



Disponible en ligne sur

ScienceDirect
www.sciencedirect.com

Elsevier Masson France

EM|consulte
www.em-consulte.com



REVIEW

Way for improvement: Primary survey on concussion knowledge of sports stakeholders in three European countries

Pistes d'amélioration : enquête primaire sur la connaissance des commotions cérébrales chez les acteurs du sport dans trois pays européens

A. Thibaut^{a,b,*}, J.-F. Kaux^{a,c}, G. Martens^a, A. Urhausen^{a,d},
P. Tscholl^{a,e}, D. Hannouche^{a,e}, S. Le Garrec^{a,f}, M. Crema^{a,f},
L. Winkler^{a,f}, J. Cabri^{a,e}, S. Leclerc^{a,g}

^a ReFORM (Réseau francophone olympique de recherche en médecine du sport – IOC Research Centre for Prevention of Injury and Protection of Athlete Health), France

^b Coma Science Group & Brain2 Clinic, University and University hospital of Liège, Liège, Belgium

^c Physical Medicine and Sport Traumatology Department, Sports², FIFA Medical Centre of Excellence and FIMS Collaborative Centre of Sports Medicine, University Hospital of Liège, Liège, Belgium

^d Clinique du sport, Luxembourg & Luxembourg Institute of Research in Orthopedics, Sport Medicine and Science, centre hospitalier de Luxembourg, Luxembourg

^e Department of Orthopaedic Surgery, Geneva University Hospitals, Geneva, Switzerland

^f Institut national du sport, de l'expertise, et de la performance (INSEP), Paris, France

^g Institut national du sport du Québec (INS Québec), Montreal, Canada

Reçu le 20 mai 2021 ; accepté le 16 août 2021

Disponible sur Internet le 14 January 2022

KEYWORDS

Concussion ;
Sport ;
Athlete ;
Mild traumatic brain injury

Summary

Objective. – Evaluate knowledge on concussion management in three countries participating to the ReFORM group.

Methods. – In this cross-sectional survey, the target population consisted of eighty-five participants of an educational conference on concussion's management given in Switzerland, Luxembourg and Belgium in September 2019. Thirty-eight participants responded an online anonymous survey out of 85 (45%). They answered to 22 multiple choice questions regarding their knowledge on concussion diagnosis, management and treatment prior the conference.

* Corresponding author.

Adresse e-mail : athibaut@uliege.be (A. Thibaut).

<https://doi.org/10.1016/j.scispo.2021.08.001>

0765-1597/© 2021 The Authors. Published by Elsevier Masson SAS. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

MOTS CLÉS

Commotion
cérébrale ;
Sport ;
Athlète ;
Traumatisme cérébral
léger

Two were excluded (not working in sport nor healthcare professionals). Participants were medical doctors (28%), healthcare professionals (41.5%), coaches (14%), physical trainers (5.5%), or stakeholders from different positions in sport (11%). Numbers of years working in sport varied from 34% > 15 years, 41% for 5–15 years and 25% for 0–4 years. Level of sport involved included recreational, international and professional athletes.

Results. – In total, 50% of the participants were not aware of international guidelines for the management of concussions, 76% and 83% were not familiar with the stepwise “return to sport” and “return to learn” protocols, respectively. Ninety-two percent responded that an education program for athletes would be necessary. Important discrepancies were found on who is responsible for recognition and diagnostic of concussion (e.g., physician, physiotherapist or coach) and its assessment and management tools.

Conclusion. – This pilot survey highlights the lack of common knowledge about concussion diagnosis, management and treatment. A larger survey is underway to better identify specific needs of each country in the ReFORM group and offer adapted training programs.

© 2021 Les Auteurs. Publié par Elsevier Masson SAS. Cet article est publié en Open Access sous licence CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Résumé

Objectif. – Évaluer les connaissances sur la gestion des commotions cérébrales dans trois pays participant au groupe ReFORM.

