Concussion diagnosis and management

Knowledge and attitudes of family medicine residents

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Abstract

Objective To assess the knowledge of, attitudes toward, and learning needs for concussion diagnosis and management among family medicine residents.

Design E-mail survey.

Setting University of Toronto in Ontario.

Participants Family medicine residents (N = 348).

Main outcome measures To describe relationships between awareness of concussion management and lifestyle, education background, and residency placement, *t* tests and χ^2 tests were used as appropriate. Linear regression was used to compare self-reported concussion knowledge with knowledge scores. Thematic analysis was used to interpret answers to the qualitative question asking residents to describe challenges they foresee physicians facing when diagnosing and managing concussion.

Results The residents who responded (n = 73, response rate 21%) correctly answered an average of 5.2 questions out of 9 (58%) regarding the diagnosis and management of concussion. Postgraduate year, sex, personal history of concussion, and clinical exposure to concussion were not significant factors in predicting the number of correct answers. Several misconceptions and knowledge gaps were revealed. Of residents who responded, 71% did not recognize chronic traumatic encephalopathy and only 63% recognized second-impact syndrome as consequences of repetitive concussions. Moreover, 32% of residents did not think that every individual with a concussion should see a physician as part of management. Knowledge scores did not predict self-reported concussion knowledge. Thematic analysis revealed 4 themes related to the challenges of concussion diagnosis and management: the nonspecificity and vagueness of symptoms, lack of formal diagnostic criteria, patient compliance with management, and counseling patients with respect to return to play, work, or learning.

Conclusion We found substantial gaps in knowledge surrounding concussion diagnosis and management among family medicine residents. This lack of knowledge should be addressed at both the undergraduate medical education level and the residency training level to improve concussion-related care and patient outcomes.

EDITOR'S KEY POINTS

- Concussion is a prevalent complex brain injury. The diagnosis of concussion is made solely based on clinical findings and physical examination. Unfortunately, there are gaps in physician knowledge regarding concussion, resulting in misdiagnoses and mismanagement that can lead to serious and severe long-term sequelae for patients. This is despite family physicians being the primary health resource for students, athletes, parents, and coaches.

- While most family medicine residents in this study defined *concussion* correctly, many residents did not recognize concussion symptoms, proper management strategies, or the consequences of repetitive concussive injury. Surprisingly, 32% of residents did not believe that every individual with a concussion should see a physician, 16% believed that direct trauma to the head was required to sustain a concussion, and 12% reported never learning about concussion during residency training.

- There is a need for better knowledge translation regarding concussion for family medicine residents. This might take the form of a mandatory academic half-day seminar or workshop on concussion diagnosis and management. Continued efforts to train and educate practising and future physicians about concussion diagnosis and management should be promoted to better serve patients.

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Diagnostic et traitement de la commotion cérébrale

Connaissances et attitudes des résidents en médecine familiale par rapport à la commotion cérébrale

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Résumé

Objectif Déterminer les connaissances, les attitudes et les besoins de formation des résidents en médecine familiale relativement au diagnostic et au traitement de la commotion cérébrale.

Type d'étude Une enquête par courrier électronique.

Contexte L'Université de Toronto, en Ontario.

Participants Des résidents en médecine familiale (N = 348).

Principaux paramètres à l'étude On a utilisé des tests de *t* et de χ^2 pour décrire la relation entre les connaissances sur le traitement d'une commotion, et le mode de vie, la formation reçue et le lieu de cette formation. Pour comparer ce que les participants disaient savoir des commotions, on s'est servi de l'analyse de régression et de scores pour la connaissance. On a utilisé une analyse thématique pour interpréter les réponses aux questions qualitatives demandant aux participants de décrire les défis que risque d'affronter le médecin qui doit établir le diagnostic et le traitement d'une commotion cérébrale.

