# Annual Trends in Follow-Up Visits for Pediatric Concussion in Emergency Departments and Physicians' Offices

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**Objective** To assess whether children and youth with concussion receive follow-up visits in accordance with the recommended guidelines.

**Study design** We conducted a retrospective, population-based study using linked health administrative data from all concussion-related visits to emergency department and physician offices by children aged 5 through 18 years (range, 5.00-18.99) in Ontario between 2003 and 2013. We analyzed the percentage of children and youth seen for follow-up. The Mann-Kendall test for trends was used to assess a monotonic increasing trend over time in concussion follow-up visits.

**Results** A total of 126 654 children and youth were evaluated for an index concussion visit. The number of children and youth assessed for concussion follow-up (N = 45 155) has increased significantly over time ($P < .001$). In 2003, 781 of 7126 patients (11.0%; 95% CI, 10.3-11.7) with an index visit for concussion had a follow-up assessment. By 2013, 6526 of 21 681 (30.1%; 95% CI, 29.5-30.7) patients received follow-up care.

**Conclusions** The proportion of children and youth receiving follow-up after an acute concussion has significantly increased between 2003 and 2013. Nevertheless, more than two-thirds of all patients do not seek medical follow-up or clearance as recommended by current concussion guidelines, suggesting that ongoing efforts to improve and monitor compliance with recommended guidelines by patients and physicians are important. *(J Pediatr 2017;■■:■■-■■).*

Concussions, a subset of mild traumatic brain injury, have long-term sequelae that are not yet fully understood.[1] However, it is believed that concussions can have long-term effects on memory and cognition, and increase the vulnerability of the brain to future trauma.[2-5] A comprehensive review suggests that concussions are associated with neurobehavioral and psychological implications, such as depression, anxiety, and paranoia.[1] An additional concern is that concussion rates in high schools have increased significantly.[6] Pediatric concussion initial visits in Canada have increased over time.[7,8] In Ontario, concussion-related emergency department (ED) and office visits rates per 100 000 children have quadrupled from fiscal 2003 to 2013,[8] with similar increases noted in the US.[9]

Management of sports-related concussions has improved in the last 10 years, yet there remains a lack of adherence to recommended treatment guidelines.[10] According to the *Consensus Statement on Concussion in Sport* a multistep protocol should be completed for a safe return to play after sustaining a concussion.[11-15] A brief period of physical and cognitive rest is advised for children who sustain a concussion followed by symptom-limited resumption of activity.[11] These recommendations suggest that children who have sustained a concussion should be supervised by a health professional with at least an initial diagnosis and final clearance from a physician.[11-15] However, there is often a lack of proper assessment of children who sustained a concussion during play, and as a result many continue to play despite the potential risks.[10] Most children will recover from concussion symptoms within 4 weeks.[11,16] A review of discharge instructions for patients with mild traumatic brain injury and their families from hospitals in Southern Ontario and Western New York found that discharge instructions were sometimes too complex, and often did not cover all the relevant information regarding the symptoms for which patients should return to the hospital.[17] Discharge instructions with a handoff to community care for children who have sustained a concussion vary widely, and there are often barriers that create

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|---|---|
| ED | Emergency department |
| ICD-10-CA | *International Classification of Diseases and Related Health Problems, 10th Revision, Canada* |
| OHIP | Ontario Health Insurance Plan |

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Supported by the Ontario Child Health SPOR Support Unit (OCHSU) and the Institute for Clinical Evaluative Sciences (ICES), which is funded by an annual grant from the Ontario Ministry of Health and Long-Term Care (MOHLTC). Parts of this material are based on data and information compiled and provided by the Canadian Institute for Health Information (CIHI). A.M. and A.G. are supported by Canadian Institutes of Health Research (CIHR) Chairs in Reproductive and Child Health Services and Policy Research (#126341). R.Z. is supported by a Clinical Research Chair in Pediatric Concussion by the University of Ottawa. The other authors declare no conflicts of interest.



https://doi.org10.1016/j.jpeds.2017.09.018

confusion for continued care.[18] Another study that examined youth sports found that, despite improvements in discharge instructions since 2010, there remains a lack of appropriate discharge instructions with referral to a concussion specialist for sports-related concussion.[19]

The objective of this study was to assess whether children and youth with concussion receive follow-up visits in accordance with the recommended guidelines.[11] We examined the percentage of children and youth who were seen for follow-up visit after a concussion, as well as trends in the percent of children with a follow-up visit after an index visit to either a physician's office or an ED.

