

Submission in response to the Inquiry into Concussions
and repeated head trauma in contact sports

Submitted by Leon Harris

10 March 2023

Senate Inquiry

Inquiry into Concussions and repeated head trauma in contact sports

Thank you for the opportunity to make this submission. My name is Leon Harris and I am a Clinical Legal Educator at the University of the Sunshine Coast and PhD candidate in the area of Concussion in Contact Sports in Australia. I have also been admitted as a solicitor to practice in the Supreme Courts of Queensland and NSW.

I make this submission based on research I am currently conducting into the risk mitigation policies adopted by the major contact sports in Australia, particularly the AFL, the Australian Rugby League Commission (the ARLC) and Rugby Australia.

In particular, I believe there is cause for concern as the current policies in all three sports are focussed around “concussion” and do not address the dangers posed by repeated sub-concussive impacts that may occur in the normal course of contact sport participation.

These impacts, which do not result in what many would understand to be a “concussion” e.g. loss of consciousness or concussion ataxia (staggering, groggy, loss of motor control, confusion), are at least as injurious to the brain if sustained often enough over a period of time. These sub-concussive impacts may go unnoticed or undetected and occur during the usual course of the game or training through contact such as tackling and being tackled. No blow to the head is needed for such impacts to occur.

The attention given to and promotion of the various concussion policies and protocols in these sports is potentially detrimental as this takes the focus away from the serious underlying health concern of sub-concussive impacts of which all participants in contact sports should be made aware. Repeated medical studies show playing a contact sport greatly increases risk of neurological disease such as Chronic Traumatic Encephalopathy, and a range of other neurodegenerative diseases such as Alzheimer's disease, amyotrophic lateral sclerosis — also known as Lou Gehrig's disease — Parkinson's disease or frontotemporal lobar degeneration.

By focussing almost solely on risk mitigation in relation to concussion, and failing to address the risk of repeated sub-concussive impacts, the brain health of millions of Australians is potentially at risk. Participants in a contact sport *who have no substantial history of concussion* are still at greatly increased risk of developing serious neurological conditions simply because they played a contact sport.

This Parliamentary Inquiry is an important step in ensuring such risks are brought to the attention of and be understood by the public. Clear and concise information around the potential risk is crucial so informed decisions can be made by those who wish to play, as well as by the parents of children who wish to play. Other adjustments can also be made to ensure these sports in Australia continue to be enjoyed by many but until the complete picture is understood by all who participate, serious concerns should exist.

Thank you for the opportunity to provide this submission. My responses to the terms of reference are in Annexure ‘A’.

Annexure “A”

Addressing the Terms of Reference:

- i. the guidelines and practices contact sports associations and clubs follow in cases of player concussions and repeated head trauma, including practices undermining recovery periods and potential risk disclosure;*

The focus of guidelines and practices for contact sports associations and clubs at present is on concussion rather than the arguably bigger risk associate with repeated head impacts that may not meet the loosely defined “concussion” threshold.

These sub-concussive impacts do not cause symptoms at the time but there is increasing evidence that exposure over a period of time to repeated sub-concussive impacts is at least as injurious, if not more so, than that posed by concussion alone according to the Concussion Legacy Foundation. "The best available evidence suggests that sub-concussive impacts, not concussions, are the driving force behind CTE."¹

CTE is a “progressive degenerative disease of the brain found in people with a history of repetitive head impacts (RHI) often incurred during contact sport play, military service, and other activities that involve repeated blows to the head.”² It causes a range of symptoms including “memory loss, confusion, impaired judgment, impulse control problems, aggression, depression, anxiety, suicidality, parkinsonism, and, eventually, progressive dementia.”³ There have been cases of CTE discovered in athletes who have never been diagnosed with a concussion, according to the Concussion Legacy Foundation.

GAME MANAGEMENT POLICIES

- [AFL Sports Trainer in Community Football Policy](#)
- [Management of Concussion in Australian Football](#)
- [Return to Play Following Concussion - Checklist Form](#)
- [Return to Play Following Concussion - Medical Clearance Form](#)
- [Pocket Concussion Recognition Tool](#)
- [Sports Concussion Assessment Tool \(SCAT5\)](#)
- [Child Sports Concussion Assessment Tool \(SCAT5\)](#)
- [AFL Concussion Management for Junior Players](#)

The number of AFL Concussion Policy Documents – none deal with sub-concussive impacts...