Résultats Il y a eu 73 répondants (taux de réponse 21%). En moyenne, ils ont répondu correctement à 5,2 des 9 questions (58%) portant sur le diagnostic et le traitement de la commotion. L'année suivant la diplomation, le sexe et le fait d'avoir déjà subi une commotion ou d'y avoir déjà été exposé cliniquement n'étaient pas des facteurs permettant de prédire le nombre des bonnes réponses. L'étude a révélé plusieurs idées erronées et un manque de connaissances. Parmi les répondants, 71% ne connaissaient pas l'encéphalopathie traumatique, tandis que seulement 63% savaient que le syndrome du deuxième impact était dû à des commotions répétitives. De plus, 32% des résidents ne croyaient pas que toute personne ayant subi une commotion devrait rencontrer un médecin durant son traitement. Les scores pour la connaissance ne permettaient pas de prédire le niveau que le résident prétendait avoir sur la commotion. L'analyse thématique a révélé 4 thèmes liés aux difficultés que présentent le diagnostic et le traitement de la commotion cérébrale: l'aspect vague et non spécifique des symptômes de la commotion; l'absence de critères de diagnostic formels; l'observance du traitement par le patient; et les conseils au patient concernant le retour au jeu, au travail ou aux études.

Conclusion Nous avons observé des lacunes importantes dans les connaissances des résidents en médecine familiale sur le diagnostic et le traitement de la commotion cérébrale. Des mesures visant à corriger cette situation devraient être prises tant au niveau des études médicales de premier cycle que de la résidence si l'on veut améliorer les soins aux victimes de commotion et les conséquences des commotions.

POINTS DE REPÈRE DU RÉDACTEUR

- La commotion cérébrale est une atteinte relativement fréquente et complexe du cerveau. Son diagnostic repose uniquement sur les données cliniques et sur l'examen physique. Malheureusement, les médecins ont souvent une connaissance incomplète de ce problème, ce qui entraîne des erreurs de diagnostic et de traitement qui peuvent avoir de graves conséquences à long terme pour le patient. Et cela, malgré le fait que le médecin de famille soit la première ressource pour les étudiants, les athlètes, les parents et les entraîneurs.

- Bien que les résidents en médecine familiale qui participaient à cette étude aient pu donner une définition correcte de la commotion cérébrale, plusieurs d'entre eux n'en connaissaient ni les symptômes, ni la façon correcte de la traiter ni les conséquences des commotions répétitives. Étonnamment, 32% des résidents ne croyaient pas que toute personne victime d'une commotion cérébrale devrait voir un médecin; 16 % pensaient qu'un traumatisme direct à la tête était nécessaire pour qu'il y ait commotion; et 12% affirmaient n'avoir jamais eu de formation sur ce sujet durant leur résidence.

- Les résidents en médecine familiale ont besoin d'une meilleure formation sur la commotion cérébrale. Cela pourrait prendre la forme d'un séminaire obligatoire d'une demi-journée ou d'un atelier sur le diagnostic et le traitement de la commotion. Il faudra également déployer des efforts constants pour mieux renseigner et former les résidents et les médecins praticiens dans ce domaine pour qu'ils puissent mieux traiter leurs patients.

Cet article a fait l'objet d'une révision par des pairs.
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In Canada, concussions occur at an alarming rate.[1] From 2003 to 2010, a total of 88 688 pediatric concussions were treated in Ontario emergency departments or physicians' offices.[2] There was a statistically significant increase in the incidence of pediatric concussion over this time, with increasing office visits in the latter years.[2] In the United States, the Centers for Disease Control and Prevention estimate that up to 75% of the 1.5 million traumatic brain injuries each year are concussions and suggest that this number is rising.[3] The incidence of concussion is even higher among athletes participating in contact sports.[4-8] The high incidence of concussion suggests that every physician will encounter patients with concussion during his or her career.[9]

Concussion is diagnosed clinically based on the presence of at least 1 sign or symptom. In many patients with concussion it is difficult to make the diagnosis; one reason for this is that symptoms in the acute phase can change rapidly and evolve over time.[1,10] Concussion is considered to be among the most complex injuries in sports medicine to diagnose, assess, and manage. Concussion should be suspected with the presence of any 1 of many possible symptoms such as headache, loss of consciousness, confusion, dizziness, and nausea and vomiting. Similarly, concussion can be difficult to treat because management needs to be individualized and promptly initiated.[1,10]

