

# Can children acquire their parents' history of fracture?

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## Summary

**Bone fractures in children can have long-term impacts on their development. As an example, a fracture that is close to the growth plates of a limb can cause stunted growth and impaired function of that limb throughout a child's life. While parental history of hip fracture is a well-established risk for fracture in the adult population, there is little data about whether parental history of fracture affects fracture risk in pediatric populations. We surveyed twelve middle and high school students to investigate this association. Fractures secondary to motor vehicle accidents were excluded from this study. Students with a history of fracture were significantly more likely to have a parental history of fracture. Moreover, students with a personal history of more than one fracture were more likely to have a greater number of parental fractures compared to students without a personal history of fractures. These findings suggest that a parental history of fracture is a risk factor for fracture in pediatric populations and that the association should be further investigated by larger-scale studies.**

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## Introduction

Bone fractures in children can cause long-term deformities, especially those involving the growth plates at the ends of bones. Growth plate fractures can disturb normal bone growth and result in angulation or bone shortening. Such deformities can have long-term consequences, including pain and malfunction. The long-term, detrimental consequences of fractures in children highlight the importance of implementing measures to minimize the occurrence of such fractures. In order to identify such measures, one would first need to determine the risk factors that lead to fractures in children. It has been well established that fractures in children commonly involve the upper extremities (1-5)

and that obesity increases the risk of fracture in children, as obese children have lower bone mineral density, lower bone mass, and reduced bone area relative to their weight, making them more prone to bone injury (6,7).

While some risks and patterns of fractures in children have been well established, others have not. There is little existing data about the role of parental history of fractures in the pediatric population. In the adult population, parental hip fracture is a well-known risk factor for similar injuries. A recent study concluded that a parental history of fracture, particularly a family history of hip fracture, is associated with an increased risk of fracture that is independent of bone mineral density (8). Parental history of hip fracture has therefore been integrated as one of the risk factors for fracture in the Fracture Risk Assessment Tool (FRAX), a tool developed to evaluate fracture risk in adult patients.

However, though parental history of fracture is a known risk for adult fractures, this does not necessarily apply to pediatric fractures, as the risk factors for adult fractures are different from those for pediatric fractures. For example, obesity is a known risk factor for pediatric fractures, while being underweight is a known risk factor for adult fractures (6,7,9). We conducted a survey study of middle- and high-school students to investigate the potential role of parental history of fracture in pediatric fractures and other possible risk factors and patterns of fracture in that age group.

## Results

Twelve students from middle and high schools enrolled in this study (sixth grade through twelfth grade). Seven students had a history of fracture (Group A) while five students did not have a history of fracture (Group B). The average age of Group A was 13.7 years and the group included four females and three males. The average age of Group B was 13.8 years and included three females and two males (**Table 1**). In Group A, the total number of personal fractures reported ranged from one to three fractures, while the total number of parental fractures reported ranged from zero to four fractures (**Table 1**). In Group B, the total number of parental fractures reported ranged from zero to two fractures. Group A had a significantly higher history of parental fracture compared

to Group B ( $p = 0.010$ ). Participant 7, who had a history of one fracture, was the only participant in Group A without a history of parental fracture. Participant 6, who reported the most extensive history of parental fractures in this study (two parents with a history of fracture and a total of four parental fractures), had the highest number of personal fractures (three personal fractures), as well. One out of the five (20%) participants without a history of fracture had a history of parental fracture. Four out of the five (80%) participants with a history of one fracture had a history of parental fracture. Additionally, two out of the two (100%) participants with a history of more than one fracture had a history of parental fracture(s) (Figure 1). The average number of parents with a history of fracture was 0.4 for participants without a history of fracture, 1.0 for participants with a history of one fracture, and 1.5 for participants with a history of more than one fracture (Figure 2). For participants without any history of fracture, the average total number of parental fractures was 0.4. For participants with one or more fractures, the average total number of parental fractures was 1.2 and 2.5, respectively (Figure 3).

Out of the ten reported fractures, seven fractures happened during summer, two fractures happened during fall, and one fracture happened during spring. None of the fractures happened during winter. Nine out of the ten reported fractures involved the upper extremities, while one fracture involved a lower extremity. There were no rib, pelvic, or spinal fractures reported. Seven out of the ten reported fractures happened during sports or a leisure activity. Two fractures occurred while using a scooter, two while using a skateboard, one while tubing, one while playing soccer, and one while playing football.