Documents drafted to provide guidelines and practices to deal with concussion do not mention the risk posed by repeated sub-concussive impacts to participants. This is so for both adults and children. The number of documents and policies across the contact sports would appear to indicate the matter is being properly addressed. It is suggested, given the absence of reference to repeated sub-concussive impacts in these documents, this is not the case.

¹ ‘Subconcussive Impacts’, *Concussion Legacy Foundation* (Web page, 2023) <<https://concussionfoundation.org/cte-resources/subconcussive-impacts>>

² ‘What is CTE?’, *Boston University CTE Research Center FAQs* (Web page, 2023) <<https://www.bu.edu/cte/about/frequently-asked-questions/#:~:text=The%20symptoms%20of%20CTE%20include,end%20of%20active%20athletic%20involvement>>.

³ Ibid

Additionally with more women participating in contact sports, there is compelling medical evidence women are at increased risk of head injury. "Women athletes are more likely to get a concussion, they tend to have longer recovery periods," Dr Ann McKee, Director of the Boston University Chronic Traumatic Encephalopathy (CTE) Center has stated.⁴

There is a lack of research focussing on women in particular. For example, in Australia there were nearly 600,000 women and girls playing AFL in 2022⁵. In rugby league 28000 women and girls were playing in 2019⁶. The number of women playing contact sports is to be applauded but the risks are clear.

A review in the British Journal of Sports Medicine looked at 171 concussion studies written since 1967 which are used to inform the consensus and position statements in treating sports-related concussions. Only one per cent of them was looking exclusively at concussions in women and 40 per cent of them didn't have any women in a sample of participants at all.⁷ In the absence of more detailed work in relation to women specifically, it is argued there exists a duty to warn of the risk that are known to exist now.

j. the long-term impacts of concussions and repeated head trauma, including but not limited to mental, physical, social and professional impacts;

Participants who play contact sports such as AFL, Rugby League and Rugby Union have suffered from CTE and a range of other neurodegenerative diseases such as Alzheimer's disease, amyotrophic lateral sclerosis — also known as Lou Gehrig's disease — Parkinson's disease or frontotemporal lobar degeneration (FLD).⁸

Evidence indicates contact sport participants are up to four times more likely to die from some form of neurodegenerative disease than those who don't.⁹ This is the case even after all other risk factors such as drug and alcohol abuse and heart disease for example are excluded from the cohort.

Evidence suggests the earlier a player begins to play, and the longer they play, the more likely they will develop such a condition.¹⁰ Studies show the risk of developing CTE increase the longer a person plays contact sport. One study put the rate as "(t)he odds of CTE double every 2.6 years of football played" in relation to American Football.¹¹ The impacts experienced in Australian contact sports are comparable.

⁴ 'These young female athletes died by suicide. They all had head injuries in common', *Nine.com.au - Wide World of Sports*, 7 February 2023, <<https://wwos.nine.com.au/news/brain-injuries-kelly-caitlin-ellie-souttar-suicide-death-linked-by-head-injuries/d19ceed4-63f3-4082-8147-6f887eba5c3d?app=applenews>

⁵ 'AFL sets out plan to drive women and girls participation', *Afl.com.au*, June 12 2022, <<https://www.womens.afl/news/94987/afl-sets-out-plan-to-drive-women-and-girls-participation>

⁶ '2019 NRL Participation' *Sports Industry AU*, < https://www.footyindustry.com/?page_id=145431

⁷ 'These young female athletes died by suicide. They all had head injuries in common', *Nine.com.au - Wide World of Sports*, 7 February 2023, <<https://wwos.nine.com.au/news/brain-injuries-kelly-caitlin-ellie-souttar-suicide-death-linked-by-head-injuries/d19ceed4-63f3-4082-8147-6f887eba5c3d?app=applenews>

⁸ Stein TD, Alvarez VE, McKee AC, 'Chronic Traumatic Encephalopathy: A Spectrum of Neuropathological Changes Following Repetitive Brain Trauma in Athletes and Military Personnel', *Alzheimers Res Ther* (2014) 6(1):4. doi: 10.1186/alzrt234.

⁹ Lehman EJ, Hein MJ, Baron SL, Gersic CM. Neurodegenerative Causes of Death among Retired National Football League Players. *Neurology* (2012) 79(19):1970-4. doi: 352 10.1212/WNL.0b013e31826daf50.

