

**Experiences With Sport-Related Concussions In Peterborough County**

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By: Jhaelyn M. Gomme

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Supervising Professor: Dr. Liana Brown

Trent Community Research Centre Project Coordinator: Brittany Finigan

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Suite 3.10, Trent University Student Centre

1600 West Bank Drive

Peterborough, ON K9L 0G2

Phone: [\(705\) 748-1093](tel:(705)748-1093)

Email: [tcrc@trentu.ca](mailto:tcrc@trentu.ca)

Website: [trentu.ca/tcrc](http://trentu.ca/tcrc)

## **Experiences With Sport-Related Concussions In Peterborough County**

Jhaelyn M Gomme

Department of Psychology, Trent University

0644077

PSYC- 3801H: Research Practicum

Dr. Liana Brown

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## **Introduction**

Concussions are a highly prevalent injury, impacting millions of athletes from all sports each year (Laker, 2011). However, despite the prevalence and awareness of concussions, they are often unreported or undiagnosed, resulting in improper treatment (Asken et al., 2018).

Concussions are caused by external acceleration and deceleration forces, either from hitting your head or a jerking body movement (Willer et al., 2019). These forces lead to the shearing of axons in the brain and a metabolic deficit causing symptoms including headaches, nausea, dizziness, and cognitive impairment (Majerske et al., 2008; Willer et al., 2019). If left untreated or improperly managed, concussions can lead to Post-Concussion Syndrome, Second-Impact Syndrome (SIS), and even death (Bey & Ostick, 2009; Chizuk et al., 2022; McCradden & Cusimano, 2019). Specifically, to avoid these negative impacts, if one sustains a concussion, they should be removed from play immediately after the injury and should not return to play or to learning/working until they have been cleared by a physician and their symptoms have improved (McCory et al., 2016). However, education surrounding the importance of proper concussion management, individuals are still not being removed from play, are returning to play too early, and are receiving inadequate concussion management leading to prolonged recovery, SIS, and sometimes death (Asken et al., 2018; Bey & Ostick, 2009; Chizuk et al., 2022; McCradden & Cusimano, 2019). For example, a study conducted by Asken et al. (2018), provided evidence that immediate removal from play after injury instead of a delayed removal can lead to a faster recovery and less severe symptoms. This reinforces the importance of proper concussion management.

In the current study, we examine individuals from all age groups. Notably, there are differences in how concussions should be managed between children and adults (McCory et al., 2016). Children's brains are still developing and therefore take more time to recover from a concussion on average than an adult's brain (McCory et al., 2016). Consequently, it is vital to research the management of concussions in adult and child populations. Overall, it is evident that proper concussion protocol must be followed to ensure a quick and smooth recovery.

This study aims to assess changes in concussion management in Peterborough County from 2020 to 2023. This study builds off the previous research conducted by Dr. Liana Brown in 2020, which determined that there are inconsistencies in the treatment of concussions.

## **Methods**

### **Participants**

Athletes or parents of athletes who sustained a sport-related concussion in Peterborough County since September 1<sup>st</sup>, 2020.

### **Participant Recruitment**

To recruit participants, emails with a letter from the researchers and a link to a survey were sent to sports organizations in Peterborough County. The contact information of potential sports organizations was obtained through publicly available information from the internet, which included contact information, the name of an appropriate contact person, their email, and phone number. Additionally, posters and social media posts were created and posted in the Peterborough County area and on multiple social media platforms.

### **Survey**

The questions for the survey were developed based on previous concussion literature and results. There were approximately 66 questions in the survey, with slight variation between the child and adult surveys. In the child survey, parents answered for their children, and the adult survey was completed by the individual who sustained the concussion. The survey included a consent and background information section explaining the study to the participant. Additionally, the survey asked questions about the individual's demographics, sports played at the time of injury, concussion management, the rate at which they returned to play and school, and their education on concussions beforehand.

### **Data Analysis**

A descriptive analysis was performed on the responses to the survey. This analysis was completed by calculating the percentages of each answer. For each question, the percentage represented the percentage of participants who endorsed that option.