Méthodes. – Dans cette enquête transversale, la population cible était constituée de quatre-vingt-cinq participants à une conférence éducative sur la gestion des commotions cérébrales donnée en Suisse, au Luxembourg et en Belgique en septembre 2019. Trente-huit participants sur 85 (45 %) ont complété une enquête anonyme en ligne. Ils ont répondu à 22 questions à choix multiples concernant leurs connaissances sur le diagnostic, la gestion et le traitement des commotions cérébrales avant la conférence. Deux personnes ont été exclues (ne travaillant pas dans le sport et n’étant pas des professionnels de la santé). L’échantillon se composait de médecins (28 %), de professionnels de la santé (41,5 %), d’entraîneurs (14 %), de préparateurs physiques (5,5 %) ou d’intervenants occupant différents postes dans le sport (11 %). Le nombre d’années de travail dans le sport variait de 34 % > 15 ans, 41 % pour 5–15 ans et 25 % pour 0–4 ans. Le niveau de sport dans lequel ils travaillaient comprenait les milieux récréatifs, internationaux et professionnels.

Résultats. – Au total, 50 % des participants ne connaissaient pas les directives internationales pour la gestion des commotions cérébrales, 76 % et 83 % ne connaissaient pas les protocoles de « retour au sport » et de « retour à l’apprentissage », respectivement. Quatre-vingt-douze pour cent ont répondu qu’un programme d’éducation pour les athlètes serait nécessaire. D’importantes divergences ont été constatées sur la question de savoir qui est responsable de la reconnaissance et du diagnostic des commotions cérébrales (par exemple, le médecin, le kinésithérapeute ou l’entraîneur), sur les outils d’évaluation et ainsi que sur la prise en charge.

Conclusion. – Cette enquête pilote souligne le manque de connaissances communes sur le diagnostic, la prise en charge et le traitement des commotions cérébrales. Une enquête plus large est en cours pour mieux identifier les besoins spécifiques de chaque pays du groupe ReFORM et proposer des programmes de formation adaptés.

© 2021 Les Auteurs. Publié par Elsevier Masson SAS. Cet article est publié en Open Access sous licence CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Concussion is defined as a temporary dysfunction secondary to a direct or indirect impact on the brain [1]. In the acute phase, many people may experience headache, fatigue, blurry vision, post-traumatic amnesia and attention disorders, among others. In some cases, concussion may result in disturbances of consciousness, ranging from a state of confusion to, more rarely, temporary loss of consciousness usually lasting a few seconds [2]. In the subacute phase, patients may experience persisting symptoms over weeks after the accident, the most common being headaches, dizziness, visual, hearing, taste or smell disorders, fatigue,

sleep disturbances [3]. The patient may further complain of memory loss and difficulty concentrating, which is particularly problematic for young patients, who are still in the learning period. Most concussions occur during recreational or sport activities, of which young people are the primary actors. In most cases, an isolated concussion is not serious, however, about 20% of patients will present a lasting complaint with a potential impact on socioprofessional life [4]. A good knowledge on concussion management is crucial to provide the appropriate cares and reduce the risks to develop chronic symptoms (i.e. post-concussion syndrome or PCS). It is especially true for athletes who represent an at-risk population, particularly in contact sports such as boxing or rugby.

They are also at higher risk to present repeated concussions, especially if a second concussion occur during the recovery phase of the initial event [5].

In the United States, between 1.6 and 3.8 million concussions occur each year [6]. A recent report using data from emergency rooms, office visits and one high school injury surveillance system estimated a rate of 1.0–1.8 million of sport related concussion per year in children under 18 years old [7], while in athletes, the number of sport related concussions is about 400,000 per year [8]. The sports that are the most concerned are: 1) the so-called “contact” or “collision” sports including martial arts and combat sports; 2) team sports such as American football, rugby, football (soccer), handball, basketball, etc. and; 3) speed sports (skiing, motorcycling, horse riding, etc.) [9]. In rugby, the incidence of concussion is estimated at an average of 10 concussions per 1000 players per hour [10]. In Europe, only a few studies have reported the incidence of concussion in sports. One study reported an incidence of 0.31 concussion per game observed in two professional rugby teams [11].

The group ReFORM (*Réseau francophone olympique de la recherche en médecine du sport*), recognized as an International Olympic Committee (IOC) Research Centre for Prevention of Injury and Protection of Athlete Health, was developed with the mission to increase knowledge, professional development and clinical application, within the Francophonie, of prevention issues related to contemporary themes in order to improve the health of athletes. One of the group main interest is to improve concussion management and knowledge in athletes, healthcare professionals, and coaches. In this context, three conferences targeting healthcare professionals to provide an overview of how to assess concussion, how to manage it in the days and week to follow, were held in Switzerland, Luxembourg and Belgium. Following the conference, participants were asked to answer questions anonymously regarding their knowledge on concussion assessment and management before having attended the conference with the aim to provide an overview of the current knowledge about concussion of sport professional.

