Acquired Brain Injury and Substance Use Health

Introduction

The ongoing drug toxicity crisis has underscored that substance use health (SUH) cannot be addressed in isolation. Rather, it requires an integrated approach that accounts for the mental, physical and social dimensions of health.

Although much media attention has appropriately focused on the more than 50,000 deaths from drug-related overdoses since 2016 (Public Health Agency of Canada, 2025), less attention has been paid to the substance use harms associated with non-fatal overdoses and weather-related health stressors such as heat stroke, frostbite (BC Emergency Health Services, 2025), pressure injuries (Jones et al., 2020), assaults (Ataiants et al., 2020) and acquired brain injury (ABI) (Brust, 2014; Hong et al., 2019; Todaro et al., 2024).

ABI has significant long-term impacts on well-being and people who use substances face heightened risks, which drives greater healthcare service demands that can meet multiple needs. For these reasons, it is a public health and community issue that deserves greater attention and support.

What Is Acquired Brain Injury?

ABI refers to a spectrum of neurological impairments and other disorders generally resulting from damage to the brain sustained after birth. ABI can affect anyone, though people who use substances face heightened risks.

ABI can include traumatic brain injury caused by falls, motor vehicle accidents, assaults or other injuries (Shah et al., 2004). It can also result from non-traumatic brain injury, such as a stroke related to blood pressure changes during intoxication or withdrawal from substances (Esse et al., 2011). Less common risks include brain infections associated with injection drug use (Tunkel & Pradhan, 2002; Martin et al., 2024) and brain tumours (Connelly & Malkin, 2007; Harnod et al., 2014).

ABI is more prevalent than the combined incidence of breast cancer, multiple sclerosis, HIV/AIDS and spinal cord injury (Brain Trust Canada, 2022). The extent of this issue has been recognized in the *BC Consensus Statement on Brain Injury, Mental Health, and*

Addiction (BC Consensus on Brain Injury, 2024) and in a private member's bill proposing a national brain strategy that is currently before the House of Commons (Bill C-206, 2025).

What Is Anoxic Brain Injury?

Anoxic brain injury is a specific type of ABI that is often under-recognized after a non-fatal overdose (Russolillo et al., 2025). It occurs when the brain is deprived of oxygen during an overdose episode until the individual is revived, causing brain damage (Mahoney et al., 2023; Martin et al., 2024; Todaro et al., 2024). This risk makes rapid overdose response critical to preventing long-term neurological harm.

Anoxic brain injury is of increasing concern given rising overdose rates and the 15-times greater risk of non-fatal versus fatal overdose (Russolillo et al., 2025). Canadian data suggests that one to four per cent of non-fatal overdose survivors are later diagnosed with anoxic brain injury. This finding is likely an underestimate as mild cases may go undetected, and people who use substances and have co-occurring mental health concerns often face barriers to accessing health care (Russolillo et al., 2025). Recent research suggests that fentanyl near-overdoses may also contribute significantly to rates of ABI, further increasing these estimates (McKinstry et al., 2026).

Anoxic brain injury affects the brain as a whole (Fugate, 2017). It produces widespread cognitive deficits that are most commonly observed in information-processing speed, attention, memory, emotional regulation and executive functioning (e.g., decision making and problem solving) (Hong et al., 2019). These deficits affect behaviour, emotions and daily functioning, including a person's ability to engage with healthcare services and attend follow-up appointments. They may also increase the likelihood of higher-risk behaviours associated with fatal overdose (Winstanley et al., 2021; National Academies of Sciences, Engineering, and Medicine, 2022).

Why Is This Issue Important?

Acquired brain injuries, regardless of the cause or substance use status of an individual, can be chronic and even fatal (Garduño-Ortega et al., 2022). Injury to certain areas of the brain can have direct effects on behavioural control (Eslinger et al., 1995; Johnson & Balleny, 1996), cognition and the ability to regulate emotions (Corrigan, 2021). As a result, participation and functioning in educational, vocational, social and daily activities may be negatively affected (Masel & DeWitt, 2010; Perrin et al., 2014).

