ACADEMIC: REVIEW ARTICLE

Traumatic brain injuries in Aotearoa New Zealand adolescents: Health inequity pathways from upstream factors to downstream causes

Angad S. Chauhan

Introduction

Children, adolescents, and young adults comprise 70% of all traumatic brain injuries (TBIs) in Aotearoa New Zealand.[1,2] TBIs are defined as acute injury incidents that cause disruption to normal brain function.[3–6] Injury is defined as transfer of energy to the human body at a force that exceeds the pathophysiological capacity of human tissues. TBI can present with loss of consciousness, headache, confusion, stroke-like symptoms, seizures, and can result in death.[1,4–7] TBIs are clinically categorised into three types based on the symptoms and severity of injury: mild (synonymously labelled concussion), moderate, and severe.[4,5] When classifying by mechanism of injury, the most common global causes of TBI are falls, assaults, and road vehicle crashes.[6,7] These immediate mechanisms of injury are also prevalent in Aotearoa, with the addition of sports-related injuries and workplace injuries.[1,2,8,9] Accounting for almost half of global TBIs, falls are a predominant mechanism of injury within the paediatric and geriatric populations, but feature less in the adolescent demographic.[1,8,10] Similarly, work-related injuries are a significant cause within the adult age groups and have a low prevalence amongst adolescents.[8]A prospective birth cohort study of Aotearoa youth reported that the three major causes of TBI during mid-adolescence were road vehicle crashes, assaults, and sports-related injuries.[8] The current literature lacks a discussion of social determinant pathways that lead to inequitable burden of TBI and hence, various upstream factors are missed in prevention strategies. This essay aims to highlight the ethnic and rural inequities along with providing a discussion of two negative and one positive social determinant pathways in the context of TBI in Aotearoa adolescents.

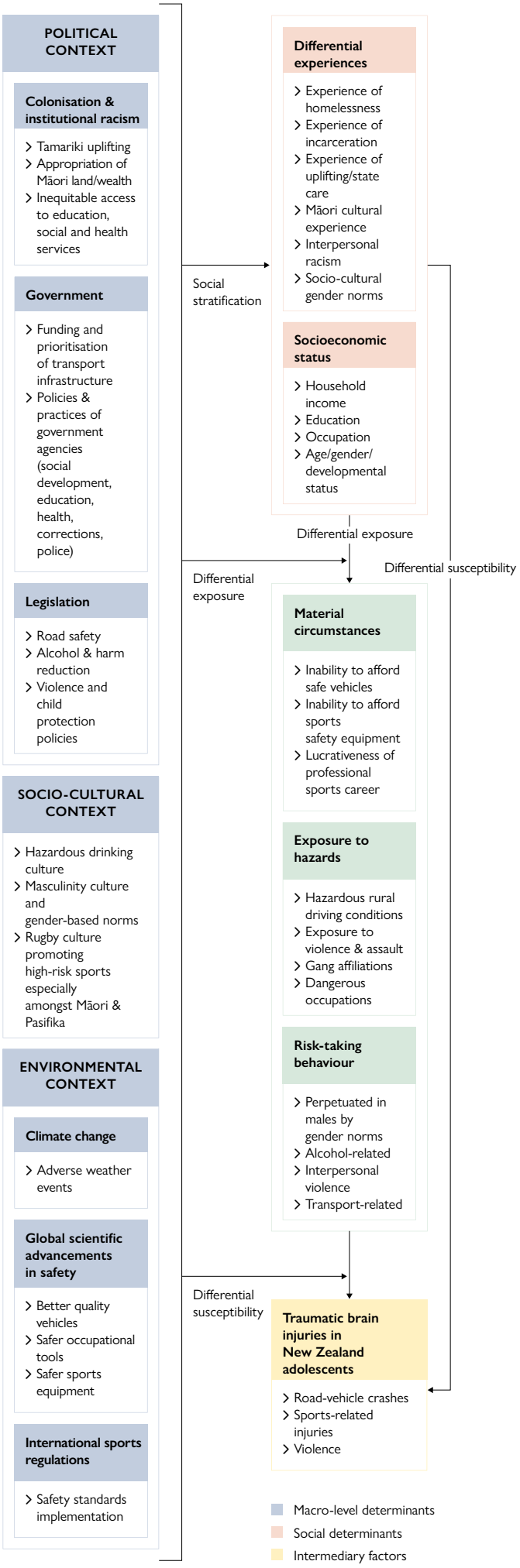
TBIs are a leading cause of death and disability worldwide.[6] Conservative measures suggest that TBIs have an annual incidence of over 50 million cases globally.[11] Although 90% of these cases are based in low- and middle-income countries, the incidence of TBI in Aotearoa is still significant, with over 36,000 annual cases.[1,6] In 2010, TBI accounted for 27% of injury-related health loss (20,300 disability-adjusted life years) in Aotearoa, with disability-adjusted life years (DALY) loss rates higher in younger age groups.[9] Amongst the adolescent population (10–19 years old), TBIs are the leading cause of mortality and are responsible for the greatest burden of disability in this age group.[12] The Aotearoa adolescent population faces the greatest burden of TBI and hence this article aims to discuss the underlying inequity pathways and social determinants that drive the incidence of TBI in Aotearoa adolescents (Figure 1).

