

**Appendix 2 (as submitted by the authors):** Additional details of study methods.

### **Inclusion / Exclusion Criteria**

Concussion cases were included in this study if they met the following criteria: 1) members of a NHL team's roster between October 1997 and April 2004; 2) played a regular season game between October 1997 and April 2004; 3) assessed for a concussion by a NHL team physician that was sustained during a regular season game; and 4) completion of an initial and/or follow-up Physician Evaluation Form by a NHL team physician. Concussion cases were excluded if they were: 1) not evaluated or confirmed by a NHL physician; 2) sustained during a practice, exhibition game, or playoff game; or 3) non-hockey related.

### **Data Completeness**

Data completeness was 94.6% (529/559) for time loss, 95.2% (532/559) for age, recurrent concussion, and position, 95% (533/559) for symptoms, 96% (534/559) for amnesia, 96% (537/559) for loss of consciousness, 93% (518/559) for physical exam findings, and 93% (519/559) for neurological exam findings.

### **Accuracy / Quality Assurance**

During the 1997-1998 to 2001-2002 NHL seasons, standardized initial and follow-up evaluation forms were used to record concussion events. All Physician Evaluation Forms were sent to a NHL-NHLPA Concussion Program (NCP) coordinator in Pittsburgh, Pennsylvania (United States of America) where they were checked for any missing or unclear data and manually entered into a database. If any questions arose, clarification was sought via direct contact with the respective team athletic therapist, athletic trainer, or physician. Following the 2001-2002 season, a formal data audit and entry was administered by a research technician in Calgary, Alberta (Canada). This involved cross-checking the existing NCP database with the original paper Physician Evaluation

Forms for completeness. Hardcopy physician-documented concussion cases that were not in the database were manually entered, and all duplicate concussion cases were removed. If a concussion was sustained during a practice, exhibition game, playoff game, or outside of hockey, as noted on the physician form, the case was removed from the NCP database as per the inclusion and exclusion criteria. In addition, the NHL Injury Surveillance System (NHLISS) database, an electronic database containing specific injury-related information for all injuries recorded by NHL team athletic therapists/trainers, was examined and cross-checked with the NCP physician database to extract time loss information that was not recorded on the Physician Evaluation Forms.

In cases where fields were completed in the NCP database with corresponding blank fields on the paper Physician Evaluation Form, the database was assumed to be correct as this had been accounted for by a NCP Coordinator who entered data after speaking directly with team athletic therapists/trainers, but did not record the updated fields on paper. In cases where discrepancies were noted in specific fields between the database and paper records, the paper record was assumed to be correct and the database was changed accordingly. If any one specific post-concussion sign/symptom field was left blank, with the remaining fields completed, it was assumed that this particular sign/symptom was not experienced by the athlete. Any inconsistencies with respect to date of injury or follow-up exam between the paper and database records (due to a mix-up of day/month vs month/day) were corrected in the database, as were any time loss discrepancies noted between the database and paper records.

As a result of the above data audit, a strict process and regular auditing procedure was put in place prospectively, starting with the 2002-2003 NHL regular season. Initial and follow-up Physician Evaluation Forms were combined into a single form, and several changes were made to the date and time fields to remove ambiguities (e.g., added “day/month/year” heading above “Injury

Date”, changed “Date Player Returned to Play” to “Date Player Returned to Unrestricted Participation” sections, added “24 hour time” label for loss of consciousness time). The post-concussion symptom scale was altered prior to the 2000-2001 season based on the frequency of reported signs / symptoms during the first three years of the program, and again before the 2002-2003 season when the Summary and Agreement Statement of the First International Conference on Concussion in Sport, Vienna 2001 was published (1). In addition, the terms used to describe some independent symptoms changed over the course of the study whilst retaining their connotation. Such signs/symptoms were combined into a single “umbrella” term (e.g., fatigue or low energy, photophobia or light sensitivity, nervousness or anxiousness, depression or sadness). Retrograde and anterograde amnesia were also combined to represent any form of amnesia to eliminate any potential misclassification. Physical and neurological exam findings were reported abnormal if there was at least one positive exam finding. From the 2002-2003 season onwards, physician hardcopy information was entered manually into the NCP database by a single technician and cross-checked for entry errors on an ongoing basis to assure a complete and accurate set of data by the end of each regular season.

### **Neuropsychological Testing as part of the NHL-NHLPA Concussion Program**

Neuropsychological testing in the NHL commenced in 1997. From 1997-2004, the NHL-NHLPA Concussion Program focussed on physician diagnosed concussions specifically to determine concussion rates and trends in the NHL, descriptively explore post-concussion signs, symptoms, physical exam findings, and examine time loss among professional ice hockey players. The neuropsychological and physician databases were completely separate entities during these seven years of study.

### **Description of the Estimation for Athlete Exposure Time**

Athlete-exposure time was estimated based on all NHL teams playing 82 regular season games per year, with three periods of 20 minutes stop time, and a roster of 18 skaters and one goalie playing per team, per game. There were 26 teams in 1997-1998 (40,508 player-hours), 27 teams in 1998-1999 (42,066 player-hours), 28 teams in 1999-2000 (43,624 player-hours), and 30 teams from 2000-2001 to 2003-2004 (186,960 player-hours). Thus, the total estimated athlete-exposure time over the study period was 313,158 player-hours.