For example, deficits in impulse control and self-awareness can cause problems in social interactions (Corrigan, 2021). Deficits in problem solving, planning, organization, attention and memory can cause difficulties with employment and everyday activities such as paying bills, completing household and personal tasks, accessing and maintaining housing, and remembering and getting to healthcare appointments (Corrigan, 2021).

ABI can also trigger other adverse consequences such as epilepsy, mood disorders (e.g., depression), anxiety, post-traumatic stress disorder, sleep disorders, impulsivity, suicide and

dementia (Brenner et al., 2017; Moreno & McKerral, 2018; Mosti & Coccaro, 2018; Scofield et al., 2017; Wojtowicz et al., 2017).

Who Is Affected by Acquired Brain Injury?

While ABI can happen to anyone due to varying pathways to injury (Lasry et al., 2017), some groups seem to be at a higher risk. Evidence shows elevated risk among men (Oliverio et al., 2020), people with prior substance use or a substance use disorder (SUD) (Yamaguchi et al., 2025), older adults, Indigenous people (U.S. Centers for Disease Control and Prevention, 2025), and individuals exposed to structural and social inequities — such as service members and veterans, people who are incarcerated or unhoused, and survivors of intimate partner violence (U.S. Centers for Disease Control and Prevention, 2025). These groups often face the poorest access to care and experience greater harms when ABI co-occurs with other conditions (U.S. Centers for Disease Control and Prevention, 2025).

Further work to understand ABI among women (Valera et al., 2021), who are largely underrepresented in the extant knowledge base, and other equity-deserving populations is currently underway.

In Canadian jurisdictions, individuals with a history of experiencing drug toxicity events were 19.5 times more likely to experience brain injury than their peers without such experiences (BC Centre for Disease Control, 2025). They are also at a significantly greater risk of adverse health outcomes (Vogler et al., 2014), including suicide rates that are three to four times higher than those of the general population (Simpson & Tate, 2007).

These disparities are shaped by intersecting social and health factors, including high-risk work and environments, exposure to violence and injury, motor vehicle collisions (Brain Injury Canada, 2025; Teasell et al., 2018; Lasry et al., 2016), medical comorbidities or the use of prescription medications (Albrecht & Gardner, 2023). As a result, services must be able to respond to the multiple intersecting factors that affect health and tailor supports to individual needs.

How Does Acquired Brain Injury Relate to Substance Use Health?

ABI is commonly linked to substance use and SUDs (Corrigan & Adams, 2019; Vadalia & Yadav, 2025). Estimates of the prevalence of co-occurring ABI and substance use or SUD range from 21 per cent to 80 per cent (Bruijnen et al., 2019; Hagen et al., 2019; Toledo-Fernandez et al., 2020). Distinguishing symptoms of ABI from those of substance use or SUD can be challenging, as both can produce similar symptoms (Auestad et al., 2025; Hoffman et al., 2020). Mental illness, which increases the risk for both ABI and substance use or SUD, may also produce overlapping symptoms (Passman et al., 2025; Schifano et al., 2024; Auestad et al., 2025). Continued substance use after ABI predicts worsened outcomes, slower recovery and a higher risk of subsequent acquired brain injuries (Vadalia & Yadav, 2025; Xie et al., 2023). These effects likely make it more difficult to interact with

emergency departments and other healthcare services and may also limit admission to treatment facilities (National Academies of Sciences, Engineering, and Medicine, 2022).

The relationship between these frequently co-occurring conditions is complex and can be bidirectional. ABI may be a consequence of substance use through impaired cognition, psychomotor deficits and heightened risk-taking (Hammig & Parker, 2024; Kureshi et al., 2024; Yamaguchi et al., 2025). In other cases, substance use may follow ABI as a coping response to post-injury symptoms and altered neurocircuitry (Adams et al., 2020; Lai et al., 2022; Olsen & Corrigan, 2022), including changes in alcohol use after a traumatic brain injury (Weil et al., 2018). ABI-related brain changes may fundamentally and irreversibly compromise an individual's functioning, self-regulation and decision making related to rewards because of the resulting structural and neurochemical changes (Bjork & Grant, 2009). However, causal interpretations of the relationship between ABI and substance use remain debated. While ABI-related brain changes may elevate risk (Olsen & Corrigan, 2022), some evidence is limited or inconsistent (Wu et al., 2016).

