

# Researchers find no age-related differences in post-concussion symptoms

September 24 2013

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Recent scientific findings have raised the fear that young athletes may fare worse after sustaining a sports-related concussion than older athletes. Researchers from Vanderbilt University School of Medicine compared symptoms associated with concussion in middle/high school-age athletes with those in college-age athletes to determine whether age-related differences exist. These researchers found no significant differences between the two age groups in the number or severity of sports-related concussion symptoms or in the amount of time it took for the athletes' concussion symptoms to return to baseline values.

These findings are reported and discussed in "Does age affect symptom recovery after sports-related concussion? A study of high school and college athletes. Clinical article," by Young M. Lee, B.S.P.H., Mitchell J. Odom, B.S., Scott L. Zuckerman, M.D., Gary S. Solomon, Ph.D., and Allen K. Sills, M.D., published today online, ahead of print, in the [\*Journal of Neurosurgery: Pediatrics\*](#).

At the 3rd International Conference on Concussion in Sport, held in Zurich in 2008, a consensus was reached that young age (less than 18 years) has a "modifying" effect on concussion management, specifically due to the fact that younger athletes display different [physiological responses](#) following concussion than their adult counterparts. Because of discordant findings in studies on the relationship between the athlete's age and sports-related concussion [symptoms](#) and their duration, Lee, Odom, and colleagues chose to study age-related differences by applying rigorous matching criteria across different age groups and by using

reliable change index (RCI) methodology. The RCI allows researchers to judge the significance of changes in an individual's pre- and post-concussion symptom scores, at a specific level of confidence, and thus rule out normal variations in daily symptom experience.

The authors hypothesized that differences would exist between age groups, with younger patients having a larger number of symptoms, greater severity of symptoms, and increased time to return to baseline after sustaining a concussion.

The design of the study was retrospective and observational. The researchers reviewed the contents of a regional (western Pennsylvania) database containing information on baseline (pre-concussion) and post-concussion symptoms in middle/high school and [college athletes](#). The data had been collected using the ImPACT® (Immediate Post-Concussion Assessment and Cognitive Testing) battery of tests, which were administered as part of routine athletic care. The researchers focused on athletes in two different age groups: younger, 13 to 16 years of age with a group mean age of  $15.0 \pm 0.8$  years; and older, 18 to 22 years of age with a group mean age of  $19.1 \pm 1.1$  years. Athletes (92 in each group) were evenly matched with respect to gender (56% female, 44% male), number of previous concussions, and time to the first post-concussion test. The primary dependent variable was the number of days post-concussion it took for an athlete's Total Symptom Scale score to return to his or her own baseline (pre-concussion) level.

Each athlete completed individual pre- and post-concussion questionnaires that covered a variety of symptoms associated with concussion, some of which were headache, nausea, dizziness, fatigue, sleep problems, irritability, and difficulties with concentration or memory. Each athlete's post-concussion scores were compared to his or her own individual baseline scores.

A comparison of the number of symptoms cited at baseline showed no significant difference between the two age groups (average number of symptoms: 3.4 in the younger group and 2.5 in the older group,  $p$

No significant age-related difference was found in the severity of symptoms cited before concussion (mean symptom score 6.77 in the younger group and 5.43 in the older group,  $p = 0.333$ ). Similarly, no significant age-related difference was found in the severity of symptoms cited after concussion (mean symptom score 19.40 in the younger group and 17.72 in the older group,  $p = 0.531$ ).

Symptoms returned to baseline levels within 30 days after concussion in 95.7% of the younger athletes and in 96.7% of the older athletes ( $p > 0.999$ ). There was a difference between age groups in the mean time it took for symptoms to return to baseline levels (mean number of days: 6.92 in the younger group and 5.66 in the older group,  $p = 0.087$ ); given a statistical threshold of 0.05, this difference was not significant. In their response to an accompanying editorial, the researchers admit that this difference may be partially due to a lack of parity in both the available resources for and scheduling of clinical testing at different schools.

The authors state that some age-related differences in outcomes (notably neurocognitive effects) may exist after sports-related concussion. Previous research from the Vanderbilt Sports Concussion Center has concluded that age-related differences exist in neurocognitive testing after sports-related concussion. Further studies are warranted to delineate this further. In the present study, the researchers focused on symptoms usually associated with a concussion. They found no statistically significant differences in the number of these symptoms, their duration, and the time before symptom resolution between the two age groups.

In speaking about the paper, Dr. Scott Zuckerman said, "In the

evaluation of sports-related concussion, it is imperative to parse out different ways of assessing outcomes: neurocognitive scores versus symptom endorsement versus balance issues, school performance, etc. It appears that symptoms may not be a prominent driver when assessing outcomes of younger versus older athletes. We hope that our study can add insight into the evaluation of youth [athletes](#) after sports-related concussion."

The paper is accompanied by an editorial, by Ann-Christine Duhaime, M.D., on the difficulties encountered in matching across age groups. She applauds Lee, Odom, and colleagues for their complete data sets and rigorous matching criteria, while cautioning that definitions of concussion itself are not uniform, its diagnosis is not standardized, and it is extremely difficult to match all potentially confounding variables in a study of sports-related [concussion](#) in different [age groups](#).

**More information:** Article: Lee YM, Odom MJ, Zuckerman SL, Solomon GS, Sills AK. Does age affect symptom recovery after sports-related concussion? A study of high school and college athletes. Clinical article. Journal of Neurosurgery: Pediatrics, published online, ahead of print, September 24, 2013; [DOI: 10.3171/2013.7.PEDS12572](#).

Disclosure: Dr. Solomon reports being a consultant for ImPACT.

Editorial: Duhaime AC. Editorial. The challenge of matching across ages. Journal of Neurosurgery: Pediatrics, published online, ahead of print, September 24, 2013; [DOI: 10.3171/2013.4.PEDS1396](#).

Provided by Journal of Neurosurgery

Citation: Researchers find no age-related differences in post-concussion symptoms (2013,

September 24) retrieved 26 April 2024 from <https://medicalxpress.com/news/2013-09-age-related-differences-post-concussion-symptoms.html>

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