2. Methods

2.1. Protocol

In September 2019, as part of the ReFORM’s goals to enhance knowledge on concussion management in the Francophonie, a series of three workshops were given in Liege (Belgium), Luxembourg (Luxembourg) and Geneva (Switzerland) to provide basic principles on concussion management in the acute phase. These workshops were addressed to an audience (30 to 40 people per workshop) of medical doctors, physiotherapist, coaches, and stakeholder working in sports specialised facilities targeting mostly the people working in sports where concussions are frequent.

The lecture was given by SL, a sport medicine doctor with special interest on concussion management and return to play.

A cross-sectional online survey was preferred and carried out due to its ability to target international participants, cost effectiveness and timely dissemination. Conference

participants were invited to respond to a questionnaire that explored the knowledge of the participants regarding the management of concussion prior to their participation in that conference.

2.2. Survey development and dissemination

SL developed the initial draft of the survey. The questionnaire was then sent for peer review to members of the ReFORM consortium (i.e., medical and sports experts). Following the conference, participants were asked to complete the survey via Google form.

The questionnaire consisted of 30 questions, mostly closed and multiple answers questions, regarding participants’ knowledge on concussion diagnosis, management and treatment prior the conference. Additional questions on demographic data were also included. The duration to complete the survey was approximatively 15 minutes. Eight questions were not included in this study as many participants did not answer.

The inclusion criteria were to be over 18 years old, having attended the conference, and working in sport or being a healthcare professional.

The list of questions and possible choices can be found in ([Supplementary material](#)).

2.3. Analyses

Responses from Google forms were extracted (Microsoft Excel for Windows 2016) and data were analyzed in a descriptive manner. Data checks ensured each respondent completed the survey only once. Only descriptive statistics are presented for all responses due to the number of participants and the exploratory nature of the survey.

3. Results

Thirty-eight participants out of 85 completed the survey over a period of three weeks, representing a 45% response rate. Two participants were excluded (not working in sport nor healthcare professionals), for a total of 36 answered questionnaires analyzed.

3.1. Demographic data

Seventeen survey participants attended the conference in Liege, 12 in Luxembourg and 7 in Geneva.

Ten participants were medical doctors (28%), 15 represented other healthcare professionals (41.5%), 5 were coaches (14%), 2 physical trainers (5.5%), or 4 stakeholders from different position in sport (11%); note that multiple answers were possible.

Eighteen percent ($n=6$) of participants had between 20–30 years old, 49% ($n=17$) between 31–40, 21% ($n=7$) between 41–50 and finally, 12% ($n=4$) were above 50 years old. Numbers of years working in sport varied from 34% ($n=11$) for more than 15 years, 28% ($n=9$) for 10 to 15 years, 13% ($n=4$) for 5–9 years and 25% ($n=8$) for 0–4 years.

The most represented sports were rugby (50% – $n=13$) and martial arts (30.5% – $n=11$), followed by football

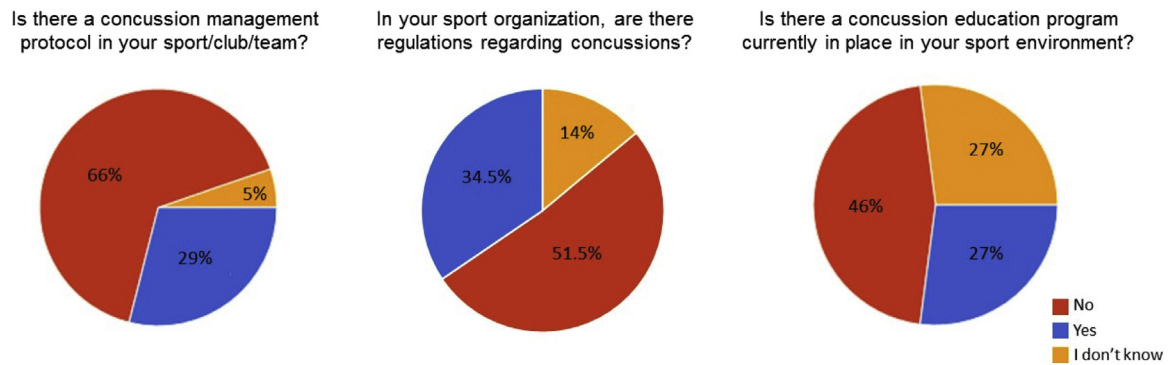


Figure 1 Percentages of responses. In red, proportion of participants who responded ‘no’, in blue, ‘yes’ and in orange ‘I don’t know’.