### **Results**

There were 41 participants in this study who were diagnosed with a concussion between September 1, 2020, and March 10, 2023. Out of the total number of participants, 11 were parents answering for their children. The other 30 participants were adults responding for themselves. In the children participant group, 54.54% of participants were male, and 45.45% were female. Most of the children participants (63.63%) were in secondary school (grades 9-12). In the adult participant group, the majority of participants were female, representing a total of 63.3% of adult participants. Additionally, most adult participants were in post-secondary school, with 23% in their first year of university (Table 1).

**Table 1**  
*Demographic Information*

Question	Children 2020	Adults/Self Respondents 2020	Children 2023	Adults/Self Respondents 2023
	(Frequency of Endorsement %)			
Sex:				
Female	33.3	36.4	45.45	63.33
Male	66.7	63.6	54.54	36.67
Other	0	0	0	0
Grade/Postsecondary year:				
Primary (grades 1-5)	33.3	0	27.27	0
Intermediate (grades 6-8)	11.1	0	9	0
Secondary (grades 9-12)	55.6	16.7	63.63	16.67
University year 1	0	16.7	0	23
University year 2	0	8.3	0	3.33
University year 3	0	16.7	0	13.33
University year 4	0	33.3	0	16.67
College	0	8.3	0	3.33
College diploma	0	0	0	6.67
Bachelors degree	0	0	0	13.33
Graduate/professional degree	0	0	0	3.33

In the children participant group, ice hockey was the most prevalent sport in which a concussion was sustained (72.72%), with box lacrosse, rugby, and soccer all demonstrating the same percentage of concussions (9.09%). In the adult participant group, rugby (20.69%), ice hockey (17.24%), and soccer (17.24%) all had the highest number of concussions. Additionally,

across both participant groups, most sports were organized by a school, club, or league. Lastly, most parents attended 81-100% of their kids’ practices and 100% of their kids’ games (Table 2).

**Table 2**  
*Sport at Time of Concussion*

Question	Children 2020	Adults/Self Respondents 2020	Children 2023	Adults/Self Respondents 2023
	(Frequency of Endorsement %)			
What organized sport were you/they playing when the concussion was sustained?				
Baseball	0	0	0	0
Basketball	0	0	0	0
Cheerleading	0	0	0	0
Dance	0	6.3	0	3.45
Equestrian	0	0	0	0
Football	0	0	0	0
Figure Skating	0	0	0	0
Field Hockey	0	0	0	0
Gymnastics	0	0	0	0
Ice Hockey	66.7	12.5	72.72	17.24
Box Lacrosse	11.1	6.3	9.09	6.90
Rugby	11.1	18.8	9.09	24.14
Soccer	11.1	25.0	9.09	17.24
Swimming	0	0	0	0
Track and Field/Cross Country	0	0	0	0
Ultimate Frisbee	0	6.3	0	3.45
Volleyball	0	18.8	0	13.79
Whitewater Rafting	0	0	0	3.45
Wrestling	0	0	0	0
Field Lacrosse	0	0	0	3.45
Skiing	0	0	0	0
Judo	0	0	0	0
Karate	0	0	0	0
Other	0	6.3	0	6.90 <sup>a</sup>

The sport is a

School sport	33.3	31.3	27.27	46.15
Club or League Sport	66.7	56.3	72.72	46.15
Neighborhood or pick-up play	0	6.3	0	3.8
other	0	6.3	0	3.8
What percentage of your child's practices do you or your co-parent attend?				
0-20%	11.1		9.09	
21-40%	0		0	
41-60%	11.1		9.09	
61-80%	0		0	
81-100%	77.8		81.8	
What percentage of your child's games do you or your co-parent attend?				
0-20%	0		0	
21-40%	0		0	
41-60%	0		0	
61-80%	0		0	
81-100%	100		100	

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<sup>a</sup>Note. Specified other sports included outdoor cycling.

In both participant groups, it was evident that the individual who sustained the concussion often recognized their own injury (41.17% of children; 36.84% of adults). Amongst both participant groups, the concussion was evaluated at the time of injury, mainly by the athletic trainer/designated first aid person. In the child participant group, 81.81% did not suspect a second concussion since September 1, 2020. Of the participants who did suspect a second concussion in the child participant group, 50% did not report it to the team staff. In the adult participant group, 45.83% suspected a concussion, and 70% did not report the suspected concussion to the team staff (Table 3).