How Can We Respond to Acquired Brain Injury Among People Who Use Substances?

Prevention and Harm Reduction

While not all acquired brain injuries can be prevented, prompt medical attention during drug overdoses can reduce injury severity and improve recovery. There are currently no medical contraindications to the use of opioid agonist therapies (i.e., best-practice treatments for opioid use disorder such as buprenorphine and methadone) for people living with ABI (Morgan et al., 2025). Naloxone can temporarily reverse opioid overdoses (Canadian Community Epidemiology Network on Drug Use [CCENDU], 2016), and expanding public awareness, training and availability is key to reducing overdose-related harms (Martin et al., 2024).

Avoiding substance use while alone, starting with small or test doses, using drug checking services, avoiding polysubstance use (Voelker, 2025) and accessing overdose response services (e.g., National Overdose Response Service, 2026) remain important harm reduction strategies that should continue to be promoted to people who use drugs.

Ignoring modifiable health risks significantly increases long-term vulnerability to poor health outcomes, regardless of an individual's history of ABI. Factors such as frailty, malnutrition and elevated risk of falls not only increase the likelihood of subsequent brain injury but also accelerate cognitive decline and can hinder rehabilitation (Okrah et al., 2025; Esquivel, 2017). Adopting healthy lifestyle habits, including regular exercise (Gomez-Pinilla et al., 2022), proper nutrition (Patel et al., 2023), good sleep hygiene (Fleming et al., 2020) and blood pressure management (Zhu et al., 2024), are universal strategies for improving health trajectories and preventing further injury.

Services and Supports After ABI

Despite the prevalence and impact of co-occurring ABI and substance use or SUD, care remains fragmented, with limited coordination, communication and support across the continuum of care (Chan et al., 2022; Estrella et al., 2021; Grewal et al., 2024). The varying presentations of ABI and related complications (e.g., substance use behaviours or other comorbidities), compounded by existing disconnected care pathways, leave service seekers vulnerable to navigating disjointed care journeys.

As a result, diagnosis and adequate treatment may remain out of reach at optimal intervention points leading to poorer health outcomes. This phenomenon has been described as "wrong door syndrome" (Grewal et al., 2024). Notably, healthcare providers do not always perceive themselves as prepared to manage the clinical complexities of ABI and SUD, perpetuating shortcomings in integrated care (McCauley et al., 2025, Lemsky, 2021). Stigma and misconceptions further contribute to people being misunderstood, with cognitive impairments interpreted as a lack of compliance or motivation, resulting in service gaps and reduced access to appropriate care (Pearce & Boyd, 2025).

Improving awareness, education and screening for ABI is critical to ensure injuries are recognized and treated by healthcare providers (Martin et al., 2024). Simple adaptations such as including cognitive screening regardless of client age in intake processes, offering appointment information and reminders through multiple communication methods, and providing flexible and accommodating pathways for re-entry to services, can improve engagement and outcomes for people living with ABI.

Evolving research on screening tools aims to provide more accurate assessments and better connect people with appropriate care and supports.

SUH treatment services can help people living with ABI reduce or stop substance use safely (Hyzak et al., 2024; McHugo et al., 2021). Yet cognitive impairments have been found to predict lower treatment retention, medication discontinuation and return to substance use (Morgan et al., 2025; Nardo et al., 2022). Interventions that restore cognitive function and improve functional outcomes are therefore highly recommended for individuals with co-occurring ABI and SU/SUD (Nardo et al., 2022).

Increased training for health and social care providers to support SUH among people living with ABI, whether diagnosed or not, is key to improving access to appropriate services (Coxe et al., 2021).

Person-centred Care Strategies

Holistic, interdisciplinary interventions that address psychological well-being, social relationships, community participation, functional abilities and ongoing support are particularly beneficial for people with co-occurring ABI and SU/SUD (Campbell et al., 2024; Estrella et al., 2021; Grewal et al., 2024; Kennedy et al., 2025).