¹⁰ Stern R, Riley DO, Daneshvar DD, Nowinski CJ, Cantu RC, McKee AC Long-term Consequences of Repetitive Brain Trauma: Chronic Traumatic Encephalopathy, *PM&R*, Volume 3, Issue 10, Supplement 2, 2011, Pages S460-S467 <https://www.sciencedirect.com/science/article/abs/pii/S1934148211005296>.

¹¹ Mez J, Daneshvar DH, Abdolmohammadi B, Chua AS, Alosco ML, Kiernan PT, Evers L, Marshall L, Martin BM, Palmisano JN, Nowinski CJ, Mahar I, Cherry JD, Alvarez VE, Dwyer B, Huber BR, Stein TD, Goldstein LE, Katz DI, Cantu RC, Au R, Kowall NW, Stern RA, McClean MD, Weuve J, Tripodis Y, McKee AC. 'Duration of American Football Play and Chronic Traumatic Encephalopathy', *Ann Neurol*. 2020 Jan;87(1):116-131. doi: 10.1002/ana.25611. Epub 2019 Nov 23. PMID: 31589352; PMCID: PMC6973077.

CTE is not an inevitable consequence of repeated head trauma but without repeated head trauma, CTE is very rare or even absent in the general population.¹²

The debilitating symptoms this range of neurodegenerative diseases produce means the impact on the lives of sufferers, their families and friends and the medical system in Australia is enormous. For example, the estimated cost of dementia in 2018-2019 was “almost \$3.0 billion of the total direct health and aged care system expenditure ...directly attributable to the diagnosis, treatment and care of people with dementia.”¹³ Given contact sport participants are up to four times more likely to develop such a condition, this is a concerning amount. Similar figures are present for other conditions such as Parkinson’s disease, ALS, Alzheimer’s disease, FLD, as well as CTE in Australia. The burden on society in general for these diseases is vast, and any activity which substantially increases the risk of these diseases in Australians needs to be carefully and properly administered and information about the known as well as the potential risks surely should be widely disseminated as a minimum precaution.

d. the liability of contact sports associations and clubs for long-term impacts of player concussions and repeated head trauma;

The absence of acknowledgment of and communication to participants and/or parents of children of the risks posed by sub-concussive impacts is apparent.

4. Limitation of Liability and Release

- (a) You understand that there are inherent risks associated with participation in the Program, which may result in personal injury (even of a serious nature) to a child and that you fully accept and agree to bear those risks.
- (b) You agree not to bring any claim, demand, action or proceeding against the AFL (which shall include its directors, employees, agents and volunteers) for any damage, loss or injury whatsoever that you or a child may suffer from participation in the Program.

AFL Clause (General)

The documentation presented to potential participants (or parents/caregivers) attempts to limit liability by referring to “inherent risk” of the sport.

¹² Forrest SL, Kril JJ, Wagner S, Honigschnabl S, Reiner A, Fischer P, et al., ‘Chronic Traumatic 382 Encephalopathy (Cte) Is Absent from a European Community-Based Aging Cohort While Cortical 383 Aging-Related Tau Astroglipathy (Artag) Is Highly Prevalent’, *J Neuropathol Exp Neurol* (2019) 384 78(5):398-405. Epub 2019/04/03. doi: 10.1093/jnen/nlz017.

¹³ ‘Dementia in Australia’, *Australian Institute of Health and Welfare*, 23 February 2023, <<https://www.aihw.gov.au/reports/dementia/dementia-in-aus/contents/health-and-aged-care-expenditure-on-dementia>

Assumption of Risk

By agreeing to the conditions set out in these Terms and Conditions, the Player acknowledges and agrees that:

- Australian Football is a body contact sport in which physical injury may occur from time to time and, based on this understanding, he or she is none the less desirous of playing Australian Football; and
- the Player **takes upon themselves the risk** (both physical and legal) of injury arising in the course of training for or participating in the game of Australian Football.

Limitation of Liability and Release

The Player acknowledges and agrees that:

- by accepting to bear **the inherent risks** of participating in Australian Football, the Player will not bring any claim or proceeding against an Australian Football Body for any damage, loss or injury whatsoever that they may suffer from participation in Australian Football;
- to the extent permitted by law, an Australian Football Body's liability to the Player is limited to the Player's Club or League supplying any services to which the Player is entitled in accordance with these Terms and Conditions;
- the Player understands that as a registered player participating in an Australian Football competition they may be entitled to certain sports injury insurance benefits subject to the terms of insurance applicable to the relevant Australian Football Body.