**Table 3**  
*Concussion Recognition*

Question (Frequency of endorsement %)	Children 2020	Adults/Self Respondents 2020	Children 2023	Adults/Self Respondents 2023
	(Frequency of Endorsement %)			
Who recognized the concussion?				
I recognized it	30.8	36.4	29.41	36.84
My Parent recognized it	0	9.1	0	7.89
My Child recognized it	38.5	0	41.17	0
Team staff/Teacher	23.1	18.2	23.53	18.42
Teammate	7.7	22.7	5.8	23.68
other	0	13.6	0	13.15 <sup>a</sup>
Was the injury evaluated at the time of the injury?				
Yes	87.5	56.3	90	57.69
No	12.5	43.8	10	38.46
Unsure				3.85
Who evaluated at the time of the injury?				
Team staff/teacher	37.5	12.5	30.77	16.67
Athletic trainer/designated first aid person	25.5	37.5	46.15	77.78
Official/judge	0	0	0	0
Nobody	0	43.8	0	0
EMT	0	6.3	0	5.55
Other	37.5	0	23.08 <sup>b</sup>	0

Thinking over the time since September 1, 2020, was there a time when you suspected a (another) undiagnosed concussion?	22.2	50	18.18	45.83
Yes	77.8	50	81.81	54.16
No				
Did you report the suspected concussion to team staff?				
Yes	50	25	50	30
No	50	62.5	50	70
Do not Remember	0	12.5	0	0

<sup>a</sup>Note. Specified other responses included Physiotherapists, Osteopaths, significant others, and co-workers.

<sup>b</sup>Note. Specified other responses were parents who are healthcare professionals.

In both participant groups, most participants were immediately removed from play after injury (70% of child participants; 53.85% of adult participants). When removed, 55.56% of children and 47.37% of adults were removed by a team staff member/teacher (Table 4).

**Table 4**  
*Concussion Removal*

Question	Children 2020	Adults/Self Respondents 2020	Children 2023	Adults/ Self Respondents 2023
	(Frequency of Endorsement %)			
Were you removed from play?				
Yes, immediately after the injury	62.5	50	70	53.85
Yes, continued to play but was removed before the game ended	25.0	18.8	20	19.23

No, continued to play until the game was over	12.5	31.2	10	26.92
Who removed you/them from play?				
Myself	12.5	36.4	11.11	31.57
Parent	25	0	33.33	0
Team staff member/teacher	50	45.5	55.56	47.37
Teammate	12.5	0	0	5.26
Official/Judge	0	0	0	5.26
Other	0	18.2	0	10.53 <sup>a</sup>

<sup>a</sup> Note. The specified other response was paramedics.

In both participant groups, evaluation by a healthcare professional was suggested to most individuals. In the children group, the most prominent healthcare professional seen by the participants was their family physician (36.36%) or an emergency room physician (27.27%). Also, in the adult participant group, a notable number of participants sought care from their family physician (30.77%), but care from physiotherapists was equally predominant (30.77%). In children, they were most commonly evaluated on the same day (36.36%) or 2-3 days later (36.36%). Similarly, adult participants were seen most often 2-3 days later (34.61%) (Table 5).

**Table 5**  
*Concussion Re-evaluate*

Question	Children 2020	Adults/Self Respondents 2020	Children 2023	Adults/Self Respondents 2023
	(Frequency of Endorsement %)			
After the injury/game/practice, did anyone suggest being evaluated for a concussion by a health-care professional?				
Yes	88.9	68.8	81.81	65.38
No	11.1	31.3	18.18	34.61

Who was the first healthcare professional to evaluate the injury?				
Physician (family doctor)	33.3	31.3	36.36	30.77
Emergency room Physician	33.3	25.0	27.27	19.23
Nurse Practitioner	11.1	12.5	9.09	11.54
Specialist	0	6.3	0	3.84
Psychologist	0	0	0	0
Chiropractor	0	0	9.09	0
Physiotherapist	11.1	25	9.09	30.77
Other	11.1	0	9.09 <sup>a</sup>	3.84 <sup>b</sup>