The Resources section provides practical strategies for healthcare providers, including considering the cognitive load of treatment programs by presenting information at a manageable pace, minimizing distractions and providing written alongside verbal instructions (Corrigan, 2021).

Other strategies include identifying the communication style that best resonates with clients and using organizational tools (Corrigan, 2019). To reduce stigma, it is important that healthcare providers recognize that missed appointments may reflect memory or organizational challenges rather than a lack of motivation (Corrigan, 2021).

Overall, more research is needed on how to best support people living with ABI and substance use or SUD. Future research priorities identified for this issue center on the intersection of ABI, mental health and substance use or SUD; social determinants, marginalization and systematic inequities; overdose-related ABI; the cognitive and psychosocial impacts of ABI; diagnosis and screening; treatments and interventions; and support for caregivers and families (Kennedy et al., 2024).

Conclusion

The toxic drug supply has affected a vast number of people, and understanding of how substance use–related disorders and ABI intersect continues to evolve. As a result, it is critical that care providers recognize the frequent co-occurrence of these conditions.

SUD treatment programs are often unable to accommodate people with co-occurring ABI and SUD and address their specific, complex needs. This gap creates significant barriers to essential substance use healthcare. People may not receive the care they need, leading to poor health outcomes and creating significant pressures across the healthcare system, including increased hospital admissions and longer hospital stays (Niyirora et al., 2026; Xie et al., 2023; Swift & Wilson, 2001).

Professionals across all relevant sectors must be equipped to identify when people may be living with complex needs associated with ABI and substance use or SUD and be prepared to implement person-centred strategies that effectively address their unique circumstances. Health systems and services must adapt to the evolving needs of this growing population. Increasing awareness of the co-occurrence of ABI and substance use, and strengthening the supports available to those affected, are important steps toward meaningfully improving health outcomes for people across Canada.

Resources

The Heller School for Social Policy and Management. (2019) *Intersection between traumatic brain injury and opioid use disorder: Recommendations for substance use treatment providers*. Waltham, MA: Author. https://heller.brandeis.edu/ibh/pdfs/inroads-tbi-oud-provider-4-1-2019-final.pdf

Lemsky, C. (2021). *Traumatic brain injury and substance use disorders: Making the connections*. Rockville, MD: Substance Abuse and Mental Health Services

Administration. https://attcnetwork.org/wp-content/uploads/2021/04/TBI-SUD-Toolkit-FINAL-11.05.2021.pdf

Manning, V., Gooden, J., Cox, C., Peterson, V., Whelan, D., & Mroz, K. (2021) *Managing cognitive impairment in AOD treatment: Practice guidelines for healthcare professionals*. https://s3-ap-southeast-2.amazonaws.com/turning-point-website-prod/drupal-s3fs/s3fs-public/2022-02/TP_Managing_Cognitive%20impairment_AOD_treatment_VS18_DH_edit.pdf

Provincial Mental Health and Substance Use Network. (2024). *"Be bold. Make changes.": Perspectives from lived experience advisors and partners (LEAP) on unmet needs of individuals with complex mental health and substance use issues*. Vancouver, B.C.: BC Mental Health & Substance Use Services. https://www.bcmhsus.ca/sites/g/files/qpdaav151/files/2024-06/LEAP-report.pdf

Toronto ABI Network. (2022). *Provincial ABI navigators/contacts*. Toronto, Ont.: https://abinetwork.ca/wp-content/uploads/2022/03/PROVINCIAL-ABI-NAVIGATORS-Contact-List.pdf

References

Adams, R. S., Corrigan, J. D., & Dams-O'Connor, K. (2020). Opioid use among individuals with traumatic brain injury: A perfect storm? *Journal of Neurotrauma, 37*(1), 211–216, https://doi.org/10.1089/neu.2019.6451

Albrecht, J. S., & Gardner, R. C. (2023). Traumatic brain injury in older adults: Epidemiology, management, outcomes. *Practical Neurology*, 22–24. https://practicalneurology.com/diseases-diagnoses/tbi/traumatic-brain-injury-in-older-adults-epidemiology-management-outcomes/31987/