TBIs in Aotearoa bring along a significant economic burden in addition to the health impacts at individual level. The Accident Compensation Corporation (ACC) states that over half of serious injury claims in Aotearoa are related to TBI resulting in a cost of over 83.5 million New Zealand dollars in 2015.[1] The New Zealand Treasury reports that TBIs are second only to strokes in terms of impact on employment and income.[13] This impact is worse in the adolescent population as TBI can often lead to lifelong debilitating injuries and this group possesses more years of working life ahead of them compared to the adult population. In addition to the population-level mortality, morbidity, and financial burden, TBI have serious impacts at the individual-level from physical disabilities to social disconnect.[14,15] Considering the Te Whare Tapa Whā Māori health framework, problems relating to *taha hinengaro* (mental wellbeing) and *taha whānau* (social wellbeing) are often overlooked in the context of injury presentations where *taha tinana* (physical wellbeing) becomes the main focus.[14–16]

TBIs are socially patterned in Aotearoa, with males, Māori, Pasifika, rural, and adolescent populations experiencing disproportionately higher rates.[1,2,8–10,17] These inequitable health outcomes may be attributed to various risk factors that either increase exposure to dangerous settings or promote high risk-taking behaviour.[18,19] These factors are driven by upstream social determinants including colonisation, institutional racism, law enforcement agencies, government, socio-economic status (SES), and cultural environment, as illustrated below in Figure 1.[20–23]

Overview of key health inequities

Within the adolescent age group, males, Māori, and rural populations suffer with the greatest burden of TBI-related health inequities. Today, compared to any other ethnicity in Aotearoa, Māori are most likely to suffer from TBI over the age of five years old.[1,2,9,17,25] SES is one of many important pathways and is a key driver of the three main proximal causes of TBI in youth: road crashes, assault, and rugby.[2,9,10] Colonisation has played a significant role in creating the SES gap between Māori and non-Māori. Colonisation brought English laws that changed perceptions of *whenua* (land) from a symbiotic relationship as viewed within *Te Ao Māori* (Māori world view) to seeing land as mere property to be owned.[20,21] With various breaches of *Te Tiriti o Waitangi* (Treaty of Waitangi), significant amounts of Māori land were appropriated by the British Empire, and led to a loss of resources and wealth for various Māori *iwi* (tribes), *hapu* (communities), and individuals.[21] Ideas of *mauri* (life force), *kaitiakitanga* (guardianship), and *manaakitanga* (showing respect and care) were swapped for viewing land as property for extraction and profit.[21] Displacement of Māori through urbanisation and loss of land led to greater socio-economic disparity between Pākehā and Māori. The historical trauma of colonisation and its associated institutional racism has led to poorer ac-



cess to education and loss of wealth amongst Māori, consequently resulting in a lower average SES within the indigenous population of Aotearoa.[20,21]