How soon after was the injury seen by a health-care professional?				
The same day (within 12 hours)	44.4	31.3	36.36	19.23
The next day (within 24 hours)	22.2	25	27.27	23.07
Within 2-3 days (Within 72 hours)	33.3	31.3	36.36	34.61
3-5 days later	0	6.3	0	7.69
5-7 days later	0	0	0	3.84
1-2 weeks later	0	6.3	0	11.54
Other	0	0	0	0

What factors influenced the timing of the first health-care visit?				
Symptoms were not clear until 1 or 2 days after the incident	25	11.8	16.67	14.28
We had to wait for an appointment with my family doctor	0	11.8	0	17.86
We didn't think it was an emergency	0	5.9	0	10.71
We wanted to wait and see if the symptoms persisted	12.5	23.5	8.33	25
We have a family/friend who is MD/Nurse Practitioner. We called them personally at first	0	0	8.33	0
It was the weekend; we waited until Monday for our family doctor's	25.0	0	33.33	0
Other	37.5	47.0	33.33 <sup>c</sup>	32.14 <sup>d</sup>

<sup>a</sup>Note. Specified other responses included parents who are health care professionals.

<sup>b</sup>Note. No specified other response

<sup>c</sup>Note. Specified other answers included the severity of symptoms requiring immediate care, the parent was a healthcare professional and provided treatment, and they recognized the symptoms from previous concussions.

<sup>d</sup>Note. Specified other responses included waiting to see if symptoms improved, waiting for a pre-planned appointment to discuss concussion, wanting to keep playing, coming in to see a specialist the same day, travelling to see a physician, being taken to the hospital by ambulance, recognizing the symptoms from previous concussions, and not being focused on head injury due to other injuries causing more pain.

In the children participant group, most participants saw a healthcare professional three times (45.45%). In the adult group, a notable number of participants saw a healthcare professional seven-plus times (36%). Interestingly, children tended to see two healthcare professionals (63.63%), whereas adults typically received care from one (44%). In both groups, most individuals were cleared by their family physician to return to play. Additionally, in the children group, none of the participants played other sports while recovering from their concussion. Similarly, the majority of the participants in the adult group did not play other sports, but a few individuals did (16.67%). Also, children returned to play without any symptoms, whereas 50% of adults were still experiencing symptoms when they returned to play. Furthermore, the majority of participants missed school or work due to their concussion; adults tended to miss more school or work than children, as a notable number of adults missed two weeks, and most children missed one to two days. Also, 90% of both groups returned to school before play. Additionally, most individuals in both groups needed extra accommodations when returning to school or work. In both groups, most participants did feel fully recovered when they returned to play (80% of children; 56.52% of adults) (Table 6).

**Table 6**  
*Concussion Return-to-Learn/Return-to-Play*

Question	Children 2020	Adults/Self Respondents 2020	Children 2023	Adults/Self Respondents 2023
	(Frequency of Endorsement %)			
How many times did you see a health-care professional (e.g., physician, nurse practitioner, chiropractor, physiotherapist, etc.) between the time of injury and time they received clearance to return to play, inclusive?				
1	11.1	18.8	9.09	16
2	0	6.3	9.09	16
3	55.6	12.5	45.45	12
4	0	0	9.09	8
5	22.2	12.5	18.18	8
6	11.1	6.3	9.09	4
7+	0	18.8	0	36
How many different health professional(s) (e.g.: physician, nurse practitioner, chiropractor, physiotherapist, etc.) did your child see between the time of injury and time of clearance?				
1	33.3	43.8	27.27	44
2	55.6	25.0	63.63	20
3	11.1	12.5	9.09	24
4	0	0	0	0
5+	0	18.8	0	12
Who provided clearance to return to play?				
Physician (family doctor)	55.6	43.8	50	56
Emergency room physician	0	0	0	0
Nurse practitioner	11.1	0	10	0
Specialist (example: neurologist, pediatrician)	0	18.8	0	12
Psychologist	0	0	0	0

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Chiropractor	0	6.3	0	4
Physiotherapist	11.1	18.8	10	12
Other	22.2	12.5	30 <sup>a</sup>	16 <sup>b</sup>

Did you play any other sports while they were sitting out of the sport in which the concussion was sustained?

Yes	0	18.8	0	16.67
No	100.00	81.3	100.00	83.33

Were you experiencing any symptoms, however mild, at the time of return to play?