Ataiants, J., Mazzella, S., Roth, A.M., Robinson, L.F., Sell, R.L., & Lankenau, S.E. (2020). Multiple victimizations and overdose among women with a history of illicit drug use. *Journal of Interpersonal Violence, 37(3-4),* Article NP1588-NP1613. https://doi.org/10.1177/0886260520927501

Auestad, N., Bogstrand, S. T., Vallersnes, O. M., Lerdal, A., & Wüsthoff, L. E. C. (2025). Cognitive function among people with severe substance use. *European Addiction Research, 31*(2), 133–144. https://doi.org/10.1159/000543755

BC Centre for Disease Control. (2025). *Brain injury following drug toxicity events in British Columbia*. Vancouver, B.C.: Author. https://www.bccdc.ca/Documents/20250205_KnowledgeUpdate_BI%20analyses41.pdf

BC Consensus on Brain Injury. (2024). *BC consensus statement on brain injury, mental health & addiction*. Victoria, B.C.: CGB Centre for Traumatic Life Losses. https://bcconsensusonbraininjury.com/wp-content/uploads/2025/01/Year-1-3-Report.pdf

BC Emergency Health Services. (2025). Extreme weather and harm reduction. https://handbook.bcehs.ca/clinical-resources/toxic-drug-crisis/harm-reduction/extreme-weather-and-harm-reduction/

Bill C-206, An Act to establish a national strategy on brain injuries, 45th Parliament, 1st Session. (2025). https://www.parl.ca/DocumentViewer/en/45-1/bill/C-206/first-reading

Bjork, J. M. & Grant, S. J. (2009). Does traumatic brain injury increase risk for substance abuse? *Journal of Neurotrauma*, *26*(7),1077–1082. https://doi.org/10.1089/neu.2008.0849

Brain Injury Canada. (2025). *Brain injury in Canada: Call for a national strategy on brain injuries*. Ottawa, Ont. : Author. https://nationalstrategyonbraininjury.ca/wp-content/uploads/2025/03/Brain-Injury-in-Canada-2025.pdf

Brain Trust Canada. (2022). Brain injury by the numbers. https://web.archive.org/web/20220224025907/https:/braintrustcanada.com/resources/brain-injury-information/

Brenner, L. A., Hostetter, T. A., Barnes, S. M., Stearns-Yoder, K. A., Soberay, K. A., & Forster, J. E. (2017). Traumatic brain injury, psychiatric diagnoses, and suicide risk among veterans seeking services related to homelessness. *Brain Injury, 31*,1731–1735. https://doi.org/10.1080/02699052.2017.1376758

Bruijnen, C. J. W. H., Dijkstra, B. A. G., Walvoort, S. J. W., Markus, W., VanDerNagel, J. E. L., Kessels, R. P. C., & De Jong, C. A. J. (2019). Prevalence of cognitive impairment in patients with substance use disorder. *Drug and Alcohol Review, 38*(4), 435–442. https://doi.org//10.1111/dar.12922

Brust, J. (2014). Neurologic complications of illicit drug abuse. *Continuum, 20*(3), 642–656. https://doi.org/10.1212/01.CON.0000450971.99322.cd

Campbell, A., Millen, S., Jordan, U., Watson, D., Watson, J., & McCorry, R. (2024). Exploring the experiences of residents and their families in an alcohol-related brain injury residential rehabilitation unit in Northern Ireland: A qualitative study. *Frontiers in Public Health, 12*, Article 1397428. https://doi.org/10.3389/fpubh.2024.1397428

Canadian Community Epidemiology Network on Drug Use (CCENDU). (2016). Ottawa, Ont.: Canadian Centre on Substance Use and Addiction. *CCENDU bulletin: The availability of take-home naloxone in Canada*. https://www.ccsa.ca/sites/default/files/2019-05/CCSA-CCENDU-Take-Home-Naloxone-Canada-2016-en.pdf

Chan, V., Toccalino, D., Omar, S., Shah, R., & Colantonio, A. (2022). A systematic review on integrated care for traumatic brain injury, mental health, and substance use. *PloS One, 17*(3), Article e0264116. https://doi.org/10.1371/journal.pone.0264116