## Discussion

Family history of fracture is a well-known risk factor for fracture in the adult population, but it has not been studied in the context of pediatric fractures. We performed this survey study to explore the role of family history of fracture as a risk factor for fracture in the pediatric population. In our study of a pediatric population ages 11-18 years old, the percentage of students with a parental history of fractures was higher in subjects with a personal history of more than one fracture compared to those without a personal history of fracture (Figure 1). There was a greater than four-fold percentage of students with a parental history of fracture in Group A (six out of seven participants ~ 86%) compared to those in Group B (one out of five participants = 20%). The significantly higher history of parental fractures reported in Group A compared to Group B ( $p = 0.010$ , Independent t-test) indicates that parental history of fracture may play a similar role in the risk for fracture in the pediatric

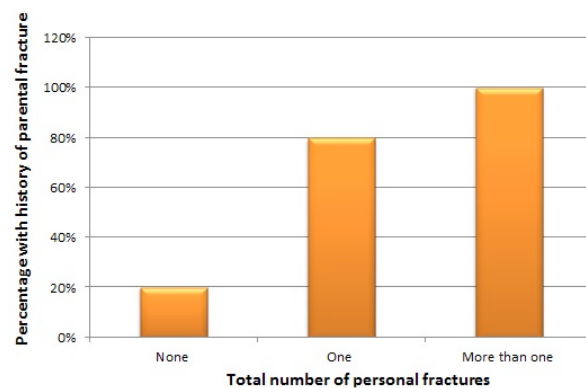
Participant	Age	Gender	Total number of personal fractures	Parental history of fractures	Number of parents who had fracture	Total number of parental fractures
1	16	Female	1	No	0	0
2	15	Male	3	Yes	2	4
3	13	Female	1	Yes	1	1
4	13	Male	2	Yes	1	1
5	14	Male	1	Yes	2	2
6	12	Female	1	Yes	1	2
7	13	Female	1	Yes	1	1
8	18	Female	0	No	0	0
9	13	Male	0	No	0	0
10	14	Female	0	Yes	2	2
11	13	Male	0	No	0	0
12	11	Female	0	No	0	0

**Table 1: Demographics of participants.** Information collected includes age, gender, total number of personal fractures, parental history of fractures, number of parents who had fracture(s), and total number of parental fractures. Group A (blue) is comprised of students with a personal history of fracture(s), while Group B (red) is comprised of students without any personal history of fracture. Body parts involved include: UE, which is upper extremity (the number of upper extremity fractures) and LE, which is lower extremity (the number of lower extremity fractures).

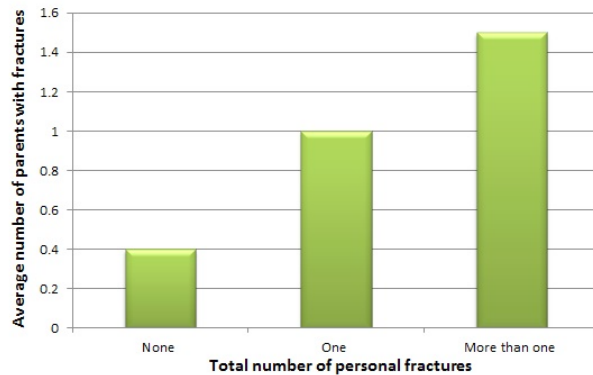
population as it does in the adult population, perhaps due to lifestyle or genetic factors.

Students with a higher number of personal fractures had a higher average number of parents with a history of fracture (Figure 2) as well as a higher average total number of parental fractures (Figure 3). Students with a history of more than one personal fracture were significantly more likely to have a greater total number of parental fractures compared to students without a personal history of fractures ( $p < 0.05$ , Independent t-test). These results raise the possibility that extensive parental history of fracture (either a greater number of parents with a history of fracture or a higher total number of parental fractures) could predispose children to fractures. Ultimately, this predisposition may result in higher fracture rates among children with a parental history of fractures than among children from parents with no history of fracture.

Several studies have shown that fractures in pediatric populations most commonly occur in the upper



**Figure 1: Percentage of students with history of parental fracture.** Graph indicates the percentage of students without a history of fracture, with a history of one fracture, and with a history of more than one fracture.



**Figure 2: Average number of parents with a history of fracture.** Average values for students without any history of fracture, with a history of one fracture, and with a history of more than one fracture.

extremities (1-5). In agreement with these previous reports, our data show most of the reported fractures occurring in the upper extremities, with nine out of the ten reported fractures involving the upper limbs. Prior research also indicates that there is seasonal variation in the incidence of limb fractures in children, with more cases in the summer and autumn months (10). Our survey study supports this conclusion, as seven fractures happened in the summer and two fractures happened in the fall out of ten fractures reported.