Yes	0	43.8	0	50
No	100.00	56.3	100.00	50

Did you miss any school as a result of the concussion?

Yes	88.9	75.0	90.90	83.33
No	11.1	25.0	9.09	16.67

How many days of school were missed?

0	0	25.0	0	0
1-2	42.9	18.8	44.4	20
3-5	0	12.5	0	20
1 week	14.3	6.3	11.11	15
2 weeks	14.3	18.8	11.11	25
3 weeks	14.3	6.3	22.22	5
4-6 weeks	14.3	6.3	11.11	10
More than 6 weeks	0	6.3	0	5

Did you return to school before returning to play?

Yes	87.5	68.8	90	90
No	12.5	6.3	10	10
Not sure	0	25	0	0

When returning to school, was extra assistance or accommodations required?

Yes	55.6	62.5	63.63	66.67
No	44.4	37.5	36.36	33.33
Not sure	0	0	0	0

When you returned to school, did the school/teachers provide extra assistance in the classroom?

Yes	60.00		71.43	
No	40.00		28.57	

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Not sure

0

0

In your opinion, did you/they seem fully recovered from the concussion when returning to play?

Did not feel fully recovered

11.1

37.5

20

43.48

Did feel fully recovered

88.9

56.3

80

56.52

Not sure

0

6.3

0

0

<sup>a</sup>Note. The specified other responses included being cleared by their parent, who was an occupational therapist, not being cleared to return to play, and seeing a specialist.

<sup>b</sup>Note. The specified other responses included being cleared by an occupational therapist or not being cleared to return to play.

***Education***

Approximately 80% of all participants received information on the signs and symptoms of a concussion before the season began, while 66% of adult participants and 91% of participants in the children participant group knew the team’s concussion policy.

***Confidence***

In the children participant group, 80% of participants felt 80-100% confident the concussion was handled properly by team staff and medical professionals. In the adult participant group, 65% of adults felt 80-100% confident the concussion was handled properly by team staff and medical professionals. However, 24% of adults felt less than 50% confident that the concussion was handled properly. Of the child participant group, 81.2% of participants and 96% of adult participants felt confident that their current team staff could properly manage a concussion.

**Discussion**

**Concussion recognition and removal**

First, in terms of recognition and evaluation of concussions, the largest portion of individuals in both groups recognized their own concussions (41.17% of child participants;

36.84% of adult participants) and were immediately evaluated for a concussion (90% of child participants; 57.69% of adult participants) by an athletic trainer or designated first aid person (60% of child participants; 57.69% of adult participants) (Table 3). However, in both groups, this still leaves a prevalent number of individuals who were not evaluated at the time of injury, leading to possible severe consequences if they were not removed from play (Bey & Ostick, 2009; Chizuk et al., 2022; McCradden & Cusimano, 2019). In this study, 70% of children and 53.85% of adults were immediately removed from play with 55.56% of child participants; 45.37% of adult participants being removed by a team staff member or teacher (Table 4). Despite the majority of participants being removed immediately from play, a notable number of individuals were not. If individuals are not being removed from play, this can lead to increased chances of the player sustaining a second concussion in that playing period, causing SIS (Bey & Ostick, 2009). SIS occurs when a player returns to play before their concussion has healed properly (Bey & Ostick, 2009). The injured athlete then sustains a second head injury with more detrimental consequences, including swelling of the brain, cognitive impairments, and death (Bey & Ostick, 2009). Therefore, the 46.15% of individuals from the adult participant group not being removed from play immediately increase the chances that they may sustain a second hit and endure SIS (Table 4).

Additionally, Asken et al. (2018) compared the ramifications of immediate removal from play to delayed removal from play. In this study, the researchers discovered that individuals who were immediately removed from play had less severe symptoms, recovered, and returned to sports more quickly (Asken et al., 2018). Therefore, the notable number of individuals not being removed from play immediately are more likely to have prolonged recovery and more severe

symptoms (Asken et al., 2018) (Table 4). Ultimately, this emphasizes the importance of removing the player from the sport immediately after the injury (Asken et al., 2018).