(14% – $n = 5$), tennis (14% – $n = 5$) and handball (11% – $n = 4$), whereas other categories were less represented (i.e., basketball, gymnastic, volleyball, ice hockey, cycling and athletics). Three respondents (8%) answered that they were working with all disciplines. Note that multiple answers were possible.

The level of sport involved ranged from recreational to international and professional teams (50% involved in local club, 41.5% in national federation, 40% in recreational sport, 30.5% in international teams, 25% in international federation, 22% in regional federation and 16.5% in professional teams).

3.2. Participants’ knowledge on concussion management (before the conference)

Note that the participants could select multiple answers for the following questions (except for yes or no questions).

The majority of participants (66% – $n = 24$) answered that there was no concussion management protocol in their club. Regarding the local regulations, 51.5% ($n = 18$) of the participants replied that no regulation regarding concussion management was in place in their organization, 14% ($n = 5$) said they did not know, the remaining 34.5% ($n = 12$) replied that such regulation exists. Out of these 12 participants, 8 were from Liege, 3 from Geneva and 1 from Luxembourg. 46% ($n = 16$) answered that no educational program was currently in place in their sport environment, 27% ($n = 10$) did not know and an additional 27% ($n = 10$) answered that such educational program was in place. Out of these 10 participants, 5 were from Liège, 3 from Geneva and 2 from Luxembourg.

Answers for the questions related to concussion management and education program are shown in Fig. 1.

The results for the questions about ‘‘who is responsible to identify a concussion’’, ‘‘who is the person responsible to confirm the diagnosis’’ and ‘‘who authorizes the return to play’’ are shown in Table 1. The majority of the participants identified the medical doctor as being the one who makes that decision.

Fifty percent of the participants ($n = 18$) replied that, prior to the conference, they were not familiar with international concussion management guidelines including the SCAT-5 [12]. When asking what tool the participants would

Table 1 Proportion of responses regarding the person responsible for identifying the concussion, confirming the diagnosis and authorizing the return to play.

Who is responsible to identify a concussion in your organization? (response rate: 33/36)	
Medical doctor	20 (60.5%)
Physiotherapist	10 (30%)
Coach	10 (30%)
Judge	4 (12%)
I don’t know	8 (24%)
Who is responsible to confirm the diagnosis of concussion (32/36)	
Medical doctor	22 (69%)
Physiotherapist	2 (6%)
Person is brought to the hospital	2 (6%)
I don’t know	6 (19%)
Who authorizes the return to play? (33/36)	
Medical doctor	23 (70%)
Physiotherapist	5 (15%)
Coach	8 (24%)
Administration of the club	1 (3%)
Player him/herself	1 (3%)
I don’t know	4 (12%)

use to assess concussion (multiple answers possible), 33% ($n = 12$) replied the SCAT-5, 42% ($n = 15$) would rely on the observation/description of the contact mechanism, 33% ($n = 12$) would use a questionnaire on the symptoms, 3% ($n = 1$) replied that such assessment was done at the hospital and 20% ($n = 7$) said that no tool was used.

To questions related to the six steps to return to sport and return to learn protocols, Fig. 2 shows that the vast majority were not aware of these protocols.

Regarding the recommendations following the diagnosis of concussion, Table 2 shows that the majority of participants either recommended 48 hours of rest or referred to a health specialist for the management.

Finally, to the question ‘‘Will you recommend an education program for athletes?’’ Ninety-two percent ($n = 33$) replied ‘‘yes’’, 2% ($n = 1$) said no and 5% ($n = 2$) did not know.

