Children and football

A cautionary tale

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As even any casual American sports enthusiast can attest, the football season occupies a special position in the popular imagination. Fans flock to stadiums and televisions to watch their teams perform in this increasingly violent contact sport, and among these fans, children may come to idolize star players and be almost irresistibly drawn to the gridiron. Parents and coaches may also exert substantial pressure on children to take up the sport. Whereas the benefits of physical exercise are undeniable for the promotion of cardiovascular health and psychological well-being, participation in football may result in neurologic sequelae ranging from mild traumatic brain injury (mTBI)[1] to death,[2] and repetitive mTBI has been associated with a degenerative dementia in later life known as chronic traumatic encephalopathy (CTE).[3] Football has the highest injury rate among team sports, and given that 70% of all football players in the United States are under the age of 14 and that every child aged 9–12 can be exposed to 240 head impacts during a single football season,[4] a better understanding of neurobehavioral sequelae among children who play football is urgently needed. Wide gaps exist in our knowledge, but an area of particularly limited information is the long-term outcome of repetitive mTBI among children in whom recovery from the acute event was apparently complete.

Until recently, a common idea was that children recover better from brain injuries than adults because of greater plasticity in the developing brain. This view is now giving way to the opposite perspective, which holds that children and adolescents are in fact more vulnerable because the immature brain must endure not only the immediate effects of the injury but also a disruption of ongoing developmental processes.[5] Children may appear to recover fully from brain insults because of functional compensatory mechanisms, but this return to health may be illusory because neuronal recovery in the brain is incomplete.[5] With respect to TBI in children, most work has focused on moderate or severe injuries, but mTBI also deserves attention in view of its high prevalence, and repetitive head impact in football offers a useful opportunity for study.

In this issue, Stamm et al.[6] address the question of long-term vulnerability to mTBI in children who play football using an innovative approach with retired National Football League (NFL) athletes. Forty-two former NFL players were studied, of whom half had been exposed to tackle football before age 12 and half had not. The mean age of the study participants was 52, and the total number of concussions was similar between the groups. Neuropsychological testing was conducted to measure executive function, memory, and intelligence, domains commonly affected not only in mTBI but also in late-life dementia. Results indicated that the players exposed to football before age 12 had greater impairment on all measures compared to the players who began to play football at age 12 or later.

These data add to the concern about the safety of football in children. Stamm et al. remind the reader of the familiar adage that children are not simply small adults.[7] Although no neuropathologic or neuroimaging data were provided in this study, the implication is that mTBI at an early age may result in measurable cognitive effects decades later. In view of the prominence of diffuse axonal injury (DAI) in mTBI[3] and recent diffusion tensor imaging evidence of persistent white matter changes after sports-related repetitive head impact,[8] a plausible explanation for long-term cognitive effects may involve injury to white matter, but the precise pathogenesis of this impairment must await further study.

An important point made by the authors is that their data do not indicate that any study participant has or will develop CTE. This controversial entity is characterized as a late-life tauopathy among former athletes and others with previous repetitive mTBI; the controversy is in part because of public alarm that is unwarranted in view of the available scientific evidence.[9] Whereas a pathogenetic cascade from the DAI of mTBI to the tauopathy of CTE is conceivable,[10] such a process remains to be established. The crucial point for clinicians is that CTE is a purely

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neuropathologic diagnosis, and it is premature to ascribe neuropsychological impairment in former professional football players to the presence of CTE.

Limitations of this work extend beyond the absence of neuropathologic or neuroimaging data. The total exposure to repetitive mTBI cannot be definitively determined retrospectively, and it may be that cumulative exposure rather than age of exposure is responsible for the reported results. Moreover, by studying retired professional athletes, all of whom, by study criteria, had cognitive or behavioral symptoms, it becomes difficult to generalize the results to society at large. Further investigations of individuals who started in youth football but did not play beyond high school (the vast majority of players) are clearly needed. Perhaps most importantly, a causal relationship between early exposure to repetitive mTBI and later cognitive impairment cannot be established by a cross-sectional study.

These shortcomings notwithstanding, Stamm et al. have reported intriguing results that help inform the evolving discussion on the safety of football and other contact sports in children. If the age at which one is exposed to mTBI is substantiated as a risk factor for cognitive impairment or even dementia in later life, the salutary effects of physical exercise may need to be qualified by attention to the kind of sports in which children participate. Contact sports such as football may require careful consideration in children, who may appear to be resilient to mTBI but could be at risk for cognitive dysfunction decades later.

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