Furthermore, individuals are often not removed from play due to players not reporting when they have sustained a hit to the head (Chrisman et al., 2013; Register-Mihalik et al., 2013). In the current study, 18.18% of children and 45.83% of adult participants suspected they had sustained a second concussion, but less than 50% reported it to team staff (Table 3). A study performed in 2013 by Chrisman et al. revealed that there are several barriers to why high school athletes do not report a suspected concussion including wanting to continue to play, not realizing the symptoms were a concussion because they were non-specific, and not feeling symptoms were severe enough. In a study performed in 2013 by Register-Mihalik et al., researchers studied how knowledge and attitude toward concussions impact concussion reporting. It was found that the more knowledge individuals have about concussions, the more likely they are to report them (Register-Mihalik et al., 2013). Additionally, they discovered that the attitude toward concussions could impact the individual's reporting (Register-Mihalik et al., 2013).

### **Concussion Re-evaluate**

To avoid more severe injuries or prolonged recovery, it is important that anyone who suspects they have sustained a concussion seek evaluation by a healthcare professional (McCory et al., 2016). Therefore, it was encouraging to see that 81.81% of the children participants and 65.38% of our adult participants were told to seek evaluation from a healthcare professional (Table 5). Most of the individuals in both groups sought care from their family physicians within the first three days of their injury (Table 5). However, 27.27% of children and 19.23% of adults received care from emergency room physicians (Table 5). Additionally, 30.77% of adults sought care from physiotherapists (Table 5). The varying number of recommendations for further

evaluation and different healthcare professionals providing care could lead to discrepancies in treatment that may lead to prolonged recovery in some individuals. Also, the prominent number of individuals seeking care from their family physician is of concern because results from a study conducted by Mann et al. (2017) revealed the limited training general practitioners receive in concussions. Their study determined that 32% of family physician residents did not think physicians should be involved in concussion management (Mann et al., 2017). Additionally, they discovered that only 63% of residents acknowledged SIS as a repercussion of multiple concussions (Mann et al., 2017). Therefore, the prevalence of these knowledge gaps surrounding concussions in family physicians is highly concerning because a prominent number of individuals seek care for concussions through their family physician. Perhaps individuals who sustain a concussion should be directly told to seek care from physicians who receive specific concussion training.

### **Concussion Return to Play and Return to Learn**

Returning to play or learning after a concussion is a serious decision and should always be made by a healthcare professional to avoid more severe injury, SIS, cognitive impairments, etc. (McCory et al., 2016). The results from this study reveal that a healthcare professional cleared all participants to return to play, the majority being family physicians (Table 6). As explained previously, this is of concern because most family physicians do not receive proper training on concussions and may have the player return to play too early (Mann et al., 2017). Additionally, 20% of children and 43.48% of adults felt they were not fully recovered when returning to play (Table 6). Similarly, a study conducted in 2014 by Carson et al. determined that over 40% of their participants returned to sports or learning prematurely. As stated previously, returning to play before fully recovering can lead to detrimental consequences for the player

(Bey & Ostick, 2009; Chizuk et al., 2022; McCradden & Cusimano, 2019). For example, Rowan Stringer passed away in 2013 due to SIS as she returned to play too early, sustaining a second hit to the head before her first concussion healed (“Holland Bloorview Kids”, 2016; McCradden & Cusimano, 2019). Due to the substantial loss this premature return to play caused, there is now a law entitled Rowan’s Law (McCradden & Cusimano, 2019). This law states that all players suspected to have a concussion must be removed from play, and ensures that specific members involved in the sport have concussion training (McCradden & Cusimano, 2019). Although this law is a positive step in ensuring that concussions are managed properly, the law does not provide specifics on the concussion protocol to follow or the education the individuals must receive (McCradden & Cusimano, 2019). Additionally, the law may provide awareness but does little to change sports culture (McCradden & Cusimano, 2019). In many sports, athletes receive pressure to continue to play and return to the game quickly for multiple reasons and are praised if they do (McCradden & Cusimano, 2019). With this ingrained in the training of athletes, the awareness of concussions and the severity of the repercussions of returning to sport too early will not significantly impact the decision to return to play (McCradden & Cusimano, 2019). Therefore, a greater emphasis on rebuilding the culture surrounding sports is needed to ensure that the law can have its greatest impact (McCradden & Cusimano, 2019). Also, the law should be made more specific to ensure all concussion protocols are protecting their athletes in the best manner possible. Therefore, returning to play is a serious decision and should not be made lightly, as it may lead to catastrophic results.