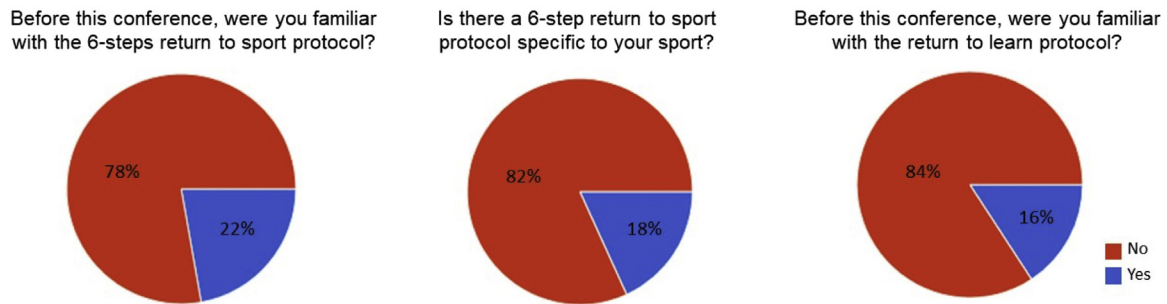


Figure 2 Percentages of responses. In red, proportion of participants who responded "no" and in blue, "yes".

Table 2 Proportion of responses regarding the recommendations following the diagnosis of concussion.

Prior to this conference, following a diagnosis of concussion, what were your recommendations? (34/36)	
48 hours of rest then a progressive return to the activity	18 (53%)
Refer to a health specialist for recommendations and management	12 (35%)
Complete rest until the symptoms have disappeared	3 (9%)
Return to sport as soon as the symptoms have disappeared	3 (9%)
To return to sport after a complete return to cognitive activities	3 (9%)
Provide the explanations of the 6 steps to return to sport including initial rest	3 (9%)
No specific recommendation	3 (9%)

SCAT-5: sport concussion assessment tool 5th edition; PCS: post-concussion syndrome.

Note that the results for some questions are not presented ($n=9$) if more than a third of the participants ($n=12$) did not answer.

4. Discussion

The aim of the survey was to provide an overview of the current knowledge of sports stakeholders and/or healthcare professionals about concussion and its management in three European countries. As expected there is still a significant lack of common knowledge about concussion diagnosis, management and treatment. Indeed, 50% of the participants were not aware of international guidelines for the management of concussions, 76% and 83% were not familiar with the 6-steps "return to sport" and "return to learn" protocols [13], respectively. In addition, important discrepancies were found between designating who is responsible for recognition and diagnosis of concussion and its assessment and management tools. On the other hand, 92% responded that an education program for athletes would be necessary, showing the interest to raise awareness among players.

Previous studies evaluated the knowledge of players and management team regarding concussion management. For instance, a study evaluated the management of concussion

in a group of nonprofessional rugby players in France who had suffered from a concussion ($n=57$) [14]. They noticed that following a concussion, only 25% of the player were examined by a doctor on the field. Sixty-one percent went to the hospital but only 53% of them were instructed to see a doctor by the management team and 61% of the players did not receive any instructions regarding the return to play. Finally, when questioned about their knowledge, 91% of the players did not know the head injury assessment protocol and 67% of them did not know the possible long-term effects of concussions [14]. Another study aiming to assess the knowledge regarding concussion of players and staff members of 47 rugby clubs showed that only 61% of respondents could give at least 3 symptoms of concussion, while all of them knew that loss of consciousness was a sign of concussion [15]. For most of the respondents, the main treatment was to rest (74%), to pass some cognitive tests (11%) and to place a neck brace (7%). Time to return to play varied across respondents (from continuing to play to more than 3 weeks of rest). This study highlighted that the diagnosis was correctly made in most of the cases, however, the knowledge on concussion management and return to sport protocol were overall quite poor [15]. In sports, it was estimated that 50% of concussions go unrecorded, do not seek for medical supervision and are not treated [16]. A better understanding of the long-term effects of concussions and an increase in scientific publications tend to decrease this percentage. However, in the present study, we observed that the majority of sport and healthcare professionals who took part to these workshops and were sensitized to the issue, representing therefore an even positive pre-selection, are not aware of the regulations, guidelines and diagnostic tools for concussion. As mentioned in the 2016 consensus statement on concussion in sports, coaches, healthcare providers, athletes and parents, must be educated regarding the detection of a concussion, how to assess it and the principles for a safe return to play [13]. The consensus also suggested web-based resources, educational videos and international outreach programs to enhance knowledge and improve management of sport related concussion [13]. As shown in a previous survey conducted in New England (USA), coaching and conferences are the two most common sources of information received about concussion [17], highlighting the importance of these vectors to improve knowledge.