Connelly, J. M. & Malkin, M.G. (2007). Environmental risk factors for brain tumors. *Current Neurology and Neuroscience Reports, 7,* 208–214. https://doi.org/10.1007/s11910-007-0032-4

Corrigan, J. D. (2021). Traumatic brain injury and treatment of behavioral health conditions. *Psychiatric Services, 72*(9), 1057–1064. https://doi.org/10.1176/appi.ps.201900561

Corrigan, J. D. & Adams, R.S. (2019). The intersection of lifetime history of traumatic brain injury and the opioid epidemic. *Addictive Behaviors, 90*,143–145. https://www.sciencedirect.com/science/article/abs/pii/S0306460318310098?via%3Dihub

Coxe, K. A., Pence, E. K., & Kagotho, N. (2021). Social work care in traumatic brain injury and substance use disorder treatment: A capacity-building model. *Health & Social Work, 46*(4), 277–288. https://doi.org/10.1093/hsw/hlab023

Eslinger, P. J., Grattan, L. M., & Geder, L. (1995). Impact of frontal lobe lesions on rehabilitation and recovery from acute brain injury. *NeuroRehabilitation, 5*(2),161–182. https:/doi.org/10.3233/NRE-1995-5206

Esquivel, M. K. (2017). Nutritional assessment and intervention to prevent and treat malnutrition for fall risk reduction in elderly populations. *American Journal of Lifestyle Medicine*, *12*(2), 107–112. https://doi.org/10.1177/1559827617742847

Esse, K., Fossati-Bellani, M., Traylor, A., & Martin-Schild, S. (2011). Epidemic of illicit drug use, mechanisms of action/addiction and stroke as a health hazard. *Brain and Behavior, 1*, 44–54. https://doi.org/10.1002/brb3.7

Estrella, M. J., Kirsh, B., Kontos, P., Grigorovich, A., Colantonio, A., Chan, V., & Nalder, E. J. (2021). Critical characteristics of housing and housing supports for individuals with concurrent traumatic brain injury and mental health and/or substance use challenges: A qualitative study. *International Journal of Environmental Research and Public Health, 18*(22), Article 12211. https://doi.org/10.3390/ijerph182212211

Fleming, M. K., Smejka, T., Henderson Slater, D., van Gils, V., Garratt, E., Yilmaz Kara, E., & Johansen-Berg, H. (2020). Sleep disruption after brain injury is associated with worse motor outcomes and slower functional recovery. *Neurorehabilitation and Neural Repair*, *34*(7), 661–671. https://doi.org/10.1177/1545968320929669

Fugate, J. E. (2017). Anoxic-ischemic brain injury. *Neurologic Clinics, 35*(4), 601–611. http://doi.org/10.1016/j.ncl.2017.06.001

Garduño-Ortega, O., Li, H., Smith, M., Yao, L., Wilson, J., Zarate, A., & Bushnik, T. (2022). Assessment of the individual and compounding effects of marginalization factors on injury severity, discharge location, recovery, and employment outcomes at 1 year after traumatic brain injury. *Frontiers in Neurology, 13*, Article 942001. https://doi.org/10.3389/fneur.2022.942001

Gomez-Pinilla, F. & Mercado, N. M. (2022). How to boost the effects of exercise to favor traumatic brain injury outcome. *Sports Medicine and Health Science*, *4*(3), 147–151. https://doi.org/10.1016/j.smhs.2022.06.001

Grewal, J., Kennedy, C. J., Mamman, R., Biagioni, J. B., Garcia-Barrera, M. A., & Schmidt, J. (2024). Understanding the barriers and facilitators of healthcare services for brain injury and concurrent mental health and substance use issues: A qualitative study. *BMC Health Services Research, 24*(1), 881. https://doi.org/10.1186/s12913-024-11316-1

Hagen, E., Sømhovd, M., Hesse, M., Arnevik, E. A., & Erga, A. H. (2019). Measuring cognitive impairment in young adults with polysubstance use disorder with MoCA or BRIEF-A: The significance of psychiatric symptoms. *Journal of Substance Abuse Treatment, 97*, 21–27. https://doi.org/10.1016/j.jsat.2018.11.010