## Methods

We conducted a retrospective, population-based study using provincially collected, linked administrative health data using all concussion-related visits to ED and physician offices by children and youth 5-18 years of age (range, 5.00-18.99) at the time of their visit. An index concussion visit was defined as the first visit to an ED or physician's office with a concussion diagnosis. Concussion-related index ED visits were defined as *International Classification of Diseases and Related Health Problems, 10th Revision, Canada* (ICD-10-CA) diagnosis of S060 ("Concussion"), and office visit records with an Ontario Health Insurance Plan (OHIP) diagnosis code of 850 ("Concussion") in Ontario between April 1, 2003, and March 31, 2014 (fiscal years 2003-2013). Follow-up visits were defined as visits with a medical provider in the first 3 months after an initial diagnosis of concussion at the ED or physician's office.

The Registered Persons Database, National Ambulatory Care Reporting System, ED, and OHIP diagnoses codes were linked by the Institute for Clinical Evaluative Sciences using anonymized encoded identifiers. The Registered Persons Database provided data on patient demographic characteristics. The National Ambulatory Care Reporting System, which is maintained by the Canadian Institute for Health Information, was used to ascertain ED visits, and OHIP provided information on physician billings. Both databases include information on visits, including diagnostic codes and medical procedures. Ontario has universal health coverage, all EDs in Ontario report data to National Ambulatory Care Reporting System, and nearly every physician bills OHIP. All physicians who bill OHIP would still need to submit the ICD-10 codes to the Ontario government through OHIP and, thus, this database is available for evaluation through Institute for Clinical Evaluative Sciences.

We identified the total number of ED and physician office visits for concussion index and follow-up visits and reported the percentage of individuals seen for follow-up in the ED and physician's offices over time.

### Statistical Analyses

The Mann-Kendall test for trends was used to assess a monotonic increasing trend over time in concussion follow-up visits.[19] All analyses were performed using SAS version 9.4 (SAS Corp, Cary, North Carolina); 95% CIs and .05 *P* values are reported. Research Ethics Board approval was obtained from Sunnybrook Health Sciences Center.

## Results

### Trends in Annual Concussion-Related Follow-Up Visits

Over the 10-year study period (2003-2013) the number of both index and follow-up visits for concussions increased (**Table I**). A total of 126 654 children and youth were evaluated for an index concussion visit in either an ED or physician's office. In 2003, 7126 children and youth were evaluated for a concussion; this increased to 21 681 index visits for concussion by 2013.

Similarly, the number of children and youth assessed for concussion follow-up (N = 45 155) has increased significantly ($P < .001$). In 2003, 781 of 7126 patients (11.0%; 95% CI, 10.3-11.7) with an index visit for concussion had a follow-up assessment. By 2013, 6526 of 21 681 patients (30.1%; 95% CI, 29.5-30.)) received follow-up care (**Figure**). This represents a percent change of 19.1% (95% CI, 18.6-19.5). The median time to the first follow-up visit was 8 days (IQR, 5-15). Demographic information and mechanism of injury for index

**Table I. Total number of individuals with concussion index and follow-up visits in physician's offices and ED (fiscal years 2003-2013)**

| | Index visits (n = 126 654) | No. of patients seen for follow-up (n = 26 850) | No. of follow-up visits (n = 45 155) | Percent of patients seen for follow-up (%) | Population-based rate of index visits per 100 000 (%) |
|---|---|---|---|---|---|
| 2003 | 7126 | 781 | 1010 | 11.0 | 312.58 |
| 2004 | 7795 | 877 | 1230 | 11.3 | 342.29 |
| 2005 | 7774 | 955 | 1311 ± 6* | 12.3 | 341.97 |
| 2006 | 7804 | 973 | 1394 | 12.5 | 345.29 |
| 2007 | 8320 | 1214 | 1725 | 14.6 | 269.74 |
| 2008 | 8811 | 1372 | 2100 | 15.6 | 393.76 |
| 2009 | 10 134 | 1730 | 2733 | 17.1 | 455.92 |
| 2010 | 11 572 | 2387 | 3836 | 20.6 | 523.60 |
| 2011 | 17 268 | 4773 | 8560 | 27.6 | 785.64 |
| 2012 | 18 369 | 5262 | 9451 | 28.6 | 841.55 |
| 2013 | 21 681 | 6526 | 11 809 | 30.1 | 1000.95 |

*We were not able to report cell sizes <6 for privacy reasons; therefore, some values are ± 6.



FLA 5.5.0 DTD ■ YMPD9455_proof ■ November 14, 2017