AFLQ Junior Registration Form Disclaimer

However, the Civil Liability Act (Qld) 2003 s.16(3) states "This section does not operate to exclude liability in connection with a duty to warn of a risk." This section is substantially the same in other Australian jurisdictions. There is clearly a risk, even if the scope of the risk is not yet fully understood, to participants for repeated sub-concussive impacts.

It would be arguable there exists a duty to warn participants of this danger, therefore liability under the legislation could not be excluded.

e. the role of sports associations and clubs in the debate around concussion and repeated head trauma, including in financing research;

There is a clear over-reliance on "concussion" centred policies to the exclusion of policies that address the risk posed by sub-concussive impacts which are much more prevalent and potentially injurious than "concussion".

Such reliance by contact sporting codes such as AFL, Rugby Union and Rugby League in Australia on developing concussion protocols based on statements issued periodically from the CISG (Concussion in Sport Group). The AFL stated in the Concussion Guidelines 2017 "The summary from the Berlin meeting provides the most up-to-date knowledge on SRC (sport related concussion). It also outlines the current best practice management guidelines."¹⁴ It is noted such an endorsement is absent from the latest guidelines.

This reliance on the CISG for guidance is problematic for a number of reasons, not least being the position assumed by this group as the world leading experts on concussion in sport is contested by many neurological researchers with vast experience in brain injuries in general and among those who have played contact sport in particular. Simply put the CISG has risen to a position of prominence that is at odds with the view of many medical professionals in the field.

The CISG's funding arrangements are questionable if potential conflicts of interest are not disclosed. The funding for the work of the CISG comes primarily from the sports themselves which calls into question the likelihood of a statements being issued from the CISG that might be perceived as negative for the sports

¹⁴ 'The Management of Concussion in Australian Football', *AFL Concussion Working Group Scientific Committee*, June 2017, >https://s.afl.com.au/staticfile/AFL%20Tenant/AFL/Files/Respect%20and%20Responsibility/2017_Community_Concussion_Guidelines.pdf

involved. There have been concerns raised with CISG statements that appear to downplay the causative links between concussion in sports and serious brain injury. There have been no statements made by this group acknowledging the risks posed from sub-concussive impacts.

A recent paper stated the CISG has “consistently failed to include experts with the diversity of training, experience, cultural competence, and affiliations it would be reasonable to expect” and that it has instead promoted a “sports-friendly” viewpoint which has “consistently downplayed the risks of concussion injury and sought to emphasise all that we do not yet know rather than all that we do know”.¹⁵

It further argues that the Consensus document needs to be subjected to additional vetting, more rigorous peer review, and include more explicit signposting of experts who have conflicts of interest because of their work with governing bodies.

Until recently, the chair of the CISG was Dr. Paul McCrory. He was also the lead author in the Concussion in Sport Consensus Statements on which many sports, including Australian contact sports, base their concussion policies. He resigned his position in 2022 following plagiarism accusations relating to his work.

A comprehensive article by leading Australian researchers in concussion in sport, Michael Buckland, Allan Pearce, and Catherine Suter, neatly summarises the problems with the reliance on CISG advice. This article outlined how Dr Chris Nowinski, the head of the Concussion Legacy Foundation in the US, pointed out the CISG is sponsored by World Rugby, FIFA, the International Olympic Committee, the International Federation for Equestrian Sports, and the International Ice Hockey Federation. He also “points out that McCrory has played a leading role in selecting the members of the CISG, and perhaps most disturbingly, he claims that McCrory “dramatically misrepresented research by Boston University in ways that minimised CTE””¹⁶.