Sport related concussion is known to be under-reported [18]. This may be directly linked to athletes that do not report a concussion, either because they do not consider it as not serious enough, or they did not realize that they

had a concussion, or they did not want to be removed from the game [18]. Kaut and colleagues showed that 56% of high school athletes reported no knowledge of concussion consequences and 30.4% reported continuing to play with a headache after getting hit in the head [19]. As mentioned in a recent review on concussion management, athletes who understand the consequences of concussions and report it more often, if not systematically, will consequently receive faster and better care [20]. Indeed, inappropriate management of concussion can lead to increased risk of subsequent injury and lead to long-term cognitive issues. For instance, a study reported that there's a five times greater chance of developing mild cognitive impairment and a three times greater chance of developing memory problems in a professional football player who had at least three concussion compared to players with no history of concussion [21]. A link between recurrent concussion and clinical depression in retired professional football players was also found [22].

It is clear that there is a critical need to educate sport and healthcare professionals, as well as athletes to enhance concussion management and limit short and long-term consequences. In this context, in a second step of the ReFORM project, we are developing a larger survey in the Francophonie to better identify specific needs of each country of the ReFORM group and offer adapted educational programs in order to improve knowledge, diagnosis and management of concussions in sport.

There are several caveats that need to be considered limiting the generalizability of the results. First, the number of participants was limited and not all sport and healthcare professionals were equally represented. Two thirds of the participants were healthcare professionals and only a few were coaches. Studies including a larger sample and a more balanced representation of various professions should be conducted. In addition, only three French countries were included, while sports culture, rules and regulations may be different in other countries, leading to different responses. Selection bias should also be acknowledged since the sample targeted to attend the three workshops was comprised of sport or healthcare professionals with interest in the lecture topic, thus knowing more about concussion than other professionals. This may have led to an overestimation of the current knowledge on concussion in various fields.

5. Conclusion

Our survey highlights the lack of knowledge regarding concussion management, and especially return to sport and return to learn protocols among healthcare professionals and staff members. Only one third of the participants were familiar with the SCAT-5 and the recommendations following a concussion were extremely heterogeneous. It seems that only one quarter of respondents were aware of an existing concussion education program or a concussion management protocol in their teams or club, while the vast majority of them recommended an educational program for athletes. It is crucial to raise awareness of both players, staff members and healthcare professionals in the management of concussion as it can induce long-term impairment.

Funding

The French-speaking network Réseau francophone olympique de la recherche en médecine du sport (ReFORM) is recognized as a research center for the Prevention of Injury and Illness and the Protection of Athletes by the International Olympic Committee (IOC). As a member of the IOC Medical Research Network, ReFORM has received funding from the IOC to establish long-term research programs on the prevention of injuries and illnesses in sport for the protection of athlete health. GM is paid full-time by ReFORM through the IOC funding.

Disclosure of interest

The authors declare that they have no competing interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://doi.org/10.1016/j.scispo.2021.08.001>.

Références

- [1] Choe MC, Giza CC. Diagnosis and management of acute concussion. *Semin Neurol* 2015;35:29–41, <http://dx.doi.org/10.1055/s-0035-1544243>.
- [2] Giza C, Greco T, Prins ML. Concussion: pathophysiology and clinical translation. *Handb Clin Neurol* 2018, <http://dx.doi.org/10.1016/B978-0-444-63954-7.00006-9>.
- [3] Hiploylee C, Dufort PA, Davis HS, Wennberg RA, Tartaglia MC, Mikulis D, et al. Longitudinal study of postconcussion syndrome: not everyone recovers. *J Neurotrauma* 2017, <http://dx.doi.org/10.1089/neu.2016.4677>.
- [4] Tator CH, Davis HS, Dufort PA, Tartaglia MC, Davis KD, Ebraheem A, et al. Postconcussion syndrome: demographics and predictors in 221 patients. *J Neurosurg* 2016, <http://dx.doi.org/10.3171/2015.6.JNS15664>.
- [5] Terwilliger VK, Pratson L, Vaughan CG, Gioia GA. Additional post-concussion impact exposure may affect recovery in adolescent athletes. *J Neurotrauma* 2016, <http://dx.doi.org/10.1089/neu.2015.4082>.
- [6] Hyder AA, Wunderlich CA, Puvanachandra P, Gururaj G, Kobusingye OC. The impact of traumatic brain injuries: a global perspective. *NeuroRehabilitation* 2007, <http://dx.doi.org/10.3233/nre-2007-22502>.
- [7] Harmon KG, Clugston JR, Dec K, Hainline B, Herring S, Kane SF, et al. American medical society for sports medicine position statement on concussion in sport. *Br J Sports Med* 2019, <http://dx.doi.org/10.1136/bjsports-2018-100338>.
- [8] Bryan MA, Rowhani-Rahbar A, Comstock RD, Rivara F. Sports and recreation-related concussions in US youth. *Pediatrics* 2016, <http://dx.doi.org/10.1542/peds.2015-4635>.
- [9] McCrear M, Guskiewicz K, Randolph C, Barr WB, Hammeke TA, Marshall SW, et al. Incidence, clinical course, and predictors of prolonged recovery time following sport-related concussion in high school and college athletes. *J Int Neuropsychol Soc* 2013, <http://dx.doi.org/10.1017/S1355617712000872>.
- [10] Gardner A, Iverson GL, Levi CR, Schofield PW, Kay-Lambkin F, Kohler RMN, et al. A systematic review of concussion in rugby league. *Br J Sports Med* 2015, <http://dx.doi.org/10.1136/bjsports-2013-093102>.