These systemic socio-economic issues have been suggested to put this vulnerable population at a higher risk for interpersonal violence and taking up higher risk occupations such as forestry, transportation, and construction.[1,2,9,10,17] Furthermore, lower SES may also impede the purchase of safer vehicles and appropriate safety equipment for sports and workplaces. As well as low SES contributing to greater exposure to risk, inequities in educational status have also been linked to inequities in risk-taking behaviours such unsafe driving, gang affiliations, and substance abuse, which contribute further to an inequitable TBI burden.[26,27]

The risk of TBI are 2.5 times greater in rural regions compared to urban areas.[2] This disparity is mainly driven by road vehicle crashes due to poorer road quality and worse driving conditions.[1] Colonisation can also be found at the heart of the issue, as the introduction of urbanisation has put rural communities in vulnerable position with worse access to healthcare.[20,21] Another key upstream determinant that increases this disparity between urban and rural populations is climate change. With increasing adverse weather events, rural communities are at a greater risk with poorer access to care and more unsafe conditions for driving, leading to increased incidence and worse outcomes of TBI.[28,29]

Males are twice as likely to suffer moderate and severe TBI than females in Aotearoa.[1,18,19,30] Male adolescents are at an even greater risk of TBI, as some studies have suggested that they possess a greater inclination for high-risk behaviour.[18,19,30] While there may be a biological component, this is compounded by the cultural context and gender-based norms of males engaging in more high-risk sports, leisure activities, and occupations.[18,31] In Aotearoa, masculinity is conflated with high risk-taking activities and hence can be hypothesised as a significant pathway contributing to TBI inequity amongst males.[32]

Social Determinant Pathways of TBI in Aotearoa Adolescents

1. HIGH-RISK SPORTS: A NEGATIVE PATHWAY TO TBI

According to ACC, over 20% of TBI are sustained through sports-related injuries.[1] Sports are an essential component of schooling in Aotearoa and have become embedded into the culture.[31] The introduction of high-risk sports such as rugby, cricket, football, cycling, and equestrian sports has brought an increased likelihood of injuries and they are the leading cause of sports-related TBI in Aotearoa adolescents.[33] These sports were introduced to Aotearoa under the process of colonisation with the aim of creating a collective cultural bond between Māori and the British Empire.[34–36]

Racism has historically occurred in conjunction with colonisation. As a result, many individuals and minorities have resorted to sports as a method to subvert racist ideologies.[35,36] Sport has provided a relatively peaceful avenue for integration and a medium for minority groups to gain *mana* (prestige) in the Pākehā-dominated world.[31,36] Amongst all sports, rugby has the highest incidence of TBI in Aotearoa but also holds a prestigious status with strong cultural roots in the Māori world today.[31,33,34,36] This originally British sport has become the pride of many Māori and Pasifika youth today. However, as evident in Figure 1, it has come at a cost. As explained by Māori academic Professor Brendan Hokowhitu, the socio-history of Aotearoa's rugby culture has given rise to the prevalent stereotype in Aotearoa that Māori and Pasifika boys are more compatible with pursuing rugby.[31] This consequently leads to a greater uptake of rugby compared to non-Māori and non-Pasifika populations and hence an increased risk of injuries such as TBI.[31]

Figure 1: The infographic to the left has been developed from a conceptual framework by Laflamme et al. and adapted for the context of TBI in Aotearoa adolescents.[24] It depicts how various macro-level and social determinants enable intermediary mechanisms to give rise to immediate causes of TBI within this population.

A study has shown that lower-SES parents value sports as a means of keeping children out of trouble more than higher-SES parents (64% vs. 40%).[37] Additionally, lower-SES parents value athletic scholarships more than higher-SES parents (26% vs. 8%).[37] These findings could potentially mean that lower-SES can lead to increased uptake of sports and hence an increased risk of sports-related injuries such as TBI. The same study also shows that the biggest concern for both low-SES and high-SES parents was the risk of concussion/mild TBI.[37] This SES gap continues to be the social driver to widen inequities, as Māori adolescents from lower SES backgrounds who play rugby may be less likely to afford appropriate safety equipment that is essential in the sport.[33,35] This can lead to further disproportionate injuries in Māori adolescents and an increased risk of TBI.