The article further details a report by the Canadian Broadcasting Corporation in 2020 detailed 32 of the 36 members of this group had close ties to professional sporting organisations.¹⁷ A parliamentary enquiry into concussion in sport in the UK criticised UK sporting bodies in their management of concussion and the long term risks of neurological disease, stating, “What is astounding is that when it comes to reducing the risks of brain injury, sport has been allowed to mark its own homework.”¹⁸

When sports in Australia rely on the findings of the CISG, it should raise serious concerns about the reliability of the statements it has made.

i. alternative approaches to concussions and repeated head trauma in contact sport, and awareness raising about its risks;

As previously stated, the lack of information made to the public by contact sports in Australia about the risks posed by repeated sub-concussive impacts is concerning. Provision of information about such risk at the time of signing participation agreements should be made a priority. The focus has been on what is not

¹⁵ Casper, S., Bachynski, K., Buckland, M., Comrie, D., Gandy, S., Gates, J., . . . Finkel, A. (2021). ‘Toward Complete, Candid, and Unbiased International Consensus Statements on Concussion in Sport’. *Journal of Law, Medicine & Ethics*, 49(3), 372-377. doi:10.1017/jme.2021.56

¹⁶ Buckland, M., Pearce, A., Suter, C., ‘Concussion in sport: conflicts of interest drive scandal’, *InSight+ Issue 13*, 11 April 2022, <https://insightplus.mja.com.au/2022/13/concussion-in-sport-conflicts-of-interest-drive-scandal/>

¹⁷ Jeremy Allingham, ‘Brain Trust: Big questions surround the most influential concussion research on the planet’, *Canadian Broadcasting Corporation News*, March 2 2020, < <https://newsinteractives.cbc.ca/longform/brain-trust/>

¹⁸ ‘Sport allowed to ‘mark its own homework’ on reducing concussion risks’ *UK Parliament Committees*, 22 July 2021, <https://committees.parliament.uk/work/977/concussion-in-sport/news/156748/sport-allowed-to-mark-its-own-homework-on-reducing-concussion-risks>

known about the risk of such impacts rather than what is clear. As a result, awareness about the particular risk of sub-concussive impacts is not widespread.

Raising public awareness of this risk may not be in the short-term interests of contact sports as the impact on potential player participation numbers, both adult and junior, could be problematic in commercial terms. This is not to suggest such an absence of awareness is intentional but may explain an underlying reluctance to acknowledge such a risk exists. Reasonable and simple steps could be taken to promote public awareness of the risk to allow informed consent such as a disclosure statement with registration documents for example. This does not currently exist in contact sport in Australia.

Other approaches taken to reduce such risk involve modifications of repeated impact loads in training. Steps to reduce impacts in training have been recommended by World Rugby, but are not mandatory. The intent to reduce repeated impact on players is clear but former Australian rugby union coach Dave Rennie pointed out, “Who’s timing it? I’m sure there’s a lot of work going into coming up with these numbers but I’m not certain how that will pan out”.¹⁹The practicalities of such measures even at the elite level of sport are questionable, which means difficulties in doing so in amateur sport are magnified.

Another example of such modifications to mitigate risk of head injury is the ban on tackles above the waist from July 2023 below the elite levels in England. Additionally, French rugby began trials in 2019 lowering the tackle height to the waist and banning two-person tackles. New Zealand began club rugby trials in 2022 with a legal tackle height of the nipple-line, or sternum, and allowed two-man tackles. The results from French rugby showed “head injuries have reduced by a factor of four and been a success in ensuring heads of defenders and attackers are not in the same airspace.”²⁰

The primary difficulty with such measures around tackle heights is they may reduce concussion but the effectiveness of measures like this on reducing harm from repeated sub-concussive impacts would be difficult to ascertain given such tackles still involve a potentially high degree of force transmitted through the body, including the head and brain, even without direct head contact.

j. international experiences in modifying sports for children;

There have been a number of modifications of contact sports for children internationally. One example is the “Tackle Can Wait” campaign in the United States.²¹ This campaign arose out of concerns about the risk of brain injury by children playing the contact sport of American Football. Recent research has indicated children playing the ‘Tackle’ version of American football over a season suffered nearly 15 times more head impacts than those who played the ‘Flag’ football version (taking of a tag attached to the body was deemed as a tackle rather than an actual tackle. Oz Tag promotes a similar version of rugby football in Australia). Additionally, the magnitude of the impacts was considerably higher. A tackle football athlete was likely to suffer 23 times more high-magnitude impacts than a flag football player.²² The “Tackle Can Wait” campaign promotes the alternative to tackle football until at least 14 years of age.