Hammig, B. & Parker, K. (2024). Co-use of cannabis and alcohol among adults and the burden of traumatic brain injury from fall-related events. *Journal of Substance Use, 30*(6), 936–940. https://doi.org/10.1080/14659891.2024.2428719

Harnod, T., Lin, C., Sung, F., & Kao, C. (2014). An association between benzodiazepine use and occurrence of benign brain tumors. *Journal of the Neurological Sciences, 336*, 8–12. https://doi.org/10.1016/j.jns.2013.11.009

Hoffman, J., Yu, J., Kirstein, C., & Kindy, M. S. (2020). Combined effects of repetitive mild traumatic brain injury and alcohol drinking on the neuroinflammatory cytokine response and cognitive behavioral outcomes. *Brain Sciences, 10*(11). https://doi.org/10.3390/brainsci10110876

Hong, J. S., Moran, M. T., Eaton, L. A. & Grafton, L. M. (2019). Neurologic, cognitive, and behavioral consequences of opioid overdose: A review. *Current Physical Medicine and Rehabilitation Reports, 7*, 305–313. https://doi.org/10.1007/s40141-019-00247-2

Hyzak, K. A., Pinto, S. M., & Hammond, F. M. (2024). Getting help for substance use disorders after a traumatic brain injury. *Archives of Physical Medicine and Rehabilitation, 105*(8), 1609–1611. https://doi.org/10.1016/j.apmr.2023.10.014

Johnson, R. & Balleny, H. (1996). Behaviour problems after brain injury: Incidence and need for treatment. *Clinical Rehabilitation, 10*(2),173–80. https://doi.org/10.1177/026921559601000215

Jones, A. L., Rankin, J. A., & Then, K. L. (2020). Drug overdose, loss of consciousness, and compartment syndrome: A life-threatening combination. *Journal of Emergency Nursing, 46*(3), 294–301. https://doi.org/10.1016/j.jen.2020.02.001

Kennedy, C. J., Grewal, J., Warren, G., Schmidt, J., Biagioni, J. B., & Garcia-Barrera, M. A. (2025). Brain injury, mental health and substance use in homeless populations: Community-generated recommendations for healthcare service delivery and research. *BMC Health Services Research, 25*, Article 715. https://doi.org/10.1186/s12913-025-12835-1

Kennedy, C. J., Woodin, E., Schmidt, J., Biagioni, J. B., & Garcia-Barrera, M. A. (2024). Ten priorities for research addressing the intersections of brain injury, mental health and addictions: A stakeholder-driven priority-setting study. *Health Expect*, *27*(4), Article e14136. https://doi.org/10.1111/hex.14136

Kureshi, N., Walling, S., Erdogan, M., Opra, I., Green, R. S., & Clarke, D. B. (2024). Alcohol is a risk factor for helmet non-use and fatalities in off-road vehicle and motorcycle crashes. *European Journal of Trauma and Emergency Surgery*, *50*, 2073–2079. https://doi.org/10.1007/s00068-024-02572-1

Lai, H., Mubashir, T., Shiwalkar, N., Ahmad, H., Balogh, J., Williams, G., … Maroufy, V. (2022). Association of pre-admission opioid abuse and/or dependence on major complications in traumatic brain injury (TBI) patients. *Journal of Clinical Anesthesia, 79*, Article 110719, https://doi.org/10.1016/j.jclinane.2022.110719

Lasry, O., Dudley, R. W., Fuhrer, R., Torrie, J., Carlin, R., & Marcoux, J. (2016). Traumatic brain injury in a rural Indigenous population in Canada: A community-based approach to surveillance. *CMAJ Open, 25*(4), E249–E259. https://doi.org/10.9778/cmajo.20150105

Lasry, O., Liu, E. Y., Powell, G. A., Ruel-Laliberté, J., Marcoux, J., & Buckeridge, D. L. (2017). Epidemiology of recurrent traumatic brain injury in the general population: A systematic review. *Neurology, 89*(21), 2198–2209. https://doi.org/10.1212/wnl.0000000000004671