Misdiagnosis and mismanagement of concussion can lead to devastating consequences including substantial disability and death. Indeed, there are a number of settings in which concussion can lead to increased morbidity and mortality.[1,10] One such setting is second-impact syndrome, in which a person with concussion returns to play before complete recovery and sustains a second brain injury, which can lead to death in a small number of cases. As well, serious long-term consequences can occur as a result of concussion, including postconcussion syndrome and chronic traumatic encephalopathy.[1,10]

As concussion is fundamentally a clinical diagnosis, it is imperative for health care practitioners to be familiar with current principles of concussion diagnosis and management to prevent devastating long-term sequelae for their patients.

Recent studies have demonstrated a clear gap in concussion knowledge among athletes, coaches, athletic trainers, and physicians.[11-24] A gap in concussion knowledge has been observed among Canadian undergraduate medical students,[25] neurology and neurosurgery residents,[26] pediatricians, emergency medicine physicians, and family medicine physicians.[15,16,20,22-24] In a study conducted by Ryu et al, expert review of medical charts demonstrated deficiencies in concussion diagnosis and management by primary care physicians.[23] Moreover, a study by Stoller et al showed that a large number of family physicians, emergency department physicians, and pediatricians in the greater Toronto area gave concussion management advice that was inconsistent with current concussion guidelines.[24] These data are also consistent with observations made by Lebrun and colleagues, who conducted a cross-border comparison of family physicians in Canada and the United States on concussion knowledge and practices.[15] Finally, primary care physicians, when compared with emergency medicine physicians, are more likely to refer to sports medicine specialists because they feel less comfortable managing concussion.[16] Combined, the data suggest inadequate health literacy and inadequate knowledge translation regarding concussion among physicians and the public.

Although there are extensive reports investigating knowledge about concussion among Canadian primary care physicians, none have investigated knowledge about concussion among Canadian residents in primary care specialties. This study aims to investigate knowledge and attitudes about concussion diagnosis and management among family medicine residents and to evaluate the need for increased concussion education at the residency level.

METHODS

We surveyed family medicine residents at the University of Toronto in Ontario to assess their knowledge of and attitudes toward concussion. This study received ethics approval from a designated ethics committee at the University of Toronto. An introductory letter preceding the survey explained that participation was voluntary and was not a requirement of their program. Completion and submission of the survey implied consent. All survey submissions were anonymous and no identifying data were collected. The online survey was administered via Google Forms to 348 family medicine residents at the university, of which 176 were in their first year and 172 were in their second year. A link to the survey was disseminated via e-mail by the Department of Family and Community Medicine postgraduate office. Data collection occurred over 5 weeks from January to March 2015, with reminder e-mails sent out to all 348 family medicine residents at 2 weeks and 4 weeks.

The survey was adapted and modified from a previous survey by Boggild and Tator.[26] The survey consisted of 25 questions divided into 3 sections. Section 1 comprised 8 questions to gather demographic data about the respondents.[26,27] Section 2 comprised 9 questions to assess participants' knowledge of the definitions and management considerations described in the 2012 Consensus Statement on Concussion in Sport from the 4th International Conference on Concussion in Sport held in Zurich, Switzerland.[10] Section 3 comprised 8 questions about past and current learning experiences regarding

concussion during medical training. The survey concluded with an open-ended question exploring the challenges that family medicine residents foresee when encountering a patient with concussion.[26] Questions 1 to 24 were analyzed quantitatively and question 25 was analyzed thematically. For section 2, a score of 0 to 9 was given. Each individual question was marked as correct or incorrect, with no partial marks. Questions that required the respondent to select all answers that applied were given a single mark only if all correct options were selected and none of the incorrect options was selected.[10,26] To describe relationships between awareness of concussion management and lifestyle, education background, and residency placement, *t* tests and χ^2 tests were used as appropriate. Linear regression was used to compare self-reported concussion knowledge with knowledge scores. Residents were asked to rate their perceived knowledge about concussion on a scale from 1 to 10 (1 being inadequate and 10 being completely adequate).