2. TAMARIKI UPLIFTING AND COLONISATION: A NEGATIVE PATHWAY TO TBI

Colonisation has resulted in significant suffering for indigenous populations worldwide. The process of colonisation was methodical and included inhumane laws that worked to systematically suppress indigenous populations for generations.[38] *Tamariki* (children) uplifting was an example of one such unethical process which had downstream consequences such as disproportionate rates of incarceration and homelessness, which are key determinants for risk of TBI (Figure 1).[19,21–23,38–42]

It is important to analyse how loss of *whenua* (land) due to colonisation and poor vagrancy laws acted in harmony to cause an intergenerational systemic inequity. [38,41] As the land was appropriated by the British Empire via repeated breaches of Te Tiriti o Waitangi, Māori communities were left with no resources and often without shelter.[20,21,38] Vagrancy laws adopted from the British legislation then came into action, making homelessness illegal. This saw many children of homeless families being separated from their whānau in vastly disproportionate numbers based on ethnicity.[41,42] Between 1960 and 1980, 1 in 12 Māori boys were placed under state care compared to only 1 in every 1000 Pākehā boys.[23] These factors consequently led to inequities in the SES of the Māori population which continue to increase the risk of TBI in this population.

Recent Waitangi Tribunal urgent inquiries Wai 2823 and Wai 2915 highlight the major inequities faced by members of the Māori population who were once uplifted as *tamariki*.[23,41,42] According to Māori health advocate Katarina Jean Te Huia, 86% of prison inmates were once in state care, and a significant proportion of Aotearoa gang members (80% of Black Power members and 78% of Mongrel Mob members) were previously wards of the state.[23,40–42] These statistics depict the negative impact of being a ward of the state and all the inequities that come with it. Due to these systemic injustices, roughly 50% of the prison population of Aotearoa are Māori despite only being 18% of the total Aotearoa population.[22,40] Homelessness has also shown to be another significant downstream effect of *tamariki* uplifting. Many children who were once uplifted as victims of institutional racism are now left without any resources due to the intergenerational loss of wealth.[38,39,41]

It has been documented that the experience of state care in childhood is associated with behavioural issues later in life, including violent tendencies, gang affiliations and substance abuse problems.[22,38,41] These are all serious risk factors for TBI. Moreover, the mild TBI faced by these populations are often undiagnosed and this puts them at an increased risk of more severe conditions such as chronic traumatic encephalopathy (CTE).[1,4,7,38] Furthermore, TBIs are also strongly linked with more aggressive behaviour in adolescence and hence, can perpetuate a cycle of violence and TBI.[22]

LEGISLATION, INSTITUTIONAL POLICIES AND ENFORCEMENT: A POSITIVE PATHWAY FOR REDUCING TBI

Not all pathways from upstream determinants result in negative statistics and inequities. Although institutional policies and enforcement agencies have been used as a tool for colonisation, another aspect of them has been the legislations that have proven to be protective against TBI. Globally and nationally, institutional policies and enforcement agencies have worked in tandem to produce a positive pathway to reduce the risk of TBI (Figure 1).[43] Sporting institutions such as World Rugby and trained referees in sports have worked together to implement successful concussion guidelines that have made the sport much safer and dramatically reduced adverse outcomes such as TBI.[44] The other major institution responsible for policies is the New Zealand Government. Policy development is guided by road toll and injury data collected by Crown entities such as ACC, WorkSafe and the New Zealand Transport Agency (NZTA).[1,43] Evidence-based policy making is critical at the population level to ensure the optimal use of resources.