- [11] Radafy A, Savigny A, Blanchard S, Chermann J-F. Incidence et mécanisme des commotions cérébrales dans le rugby professionnel: 2 clubs du top 14. *J Traumatol Sport* 2018, <http://dx.doi.org/10.1016/j.jts.2018.04.001>.
- [12] Echemendia RJ, Meeuwisse W, McCrory P, Davis GA, Putukian M, Leddy J, et al. The sport concussion assessment tool 5th edition (SCAT5): background and rationale. *Br J Sports Med* 2017, <http://dx.doi.org/10.1136/bjsports-2017-097506>.
- [13] McCrory P, Meeuwisse W, Dvořák J, Aubry M, Bailes J, Broglio S, et al. Consensus statement on concussion in sport – the 5th international conference on concussion in sport held in Berlin, October 2016. *Br J Sports Med* 2017, <http://dx.doi.org/10.1136/bjsports-2017-097699>.
- [14] Pecoul T, Renard A, Foucher S, Guitierrez D, Sellier A, Dagain A. Suspected brain trauma in amateur rugby players: management by the general practitioner, situation in Provence-Alpes-Côte d’Azur 2016–2017. *J Traumatol Sport* 2018, <http://dx.doi.org/10.1016/j.jts.2018.09.002>.
- [15] Brauge D, Moulin B, Lafargue M, Nogué E, Rivière D, Pariente J. Brain concussion in Midi-Pyrénées amateur rugby. *Sci Sport* 2016, <http://dx.doi.org/10.1016/j.scispo.2016.04.009>.
- [16] Harmon K, Clugston J, Dec K, Hainline B, Herring S, Kane S, et al. American Medical Society for Sports Medicine Position Statement. *Clin J Sport Med* 2013;23(1), <http://dx.doi.org/10.1097/jsm.0b013e31827f5f93>.
- [17] Guilmette TJ, Malia LA, McQuiggan MD. Concussion understanding and management among New England high school football coaches. *Brain Inj* 2007, <http://dx.doi.org/10.1080/02699050701633080>.
- [18] McCrea M, Hammeke T, Olsen G, Leo P, Guskiewicz K. Unreported concussion in high school football players: implications for prevention. *Clin J Sport Med* 2004, <http://dx.doi.org/10.1097/00042752-200401000-00003>.
- [19] Kaut KP, DePompei R, Kerr J, Congeni J. Reports of head injury and symptom knowledge among college athletes: implications for assessment and educational intervention. *Clin J Sport Med* 2003, <http://dx.doi.org/10.1097/00042752-200307000-00004>.
- [20] Littleton A, Guskiewicz K. Current concepts in sport concussion management: a multifaceted approach. *J Sport Heal Sci* 2013, <http://dx.doi.org/10.1016/j.jshs.2013.04.003>.
- [21] Guskiewicz KM, Marshall SW, Bailes J, McCrea M, Cantu RC, Randolph C, et al. Association between recurrent concussion and late-life cognitive impairment in retired professional football players. *Neurosurgery* 2005, <http://dx.doi.org/10.1093/neurosurgery/57.4.719>.
- [22] Guskiewicz KM, Marshall SW, Bailes J, McCrea M, Harding HP, Matthews A, et al. Recurrent concussion and risk of depression in retired professional football players. *Med Sci Sports Exerc* 2007, <http://dx.doi.org/10.1249/mss.0b013e3180383da5>.