RESULTS

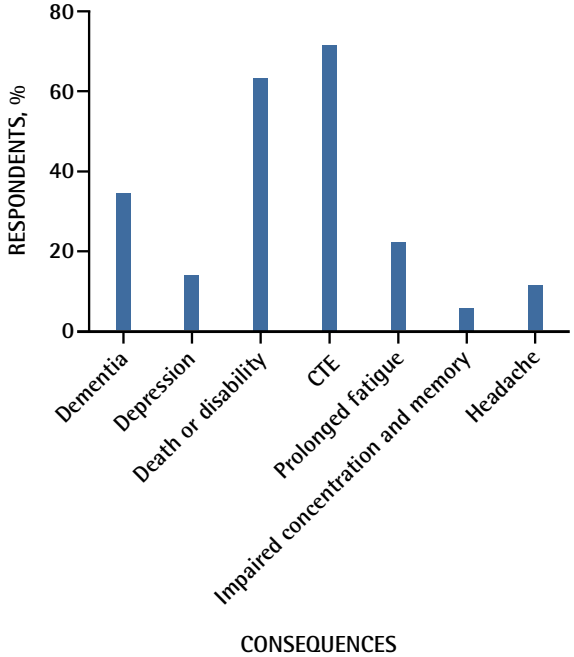
The survey was e-mailed to 348 family medicine residents and 73 were returned (21% response rate). Of the respondents, 50 (68%) were in their first year, 23 (32%) were in their second year, 26 (36%) were men, and 47 (64%) were women. Of the 73 respondents, 18 (25%) reported a history of 1 or more personally experienced concussions, of which 14 (78%) were sports related. Those who completed the survey were also classified as either early or late respondents. Early respondents (n = 39; 53%) were those who responded to the initial survey request and late respondents (n = 34) were those who responded following repeated reminders. The approximate time interval was 1 month.

On the knowledge portion of the survey, the family medicine residents correctly answered a mean (SD) of 5.2 (1.4) out of 9 questions (95% CI 4.9 to 5.6). There were no significant differences in scores when analyzing data by postgraduate year, personal history of concussion, or sex. Second-year family medicine residents were not significantly more likely to have seen a patient with concussion than first-year family medicine residents were (Yates correction χ^2, $P = .1$), and previous experience encountering concussion in the acute or chronic phase did not significantly affect knowledge scores (2-tailed *t* test; mean score = 5.2 vs 5.3, $P = .4$ for acute phase; mean score = 5.2 vs 5.0, $P = .5$ for chronic phase). When we compared early and late respondents, there was no significant difference in knowledge scores between the 2 groups (early mean [SD] 5.2 [0.2] vs late 5.3 [0.2]; 95% CI -0.7 to 0.6; $P = .052$).

Of the family medicine residents who returned the survey, 63 (86%) attended a Canadian university for their undergraduate medical education, while 10 (14%) attended a university elsewhere. Of those who attended a university in Canada, most attended either the University of Toronto or McMaster University in Hamilton, Ont (18 [29%] and 10 [16%] of the 63 respondents, respectively). Knowledge scores among respondents did not differ significantly based on location of undergraduate medical education.

Of the residents who responded, 71% (n = 52) did not select chronic traumatic encephalopathy, 63% (n = 46) did not select second-impact syndrome, and 34% (n = 25) did not select dementia as consequences of concussion (**Figure 1**). When asked to select red flags of concussion that might influence prognosis and management, 68% (n = 50) did not select young age and 25% (n = 18) did not select repeated concussions with progressively less impact force as predictors of prolonged symptoms and severe outcomes (**Figure 2**). When asked to identify appropriate management of concussion, 32% (n = 23) of respondents did not recognize that every individual with a concussion should see a physician (**Figure 3**). To sustain a concussion, 16% (n = 12) of family medicine residents believed that direct physical contact to the head was necessary. To diagnose a concussion, 47 of the 73 family medicine residents (64%) knew that only 1 or more symptoms are necessary. Of the respondents, 81% (n = 59) correctly identified that loss of consciousness occurs in less than one-third of all concussions. However, 62% (n = 45) of residents did not recognize

Figure 1. Respondents who failed to recognize possible consequences of concussion



CTE—chronic traumatic encephalopathy.