In 2011, NZTA introduced three major legislative changes in 2011 targeting risk-taking behaviour in adolescents related to driving.[43] These four changes were: increasing the minimum age of driving from 15 to 16; introduction of more rigorous licensing provisions; zero blood alcohol concentration for drivers under 20; and increasing penalties for dangerous drink driving offences.[43] This approach was taken to target the adolescent population as they are a high-risk population for road vehicle crashes.[2,9,12] Although the efficacy of these changes are yet to be evaluated in Aotearoa, other countries have shown a reduction in TBI incidence due to similar legislative changes.[45,46] The Warrant of Fitness to regularly test the safety of vehicles is another NZTA policy that has proven to be successful at reducing the road vehicle crashes which are a major cause of TBI.[43]

The Sale and Supply of Alcohol Act 2012 is another example of protective legislation which introduced restrictions on the licensing, promotion and supply of alcohol to young people.[43] This Act also targeted the adolescent population by making it harder for young people to access alcohol which is a key driver of high-risk behaviour in the population.[8,12,19] Alcohol intake is one of the greatest predictors of TBI and laws such as these help reduce the risk of TBI in adolescents at a population level.[45,47] Additionally, ACC's TBI Strategy and Action Plan (2017–2021), built in conjunction with the Ministry of Health, shows how regulatory bodies can help shape policies for intervention at the public-level for better outcomes.[1] Law enforcement agencies such as the New Zealand Police act as the branch of government which ensures the laws are adhered to regarding road safety and criminal activity such as interpersonal violence. Hence, these act as another layer of protection for adolescents from serious injuries such as TBI.

However, unfavourable legislative changes can also result in worse outcomes as evident through Aotearoa's decision to lower the minimum age for alcohol purchase from 20 years old to 18 years old in 1999. A study evaluating the long-term impact of this change showed that 18–19 year-olds had 21% higher odds of being in an alcohol-involved crash than 20–24 year-olds, and consequently the law change may have increased the risk of road crash related TBI.[48] Therefore, it is important to understand that the protectiveness of laws and regulations is only as good as their quality. Overall, these policies and enforcement agencies have built a strong framework and pathway that can reduce the risk for TBI when used appropriately.

Conclusion

There is a high TBI burden amongst adolescents in Aotearoa. The Māori adolescent population faces even more inequities originating from upstream determinants of health such as colonisation and its associated institutional racism and socioeconomic injustices. There are various pathways that lead to this inequitable outcome including the popularity of high-risk sports and inappropriate *tamariki* uplifting which has caused generational challenges increasing exposure to violence and hence the risk of TBI. Concurrently, there are positive upstream determinants such as international sports safety regulations against concussions and laws promoting safe driving practices amongst adolescents. In addition to the three social determinant pathways mentioned in this essay, there are also various other pathways that give rise to inequities in the context of TBI in Aotearoa adolescents.

Going forward, equitably delivered injury prevention strategies are critical in the domains of road safety, assault prevention, and sports safety in Aotearoa. This article highlights the importance of population-level interventions at various causal stages in addressing the TBI risk in the adolescent population of Aotearoa New Zealand.

References

1. Accident Compensation Corporation. Traumatic brain injury strategy and action plan 2017-2021 [Internet]. Wellington, New Zealand; 2017 Sep [cited 2022 Jul 15]. Available from: https://www.acc.co.nz/assets/provider/1bf15d391c/tbi-strategy-action-plan.pdf

2. Feigin VL, Theadom A, Barker-Collo S, Starkey NJ, McPherson K, Kahan M, et al. Incidence of traumatic brain injury in New Zealand: a population-based study. Lancet Neurol. 2013;12(1):53–64. Available from: https://doi.org/10.1016/s1474-4422(12)70262-4

3. The National Academies of Science, Engineering, and Medicine. Evaluation of the disability determination process for traumatic brain injury in veterans [Internet]. National Academies Press; 2019 [cited 2022 Jul 23]. 198 p. Available from: https://doi.org/10.17226/25317

4. Blennow K, Brody DL, Kochanek PM, Levin H, Mckee A, Ribbers GM, et al. Traumatic brain injuries. Nat Rev Dis Primers. 2016;2:Article 16084. Available from: https://doi.org/10.1038/nrdp.2016.84

5. Lefevre-Dognin C, Cogné M, Perdrieau V, Granger A, Heslot C, Azouvi P. Definition and epidemiology of mild traumatic brain injury. Neurochirurgie. 2021 May 1;67(3):218–21. Available from: https://doi.org/10.1016/j.neuchi.2020.02.002

6. Johnson WD, Griswold DP. Traumatic brain injury: a global challenge. Lancet Neurol. 2017;16(12):949–50. Available from: https://doi.org/10.1016/s1474-4422(17)30362-9