¹⁹ “Who’s timing it?’ Wallabies coach Dave Rennie queries contact training limits’, *The Guardian Australia*, September 23 2021, <https://www.theguardian.com/sport/2021/sep/23/whos-timing-it-wallabies-coach-dave-rennie-queries-rugby-contact-training-limits>

²⁰ Iain Payten, ‘Australia won’t rush to change tackle laws despite World Rugby push’, *The Sydney Morning Herald*, January 27 2023, <https://www.smh.com.au/sport/rugby-union/australia-won-t-rush-to-change-tackle-laws-despite-world-rugby-push-20230127-p5cfz3.html>

²¹ ‘Tackle Can Wait’, *Concussion Legacy Foundation*, <https://www.tacklecanwait.com/>

²² ‘Comparing Head Impacts in Youth Tackle and Flag Football’, *Centers for Disease Control and Prevention*, May 19 2021, https://www.cdc.gov/traumaticbraininjury/pubs/youth_football_head_impacts.html

In Canada from 2022, children 12 and younger no longer play full squad tackle football. This was done in response to brain injury concerns and a 40% reduction in player numbers.²³ Hockey in Canada has also modified the game.²⁴ Bodychecking (slamming into another player to keep them away from the puck) has been banned across the nation since 2013 for children under 13.

Even in the sport of association football (soccer), which is not thought of as a 'contact' sport generally (as you play the ball not the body of the opponent), concerns around brain injury have led to modifications. The United States Soccer Federation banned heading for children aged 10 or under in 2015, while the English Football Association will begin a trial in 2023 to forbid the practice for under 12s.²⁵ In Scotland, there has been a heading ban for children under 12 in place since 2020 and further restriction recommended between the ages of 12 to 17.²⁶

The contrast with Australian sports is stark. In rugby league, "no players will be able to participate in tackle rugby league until midway through the under 7s season".²⁷ In AFL, tackling is banned in Auskick until around the age of 11, although it appears a form of tackling is introduced around 9 years of age.²⁸ In rugby union, tackling is introduced in under 8s.²⁹ It is clear Australia does not have the same modified policies in contact sports played here that some countries have adopted in their contact sports. With increasing evidence the earlier a child start contact sport, the more likely it is they will suffer some sort of neurological condition later in life³⁰, the early ages at which Australian sports start contact is problematic.

²³Ken Belson, 'Football Canada approves ban on full-squad tackle football for kids 12 and under', *The New York Times*, April 4 2019, < <https://www.nytimes.com/2019/04/04/sports/-football-concussions-canada.html>

²⁴Randi Myers, 'Concussions: Tackling the hockey problem head-on', *Today's Parent*, July 13 2021, <<https://www.todaysparent.com/kids/kids-health/concussions-hockey-problem/>

²⁵Adam Pengilly, 'Concussion expert wants tackling ban for under 14s', *Sydney Morning Herald*, September 7 2022, <<https://www.smh.com.au/sport/concussion-expert-wants-tackling-ban-for-under-14s-20220905-p5bflr.html>

²⁶Sam Shedden, 'Scottish FA ban children under 12 heading footballs' *The Scotsman*, 24 February 2020, <https://www.scotsman.com/health/scottish-fa-ban-children-under-12-heading-footballs-1888923>

²⁷Michael Chammas, Sarah Keoghan and Kate Aubusson, 'Tackles banned, competitive games canned: Biggest junior league shake-up in decades', *Sydney Morning Herald*, September 30 2022, < <https://www.smh.com.au/sport/nrl/tackles-banned-competitive-games-canned-biggest-junior-league-shake-up-in-decades-20220929-p5bm4h.html>

²⁸Olivia Di Iorio, 'Tackling in kids' sport defended despite new report warning of long-term risks', *ABC News Online*, 30 July 2022, <<https://www.abc.net.au/news/2022-07-30/tackling-kids-footy-defend-harvard-report-brain-impacts/101283510>

²⁹ Brisbane Junior Rugby Union, Under 6-u9 Mixed Rules, <<https://www.bjru.com.au/copy-of-boys-rugby-1>

³⁰ Stern R, Riley DO, Daneshvar DD, Nowinski CJ, Cantu RC, McKee AC, 'Long-term Consequences of Repetitive Brain Trauma: Chronic Traumatic Encephalopathy', *PM&R*, Volume 3, Issue 10, Supplement 2, 2011, Pages S460-S467 <https://www.sciencedirect.com/science/article/abs/pii/S1934148211005296>.