Figure 2. Respondents who did not recognize red flags of concussive injury that might predict prolonged symptoms and severe outcomes

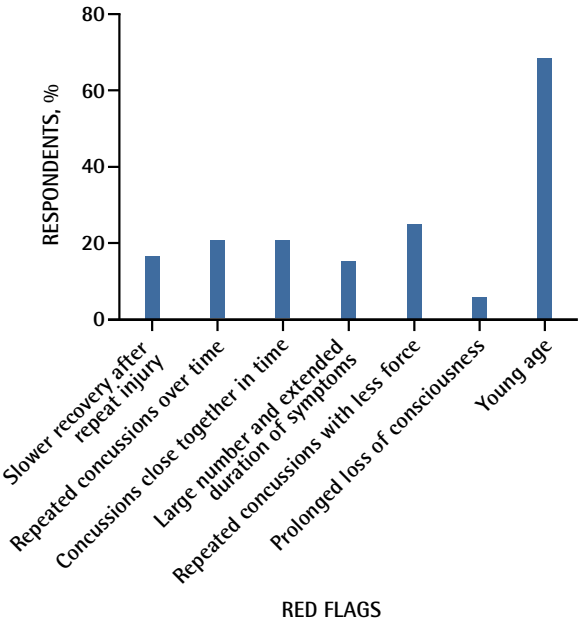
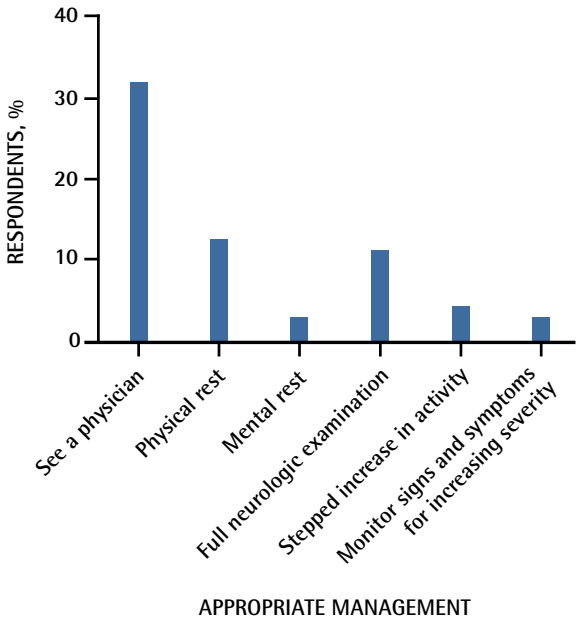


Figure 3. Respondents who failed to recognize aspects of appropriate management of concussive injury



tinnitus and 49% (n = 36) did not recognize vertigo as signs or symptoms of concussive injury (**Figure 4**). Finally, scores obtained from the knowledge section of the survey were not able to predict individuals' self-ranking of concussion knowledge (linear regression, $r^2 = 0.005$; $P = .6$) (**Figure 5**).

When residents were asked how they learned about concussion in their undergraduate medical education, lecture and emergency medicine clerkship rotation were the most frequent answers with 74% (n = 54) and 49% (n = 36), respectively. Three percent (n = 2) of residents reported never learning about concussion, while 16% (n = 12) of residents could not remember if they had learned about concussion in their undergraduate medical education. Residents reported learning about concussion during their residency training most frequently through clinical experience (70%, n = 51), self-study (60%, n = 44), and lectures (38%, n = 28). However, 12% (n = 9) of residents reported never learning about concussion during residency training (**Figure 6**). When asked to identify their preferred learning format for concussion education, the most frequent methods selected were seminar or workshop at 45% (n = 33) and lecture at 29% (n = 21).