7. Hyder AA, Wunderlich CA, Puvanachandra P, Gururaj G, Kobusingye OC. The impact of traumatic brain injuries: a global perspective. NeuroRehabilitation. 2007;22:341–53. Available from: https://doi.org/10.3233/NRE-2007-22502

8. Mckinlay A, Grace RC, Horwood LJ, Fergusson DM, Ridder EM, Macfarlane MR, et al. Prevalence of traumatic brain injury among children, adolescents, and young adults: prospective evidence from a birth cohort. Brain Inj. 2008;22(2):175–81. Available from: https://doi.org/10.1080/02699050801888824

9. Te-Ao B, Tobias M, Ameratunga S, McPherson K, Theadom A, Dowell A, et al. Burden of traumatic brain injury in New Zealand: incidence, prevalence and disability-adjusted life years. Neuroepidemiology. 2015;44(4):255–61. Available from: https://doi.org/10.1159/000431043

10. Bentley M, Singhal P, Christey G, Amey J. Characteristics of patients hospitalised with traumatic brain injuries. N Z Med J. 2022;135(1550):111–20.

11. James SL, Bannick MS, Montjoy-Venning WC, Lucchesi LR, Dandona L, Dandona R, et al. Global, regional, and national burden of traumatic brain injury and spinal cord injury, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet Neurol. 2019;18(1):56–87. Available from: https://doi.org/10.1016/s1474-4422(18)30415-0

12. Thurman DJ. The epidemiology of traumatic brain injury in children and youths: a review of research since 1990. J Child Neurol. 2016;31(1):20–7. Available from: https://doi.org/10.1177/0883073814544363

13. Dixon S. The employment and income effects of eight chronic and acute health conditions [Internet]. 2015 Dec [cited 2022 Jul 23]. Available from: https://www.treasury.govt.nz/sites/default/files/2015-12/twp15-15.pdf

14. Levack WMM, Kayes NM, Fadyl JK. Experience of recovery and outcome following traumatic brain injury: a metasynthesis of qualitative research. Disabil Rehabil. 2010;32(12):986–99. Available from: https://doi.org/10.3109/09638281003775394

15. Robertshaw M. A qualitative exploration of experiences following traumatic brain injury [Internet]. [Manchester]: The University of Manchester; 2013 [cited 2022 Jul 23]. Available from: https://research.manchester.ac.uk/en/studentTheses/a-qualitative-exploration-of-experiences-following-traumatic-brai

16. Durie M. Māori health model - Te Whare Tapa Whā [Internet]. 1984 [cited 2023 Feb 2]. Available from: https://www.health.govt.nz/our-work/populations/maori-health/maori-health-models/maori-health-models-te-whare-tapa-wha

17. Lagolago W, Theadom A, Fairbairn-Dunlop P, Ameratunga S, Dowell T, McPherson KM, et al. Traumatic brain injury within Pacific people of New Zealand. N Z Med J. 2015;128(1412):29–38.

18. Tamás V, Kocsor F, Gyuris P, Kovács N, Czeiter E, Büki A. The young male syndrome—an analysis of sex, age, risk taking and mortality in patients with severe traumatic brain injuries. Front Neurol [Internet]. 2019 [cited 2022 Jul 24];10:Article 366. Available from: https://doi.org/10.3389%2Ffneur.2019.00366

19. Simon D, Viner RM, Ozer EM, Denny S, Marmot M, Resnick M, et al. Adolescent health 2 adolescence and the social determinants of health. Lancet. 2012;379(9826):1641–52. Available from: https://doi.org/10.1016/s0140-6736(12)60149-4

20. Pihama L, Reynolds P, Smith C, Reid J, Tuhiwai Smith L, Te-Nana R. Positioning historical trauma theory within Aotearoa New Zealand. AlterNative. 2014;10(3):248–62. Available from: https://doi.org/10.1177/117718011401000304

21. Moewaka Barnes H, McCreanor T. Colonisation, hauora and whenua in Aotearoa. J R Soc N Z [Internet]. 2019 Nov 29 [cited 2022 Jul 24];49(suppl 1):19–33. Available from: https://doi.org/10.1080/03036758.2019.1668439

