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## NFL concussions study shows higher altitudes reduce risk significantly

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**Summary:** A new study analyzing concussion data for NFL players during the 16-game regular season schedules for 2012 and 2013 may provide insight that could lead to safer play, including a pathway for concussion-prevention strategies.

A new study analyzing concussion data for NFL players during the 16-game regular season schedules for 2012 and 2013 may provide insight that could lead to safer play, including a pathway for concussion-prevention strategies. Highlights of the study include:

- NFL players are 30 percent less likely to sustain concussions when playing at higher altitudes
- "Brain slosh" is the suspected common cause of concussions, not direct impact to the head
- New helmet designs and rule changes, such as penalizing helmet-to-helmet contact, have not shown a measurable impact in reduction of concussions in the NFL
- Woodpeckers and big horn (head-ramming) sheep may provide insight on how to reduce concussions

**Safer cities:** The study concludes that the risk of sustaining a concussion is significantly less at games played in the nine NFL cities with the highest altitudes, cities that range from 644 to 5,192 feet above sea level:

- Phoenix
- Atlanta
- Buffalo
- Charlotte
- Denver
- Indianapolis
- Kansas City
- Minneapolis
- Pittsburgh

The combined odds of concussion during a game in one of these cities was 30 percent less than in the 23 other cities with NFL teams.

"Brain slosh" and theories on how altitude influences concussions in football: Many football-related concussions are suspected to be caused by brain slosh. Because the brain doesn't fit tightly inside the skull, rapid acceleration and deceleration of the head puts the brain at risk for a slosh-induced injury. Cerebral blood flow rises at higher altitudes, causing the brain to fit tighter inside the skull, thus reducing the risk of concussion. It's like bubble wrapping the brain.

"If we're going to solve this problem, we have to figure out a way to protect the brain from the inside out. That's why we think we might be on the front edge of something that could influence a paradigm shift in concussion prevention-strategies," states Greg Myer, PhD, director of sports medicine research at Cincinnati Children's Hospital Medical Center. Dr. Myer is lead author of the study published this week in the *Journal of Orthopaedic and Sports Physical Therapy*.

### **Better helmets and rule changes aren't working**

Two years of data on NFL concussions from the 2012 and 2013 seasons show rule changes have not had a significant impact on the number of helmet-to-helmet hits, nor has there been a reduction in concussions. If brain slosh causes concussions and the related symptoms, then creating a better helmet will not likely solve the problem, according to Dr. Myer.

"Our brains already have a natural protective shield. Our skull is the brain's natural helmet," he says. "What modern helmets do very well is protect our skulls from fractures and lacerations. So the concept of adding more weight (and padding to a helmet) or size can create more acceleration and leverage on the head, which can increase risk of injury. From a physics perspective, helmet designs do not appear to offer effective solutions to prevent concussions. You're still going to have the brain sloshing inside of the head."

### **Animal insights**

Dr. Myer's study cites the out-of-the box thinking led by Dr. David Smith, a co-author of the study, who has researched big horn sheep and woodpeckers as animals that routinely tolerate high-speed cranium collisions with no adverse impact. A head-on collision between two rams can be 10 times greater than that of two football players; a woodpecker's impact against a tree is 20 times greater. These animals don't appear to sustain injury because they employ mechanisms that cause their brains to swell and fit tightly inside their skulls prior to impact. Dr. Myer's study suggests seeking a way for an athlete's brain to mimic that of a woodpecker or ram. "We're exploring approaches where we might be able to protect the brain from the inside out. So the question we need to answer is whether or not there is a way we can do this," he says.

### **Caffeine and oxygen**

While playing at higher altitudes corresponds with a lesser risk of sustaining a concussion, using caffeine and oxygen counteract this beneficial reduction. Why? "Oxygen use on the sideline could cause a substantial decline in cerebral blood flow and thus an increase in brain slosh. Similarly, caffeine use on the day of a game could adversely influence concussion rates," the study authors suggest.

### **NFL vs high school**

The results of Dr. Myer's NFL study mirror those of a similar study on high school athletes. The latter reviewed concussion data involving 21 million athletic exposures at 417 high schools across the country. In games played at higher than 644 feet above sea level, football players experienced 28 percent lower risk of competition-related concussions.

While the NFL and high school studies show consistent results, Dr. Myer points out he's not aware of any other research providing real insight on how to reduce football-related concussions: "Many intelligent researchers have been investigating methods to prevent concussion for many years and have not yet defined strategies that have demonstrated significant reductions in concussion rates. So the 30 percent reductions noted in the current altitude investigation is highly significant by comparison. These results indicate that further research designed to mimic the effects noted at higher altitudes are warranted."

### **Keeping kids active**

This research couldn't come at a better time. More parents are limiting the types of sports they allow their children to play because of the potential for concussions and injuries in general. USA Football, a national governing body partially funded by the NFL, states that players ages 6-14 dropped from 3 million to 2.8 million in 2011 alone.

Dr. Myer says, "It makes sense. As parents we should be taking steps to keep our children safe. And many sports do have the potential for injury. But on the flip side, I worry about the detrimental effects of inactivity. And the trends. Growing childhood obesity. Less participation in sports. More TV. Less recess. It's a recipe for inactivity and adult diseases happening earlier in childhood."

As director of sports medicine research at Cincinnati Children's and a former college football player, Dr. Myer wants to create more opportunities for kids to be active by making sports safer. Hopefully fewer concussions at the NFL level will eventually translate into more kids playing football at the peewee level.

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### **Story Source:**

The above story is based on materials provided by **Cincinnati Children's Hospital Medical Center**.

*Note: Materials may be edited for content and length.*