Finally, a qualitative question asked residents to describe challenges that they foresee physicians facing when diagnosing and managing concussion. The responses were analyzed thematically and 4 consistent themes arose: the nonspecificity and vagueness of symptoms, lack of formal diagnostic criteria, patient compliance with management, and counseling patients with respect to return to play, work, or learning.

Figure 4. Respondents who failed to recognize signs or symptoms of concussion

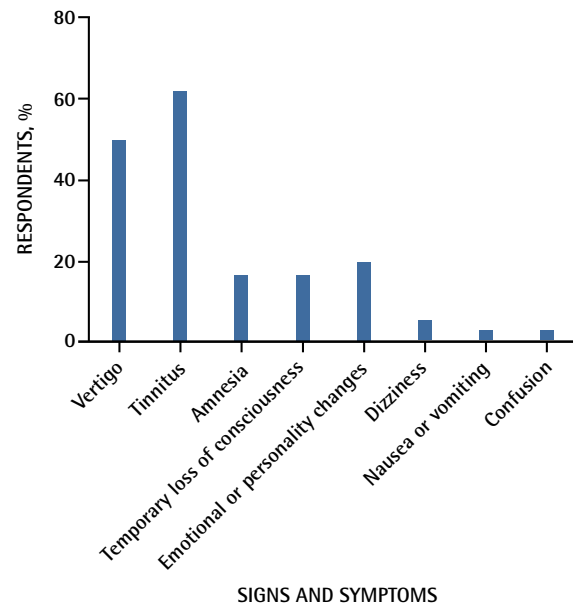


Figure 5. Respondents' knowledge scores (out of 9) vs self-rank of knowledge: *No correlation was observed (r^2 = 0.005, P = .6).*

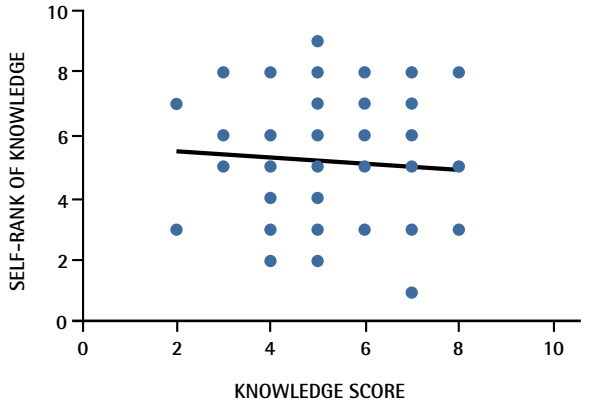
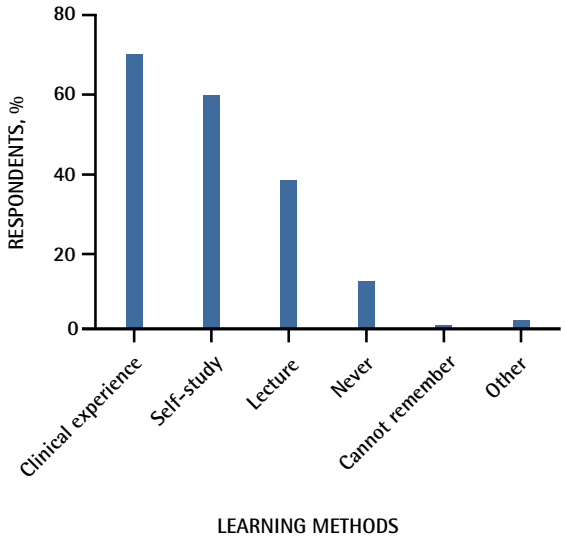