22. Horspool N, Crawford L, Rutherford L. Traumatic brain injury and the criminal justice system [Internet]. Ministry of Justice New Zealand. 2017 [cited 2022 Jul 24]. Available from: https://www.justice.govt.nz/assets/Documents/Publications/Traumatic-Brain-Injury-paper-.pdf

23. Waitangi Tribunal. He Pāharakeke, he Rito Whakakīkinga Whāruarua: Oranga Tamariki Urgent Inquiry: Wai 2915 [Internet]. Legislation Direct; 2021 [cited 2022 Jul 24]. Available from: https://forms.justice.govt.nz/search/Documents/WT/wt_DOC_171027305/He%20Paharakeke%20W.pdf

24. Laflamme L, Diderichsen F. Social differences in traffic injury risks in childhood and youth - a literature review and a research agenda. Injury Prevention. 2000 Dec 1;6(4):293–8. Available from: https://doi.org/10.1136/2Fip.6.4.293

25. Barker-Collo S, Krishnamurthi R, Theadom A, Jones K, Starkey N, Feigin V. Incidence of stroke and traumatic brain injury in New Zealand: contrasting the BIONIC and ARCOS-IV studies. N Z Med J. 2019;132(1502):40–54.

26. Wong MD, Coller KM, Dudovitz RN, Kennedy DP, Buddin R, Shapiro MF, et al. Successful schools and risky behaviors among low-income adolescents. Pediatrics. 2014 Aug 1;134(2):e389–96. Available from: https://doi.org/10.1542/peds.2013-3573

27. World Health Organisation. School-based violence prevention: a practical handbook [Internet]. 2019 [cited 2022 Jul 24]. Available from: https://apps.who.int/iris/handle/10665/324930

28. Krystyna G, Eggleton K, Davis R, Gosman K, Macmillan A. Understanding and experience of climate change in rural general practice in Aotearoa New Zealand . Fam Pract [Internet]. 2022 Sep 28 [cited 2023 Feb 2]; Available from: https://doi.org/10.1093/fampra/cmac107

29. Byett A. Climate change adaptation within New Zealand's transport system [Internet]. Motu Economic & Public Policy Research. 2019 [cited 2023 Feb 2]. Available from: https://deepsouthchallenge.co.nz/wp-content/uploads/2021/01/Climate-Change-Adaptation-within-New-Zealands-Transport-System.pdf

30. Mollayeva T, Colantonio A. Sex, gender, and traumatic brain injury: implications for better science and practice. The Challenge! [Internet]. 2019 [cited 2022 Jul 23];13(1):4–6. Available from: https://www.biausa.org/public-affairs/media/sex-gender-and-traumatic-brain-injury-implications-for-better-science-and-practice

31. Hokowhitu B, Sullivan SJ. Rugby culture, ethnicity and concussion. MAI Review [Internet]. 2008 [cited 2022 Jul 24];1:Article 4. Available from: https://www.review.mai.ac.nz/mrindex/MR/article/download/82/82-543-1-PB.pdf

32. Willott S, Lyons AC. Consuming male identities: masculinities, gender relations and alcohol consumption in Aotearoa New Zealand. J Community Appl Soc Psychol. 2011 Aug 25;22(4):330–45. Available from: http://dx.doi.org/10.1002/casp.1115

33. Theadom A, Starkey N, Dowell T, Hume PA, Kahan M, McPherson K, et al. Sports-related brain injury in the general population: an epidemiological study. J Sci Med Sport. 2014;17(6):591–6. Available from: https://doi.org/10.1016/j.jsams.2014.02.001

34. Hutchison PM. Breaking boundaries: football and colonialism in the British empire. Inquiries Journal [Internet]. 2009 [cited 2022 Jul 24];1(11):1–2. Available from: http://www.inquiriesjournal.com/articles/64/breaking-boundaries-football-and-colonialism-in-the-british-empire

35. Hughson J. The middle class, colonialism and the making of sport. Sport Soc. 2009;12(1):69–84. Available from: https://doi.org/10.1080/17430430802472319

