

Trends in brain injury among United States female students linked to consumer products

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Abstract: Consumer products related brain injury is common and more frequent in children resulting in poor outcomes but has not well characterized in female children. Recent surge in the participation of female students in sports and physical and other activities may have led to increased trends in traumatic brain injury (TBI) in female students. Understanding the trends and risk factors of consumer product-related TBI (CP-TBI) in school age females and all children may inform and contribute to implementation of effective prevention strategies reducing incidence, morbidity, and mortality.

This study aims to examine trends and consumer products related trends and risk factors of TBI linked to U.S. school age female students. Serial cross-sectional data extracted from the National Electronic Injury Surveillance System (NEISS) – All Injury Program from January 2000 to December 2019 were used. The incidence rate of CP-TBI was the primary outcome. TBI incidence rates were calculated as TBI cases per 100,000 person-year using statistical weights and standardized using the U.S. Census population corresponding to calendar year by sex and age groups. Joinpoint regression was used to examine temporal trends for CP-TBI incidence changes in magnitude and direction of changes in TBI trends illustrated by annual percent changes (APC) and average annual percent changes (AAPC).

Approximately 6.2 million school-aged children, accounting for 8.1% of all NEISS- hospitals admissions for CP-TBI care in 2000-2019, with an overall average of 308,496 CP-TBI cases and an increased TBI incidence rate of 3.6% annually. Of these CP-TBI admissions, school-aged females accounted for 34.5% of all school-aged children (2.1 million TBI cases) and a lower proportion of CP-TBI to CP-ED visits than males, 7.4% vs. 8.4%. Overall TBI incidence rate was lower in females (375.8) than in males (681.2) and increased strikingly after 2007. Regarding gender and age groups, TBI incidence rates in females were highest in the group of 14–18-year-olds (433.3), while TBI incidence rate was highest among 11-13-year-old males (734.0). Joinpoint regression models revealed TBI trends in all school-aged children were segmented into 3 periods by 2 joinpoints in 2007 and 2012, respectively, with an average annual percentage change (AAPC) of 3.6% and a higher AAPC in females (5.1%) than males (2.8%). The highest AAPC change was in the 14-18-year-old females (6.6%). TBI incidence rates increased significantly in females in all three segments, whereas TBI incidence rates decreased significantly after 2012. Most incidents of TBI occurred in sports and recreation areas, at home, and in school, 27.0%, 22.4%, and 19.9%, respectively. The most common causes of CP-TBI were activities in contacting floors/flooring materials, soccer, basketball, and bicycling were the salient activities in females, whereas football, bicycling, basketball, and in contacting floor/flooring materials in males. TBI incidence rates in school-age children increased from 2000 to 2019, peaked in 2012, and then declined in school-aged males but not females.

Effective prevention strategies should be utilized to tailor to children while informing their parents and coaches. Special attention should be given to sporting and recreational venues and salient activities at homes where female students play as part of a comprehensive safety and risk mitigation program.

Keywords: Traumatic brain injury, consumer products, school-aged children, female students