There are some limitations to our study. Our participants came from a particular age group and part of the country, and so this study may not represent children of all ages or in all regions of the United States of America. This is a survey study, which makes it subject to response bias (11,12). This study did not include a radiological verification of the reported fractures, and thus was subject to the validity of parental recall of children's fractures and of self-report of fractures (13,14). Studies with broader enrollment would help to further investigate the role of parental fractures in the risk for pediatric fractures and to determine if there is a correlation between parents with an extensive history of fractures and children with a recurrent history of fractures.

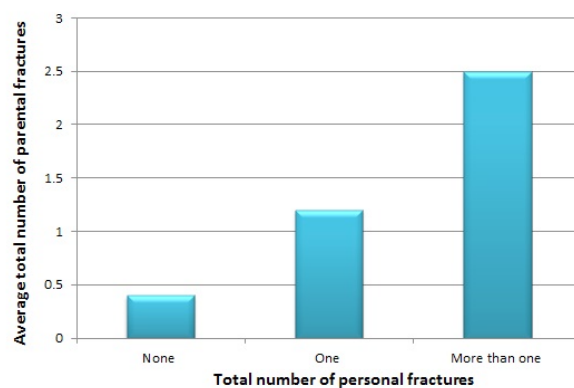
We excluded fractures caused by motor vehicle accidents because we believe that a motor vehicle accident would be a positive confounding variable in this study. Children in the age group studied in this survey are most likely to be accompanied by their parents while in cars. Children with a history of fractures related to a motor vehicle accident could possibly have parents with fractures related to the same motor vehicle accident. In this case, the motor vehicle accident would be the risk factor for the fractures, not the parental history of fracture.

Elementary school students were not included in this

study because they may not have had enough exposure to show their risk of fracture. For instance, an elementary school student with a family history of fracture may report no personal fractures during the elementary school years, but could experience fractures in the middle and high school years as the individual gets more involved in sports and other activities.

Our study reveals a possible role for a family history of fracture in children with fractures, but it does not address the factors that could account for such a correlation. A number of elements could be responsible for increased parental fractures among children with pediatric fractures, including factors dependent on or independent of low bone density. Due to the complexity of these elements, it is not feasible to capture them in this survey. Inheritable skeletal diseases could lead to low bone density, which in turn could cause increased risk of fractures in families. Other factors besides inheritable diseases include social and psychological factors. Children and their parents could share similar dietary habits—like having less calcium in their diet, leading to low bone density—that would predispose both of them to having fractures. Parents with a history of depression or alcoholism could perhaps get involved in unhealthy dietary habits and high-risk behaviors that would increase their fracture risk and could expose their children to increased risk of fracture through improper care they could provide to their children. Families with active lifestyles or who partake in high-risk activities have a higher chance of having accidents, thus increasing fracture risk for both the parents and the children. Families living in neighborhoods where the sidewalks have more cracks for them to trip on are also at an increased fracture risk.

The data from our survey study confirmed previously reported observations about pediatric fractures, such



**Figure 3: Average total number of parental fractures.** Average values for students without any history of fracture, with a history of one fracture, and with a history of more than one fracture.

as the frequent involvement of the upper extremities and a higher incidence during summer, and further suggests that that a parental history of fracture may be a risk factor for pediatric fractures. Though our study showed that parental history of fractures could be a risk factor for pediatric fractures, there are limitations to our study. Larger studies are needed to confirm that the correlation between parent and child fractures exists, and follow-up studies investigating the potential causes behind this correlation are also needed. If causes are found, recommendations could be given to families with a history of fracture to help prevent fractures in young children.

### Methods

Middle and high school students at Main Street School (in Norwalk, Iowa) and Des Moines Christian School (in Urbandale, Iowa) were invited to conduct a survey study. We attempted to inform every middle and high school student in the schools about the survey by placing a flyer on the students' lockers. The schools are located in the Midwest region of the United States of America. Fractures caused by motor vehicle accidents were excluded. The rewards for participation were two items of the participating student's choice (candy, donut, chocolate chip cookie, soda) and an entry for a \$15 gift card drawing. Signed consents from the students' parents stated that they agreed to having their children participate in this survey for research purposes, and that they reviewed the accuracy of the answers. The answers to the survey questions were anonymous. The information collected in the survey included the student's age at the time the survey was conducted, gender, the number of lifetime fractures, and any parental history of fracture, including the body parts involved. For each fracture, additional information was collected: the student's age at the time of fracture, the body part involved in the fracture, the season during which the fracture occurred, and any circumstances or activities during which the fracture happened. An independent t-test was used for statistical analysis between Group A and Group B (those with a personal history of fractures and those without, respectively).

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