36. Hokowhitu B. Māori rugby and subversion: creativity, domestication, oppression and decolonization. Int J Hist Sport. 2009 Dec;26(16):2314–34. Available from: http://dx.doi.org/10.1080/09523360903457023

37. Kroshusid E, Qu P, Chrisman S, Herring S, Rivara F. Socioeconomic status and parent perceptions about the costs and benefits of youth sport. PLoS One [Internet]. 2021 [cited 2023 Jan 22];16(11):Article e0258885. Available from: https://doi.org/10.1371/journal.pone.0258885

38. Elkington B, Jackson M, Kiddle R, Mercier OR, Ross M, Smeaton J, et al. Imagining decolonisation. Bridget Williams Books; 2020. 184 p. Available from: https://doi.org/10.7810/9781988545783

39. Angus EM. Exploring health inequities: head injuries in people experiencing homelessness [Internet]. [Ontario]: The University of Western Ontario; 2022 [cited 2022 Jul 15]. Available from: https://ir.lib.uwo.ca/cgi/viewcontent.cgi?article=11159&context=etd

40. Smith CW, Mana HR, Pihama L, Reid J. Traumatic brain injury of tangata ora (Māori ex-prisoners). AlterNative. 2017 Dec 1;13(4):226–34. Available from: http://dx.doi.org/10.1177/1177180117729852

41. Te-Huia J. Brief of evidence of Katarina Jean Te Huia: Wai 2823 [Internet]. Waitangi Tribunal; 2019 [cited 2022 Jul 24]. Available from: https://static1.squarespace.com/static/6182360ae5fdbc615020237d/t/6202eb38e18a00096d4a5227/1644358458507/Jean+Te+Huia+Brief+of+Evidence.pdf

42. New Zealand Nurses Organisation. Colonisation and archaic British law behind appalling Māori child state welfare: changes called for [Internet]. 2019 [cited 2022 Jul 24]. Available from: https://www.nzno.org.nz/about_us/media_releases/artmid/4731/articleid/1766/colonisation-and-archaic-british-law-behind-appalling-m%C4%81ori-child-state-welfare-changes-called-for

43. Lewycka S, Clark T, Peiris-John R, Fenaughty J, Bullen P, Denny S, et al. Downwards trends in adolescent risk-taking behaviours in New Zealand: exploring driving forces for change. J Paediatr Child Health. 2018 Jun 1;54(6):602–8. Available from: https://doi.org/10.1111/jpc.13930

44. World Rugby. New World Rugby graduated return to play protocols set "gold standard" [Internet]. 2022 [cited 2022 Jul 24]. Available from: https://www.world.rugby/news/726163

45. Fell JC, Fisher DA, Voas RB, Blackman K, Tippetts AS. The impact of underage drinking laws on alcohol-related fatal crashes of young drivers. Alcohol Clin Exp Res. 2009 Jul;33(7):1208–19. Available from: https://doi.org/10.1111%2Fj.1530-0277.2009.00945.x

46. Lieutaud T, Gadegbeku B, Ndiaye A, Chiron M, Viallon V. The decrease in traumatic brain injury epidemics deriving from road traffic collision following strengthened legislative measures in France. PLoS ONE [Internet]. 2016 [cited 2023 Jan 22];11(11):Article e0167082. Available from: https://doi.org/10.1371/journal.pone.0167082

47. Weil ZM, Corrigan JD, Karelina K. Alcohol use disorder and traumatic brain injury. Alcohol Res. 2018;39(2):171.

48. Huckle T, Parker K. Long-term impact on alcohol-involved crashes of lowering the minimum purchase age in New Zealand. Am J Public Health. 2014;104(6):1087. Available from: https://doi.org/10.2105%2FAJPH.2013.301734

About the author

› Angad is a fifth-year medical student at the University of Otago, Wellington. He is interested in pursuing a clinical and academic career in neurosurgery. He likes to dedicate his spare time to sustainability and climate action initiatives. He also enjoys traveling and cooking various cuisines.

Correspondence

Angad S. Chauhan: chaan914@student.otago.ac.nz