries increased significantly over time (+3.2 cases/year, R^2=0.685, p<0.001). The thoracic spine was the most common level of injury (618 cases, 50.8%), followed by the lumbar spine (370, 30.4%). Fewer injuries involved the cervical spine (50, 4.1%), sacrum (3, 0.2%), multiple regions (65, 5.3%), or were unspecified (111, 9.1%). 75 cases (6.16%) were classified as burst fractures, most often in the lumbar (53.3%) and thoracic (17.3%) regions. When compared to non-burst fractures, burst fractures were significantly more likely to occur in the lumbar region (OR=2.81, adjusted p<0.001) and cervical region (OR=4.24, adjusted p=0.001), but significantly less likely in the thoracic region (OR=0.19, adjusted p<0.001).

Falls were the leading mechanism of injury, including falls from height (495 cases, 40.7%), down stairs (106, 8.7%), or from standing level (78, 6.4%). Other common mechanisms included contact sports (90 cases, 7.4%), crashes or collisions (84, 6.9%), and trampoline injuries (58, 4.8%). Injuries most often occurred while going up or down stairs (102 cases, 8.4%), playing football (64, 5.3%), climbing on monkeybars (63, 5.2%), and jumping on a trampoline (60, 4.9%). Fracture region was significantly associated with mechanism of injury (p<0.001), with cervical fractures more often resulting from contact sports and diving, and other levels linked to falls from height.

Younger children (≤13 years old) were more often injured on monkey bars (9.8% vs 0.3%) and playground equipment (8.7% vs 0.5%), while older (>13) can be children were more frequently injured during motorbike riding (7.4% vs 1.4%), horseback riding (6.6% vs 1.6%), and snowboarding (6.2% vs 1.8%) (adjusted p<0.001). In addition, thoracic fractures occurred more often in younger children (59.6% vs 41.6%), while lumbar (39.2% vs 22.0%) and cervical fractures (5.6% vs 2.7%) were more frequent in older children (adjusted p<0.001).

Overall, 329 patients (27.0%) required hospitalization. Falls from a window were associated with higher odds of admission (OR 5.13, adjusted p<0.001), while going up or down stairs was associated with lower odds (OR 0.38, adjusted p=0.017).

CONCLUSION- Vertebral compression fractures in children are becoming increasingly common and are most often related to falls, sports, and recreational activities. In this study, we found that compression fracture patterns differed by mechanism of injury and activity, and that certain activities carried higher or lower risks of hospitalization. We also found age-related differences, with younger children more likely to suffer from thoracic fractures, and older children from cervical and lumbar fractures. The main limitations include reliance on NEISS narratives, potential misclassification, and lack of long-term outcome data.

SIGNIFIANCE- These findings highlight the importance of considering both the child's age and the context of injury when evaluating vertebral compression fractures in the emergency setting. They also point to opportunities for prevention, particularly through improved playground safety measures and safer participation in sports.

Figure 1. Comparison of injury characteristics between younger (≤13) vs. older (>13) children