Similarly, returning to learning after a concussion should be a decision made between a healthcare professional and the individual based on their symptoms (McCory et al., 2016). Individuals recovering from a concussion may have challenges with memory, the school

environment, and other functional cognitive issues and thus need extra accommodations as they return to learning (Halstead et al., 2013). This current study determined that over 60% of participants required accommodations and assistance when they returned to school after their concussion (Table 6). Overall, avoiding returning to learning too early and utilizing accommodations when you do are important, as these factors can impact recovery time and symptom levels (Halstead et al., 2013; McCory et al., 2016).

### **Concussions from 2020-2023**

This study aimed to determine if there were changes in concussion management from 2020 to 2023 in Peterborough County. This data shows no notable differences in the last three years; however, further statistical analysis is needed to directly assess differences. This preliminary finding may suggest that concussion management has remained stable through the COVID-19 pandemic and the release of new concussion research. A future study done in another five years may be important to determine how current concussion research is implemented into concussion management. Additionally, in the next five years, the ramifications of COVID-19 may be further resolved.

### **Limitations**

This study had several limitations, including sample size, lack of significance analysis, length of inclusion criteria, and a lack of research questions inquiring about the assessment tools and treatments used in the participant's recovery. The sample size comprised 41 participants, of which not all participants answered every question. This small sample size can lead to data discrepancies due to participants not consistently answering all the questions and not having enough participants for the data to make a substantial impact that can be representative of the whole population. Additionally, further analysis is needed for statistical comparison of the results

of the 2020 and 2023 surveys. . Finally, individuals who sustained a concussion after September 1, 2020, in Peterborough County were included in the study. Therefore, it is possible participants may sustained their concussion three years prior to taking this survey. Due to this delay, individuals may not recall details precisely, leading to inaccurate results. Lastly, the manner in which concussions were diagnosed and treated was not evaluated in this study. This may be important as new research comes out on the effectiveness of diagnostic and treatment tools.

### **Solutions/Suggestions**

From this data, it is evident that concussions are still being improperly managed and unreported for various reasons. As determined by previous studies, one of the reasons includes knowledge and attitudes towards concussions and sports culture (McCradden & Cusimano, 2019; Register-Mihalik et al., 2013). Therefore, it is suggested that HeadsUP Concussion Advocacy Network (CAN) provide educational sessions for team staff, athletes, parents, and physicians based on the data from this study and previous studies. Specifically, I think they should review the impact sports culture has on concussion reporting, the prevalence of improper concussion management in Peterborough County, and the implications of improper concussion management. This will hopefully improve the understanding of concussion management for all the individuals involved in the concussion and eliminate improper care. Furthermore, promotion of the prevalence of improper management of concussions from this study could be posted on Peterborough Athletic Concussion Awareness (PACA) and HeadsUP CAN social media platforms in hopes of having more people understand the impact concussions have on the Peterborough County population. Additionally, in this study, it has been revealed that family physicians often manage concussions. However, as discussed previously, these physicians do not receive extensive training in concussions (Mann et al., 2017). Therefore, the Peterborough

Family Health Team should be made aware of this data and request that physicians who see more than three concussions annually receive more training. Additionally, HeadsUP CAN and PACA should promote these statistics to local physician offices and encourage them to read current literature and receive more training on concussions. Lastly, I feel that PACA and HeadsUP CAN should suggest that researchers repeat this study in another five years, after COVID-19 ramifications have been resolved, and ask more questions on concussion treatment and diagnosis.

### **Conclusion**

In conclusion, the impact of COVID-19 and updated concussion research have not evolved the management of concussions in Peterborough County, as there have been no changes in the data since the last time this study was conducted in 2020. From both studies, it has been determined that in Peterborough County, most individuals who sustained a sport-related concussion were evaluated at the time of injury by a team staff member, removed from play, and further evaluated by a healthcare professional. These results show promise that concussions are being managed properly. However, a notable number of individuals were still not receiving this standard and consistent concussion management. Therefore, this data should be utilized by healthcare professionals, sports organizations, and concussion advocates in Peterborough County to promote consistent concussion management.

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