Figure 6. Residents' reported learning methods for concussion



DISCUSSION

The average score of 5.2 (58%) correct answers out of 9 questions demonstrates a considerable lack of knowledge among the family medicine residents surveyed. A large number of residents did not recognize chronic traumatic encephalopathy (71%, n = 52) or second-impact syndrome (63%, n = 46) as consequences of repetitive concussive injury. Chronic traumatic encephalopathy and second-impact syndrome have both been previously described in the literature as key reasons why expert management is necessary and why premature return to play can be devastating.[1,3] Most surprising is that 32% (n = 23) of residents did not believe that every individual with a concussion should see a physician. This is particularly concerning as it is a key component of ensuring proper concussion management and prevention.[1,3] It might indicate that some physicians still regard all concussions as benign and not requiring physician intervention. Of interest, 16% (n = 12) of surveyed family medicine residents still believed that direct trauma to the head was required to sustain a concussion. This is especially concerning, as this perception might lead to underdiagnosis and mismanagement. Although most respondents (64%, n = 47) recognized that a diagnosis of concussion requires only 1 or more symptoms, some symptoms, particularly tinnitus (62%, n = 45) and vertigo (49%, n = 36), were relatively underrecognized as being potentially caused by concussions.

Thus, the present study reveals gaps in resident knowledge about concussion that reflect a need for improvement in medical education. Some respondents reported never learning about concussion or could not remember learning about concussion in their undergraduate medical education. Moreover, 12% (n = 9) of residents reported never learning about concussion in their current residency training. Of interest, clinical experience was the most frequently selected method of concussion learning during residency; however, clinical exposure to concussion in the acute or chronic phase had no effect on knowledge scores. This study reveals opportunities for improvement in concussion teaching both in undergraduate medical education and residency training programs.

The qualitative segment of the questionnaire revealed 4 main challenges to concussion diagnosis and management perceived by the residents, and these should be addressed by those responsible for educating and preparing future physicians for clinical practice. The current gaps in physician knowledge regarding concussion reflect inadequate concussion-based teaching at the medical education level, and thus earlier educational intervention during undergraduate medical education and residency is needed. The need for enhanced concussion education is also present in other specialties, such as neurology and neurosurgery.[26]

Limitations

The sample size in this study is small (n = 73, 21% response rate). It is possible that those surveyed are not a representative sample of the family medicine residency class at the University of Toronto. Knowledge scores between early and late respondents were not

significantly different (early mean [SD] 5.2 [0.2] vs late 5.3 [0.2]). Thus, nonrespondents might be similar to late respondents in terms of knowledge scores, and we might be able to generalize these findings to the local population of family medicine residents.[28] We were unable to directly compare the demographic characteristics of our sample to the full cohort of family medicine residents, as this information is not available from the Department of Family and Community Medicine postgraduate office.

Conclusion

While most family medicine residents correctly defined *concussion*, there were clear inconsistencies in recognizing concussion symptoms and knowing proper management strategies. This study calls for better knowledge translation about concussion for family medicine residents. This might take the form of a mandatory academic half-day seminar or workshop regarding concussion diagnosis and management. Continued efforts to train and educate practising and future physicians regarding concussion diagnosis and management should be promoted to better serve patients.

Ms Mann is a medical student in the Faculty of Medicine at the University of Toronto in Ontario. **Dr Tator** is Professor in the Division of Neurosurgery at the University of Toronto, Director of the Canadian Concussion Centre at Toronto Western Hospital, Principal Investigator at the Krembil Research Institute, and a board member of Parachute Canada. **Dr Carson** is Associate Professor in the Department of Family and Community Medicine at the University of Toronto and a sports medicine physician at Markham Stouffville Hospital and the Scarborough and Rouge Hospital.

Contributors

Ms Mann was responsible for study conception and design, collection and assembly of data, data analysis and interpretation, and drafting and final approval of the manuscript. **Dr Tator** was responsible for research design, data acquisition and interpretation, and revising and approving the final manuscript. **Dr Carson** oversaw data analysis and interpretation, and provided revisions and final approval of the manuscript.

Competing interests

None declared

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