Mahoney, J. J. 3rd, Winstanley, E. L., Castillo, F., Luba, R., Marton, J., Alschuler, D. M., … Comer, S. D. (2023). A pilot study investigating cognitive impairment associated with opioid overdose. *Drug and Alcohol Dependence, 247*. https://doi.org/10.1016/j.drugalcdep.2023.109865

Martin, S. I., Bennett, A. S., Elliott, L., & Gorgens, K. A. (2024). Overdose risk and brain injury (traumatic brain injury/acquired brain injury), a commentary. *Substance Use & Misuse*, *59*(11), 1656–1659. https://doi.org/10.1080/10826084.2024.2359722

Masel, B. E. & DeWitt, D. S. (2010). Traumatic brain injury: A disease process, not an event. *Journal of Neurotrauma, 27*(8), 1529–1540. https://doi.org/10.1089/neu.2010.1358

McCauley, K. L., Wallace, T., Moran, T. P., Palacios, J., Forehand, D., Breitenstein, J., … Gore, R. K. (2025). Exploring integration of support for co-occurring substance use-related needs in interdisciplinary traumatic brain injury treatment for military service members and veterans. *Archives of Rehabilitation Research & Clinical Translation*, *7*(3), Article 100468. https://doi.org/10.1016/j.arrct.2025.100468

McHugo, G. J., Drake, R. E., Haslett, W. R., Krassenbaum, S. R., Mueser, K. T., Sweeney, M. A., … Harris, M. (2021). Algorithm-driven substance use disorder treatment for inner-city clients with serious mental illness and multiple impairments. *Journal of Nervous and Mental Disease, 209*(2), 92–99. https://doi.org/10.1097/nmd.0000000000001296

McKinstry, D., Shi, Z., Ramos-Rolón, A. P., Phillips, J., Das, S., Li, X., … Wiers, C. E. (2026). Hippocampal volume and brain tau pathology in opioid use disorder: Associations with non-fatal opioid overdose. *Addiction Neuroscience*, *19*, Article 100253. https://doi.org/10.1016/j.addicn.2026.100253

Moreno, J. A. & McKerral, M. (2018). Relationships between risky sexual behaviour, dysexecutive problems, and mental health in the years following interdisciplinary TBI rehabilitation. *Neuropsychological Rehabilitation, 28*, 34–56. https://pubmed.ncbi.nlm.nih.gov/26872445/

Morgan, J. R., Reif, S., Stewart, M. T., Larochelle, M. R., & Adams, R. S. (2025). Characterizing the association between traumatic brain injury and discontinuation of medications for opioid use disorder in a commercially insured adult population. *Journal of Head Trauma Rehabilitation, 40*(2), E111–E120. https://doi.org/10.1097/htr.0000000000000964

Mosti, C. & Coccaro, E. F. (2018). Mild traumatic brain injury and aggression, impulsivity, and history of other-and self-directed aggression. *Journal of Neuropsychiatry and Clinical Neurosciences, 30*(3), 220–227. https://doi.org/10.1176/appi.neuropsych.17070141

Nardo, T., Batchelor, J., Berry, J., Francis, H., Jafar, D., & Borchard, T. (2022). Cognitive remediation as an adjunct treatment for substance use disorders: A systematic review. *Neuropsychology Review, 32*, 161–191. https://doi.org/10.1007/s11065-021-09506-3

National Academies of Sciences, Engineering, and Medicine. (2022). Rehabilitation and long-term care needs after traumatic brain injury. In C. Matney, K. Bowman, & D. Berwick (Eds.), *Traumatic brain injury: A roadmap for accelerating progress*. Washington, DC: The National Academies Press. https://www.ncbi.nlm.nih.gov/books/NBK580075/

National Overdose Response Service. (2026). About us. https://www.nors.ca/about

Niyirora, J., Harmon, E. Y., & Melewski, M. (2026). Relationships of substance use disorders with discharge outcomes after inpatient rehabilitation: A retrospective cohort study. *Archives of Physical Medicine and Rehabilitation*, S0003-9993(26)00618-0. Advance online publication. https://doi.org/10.1016/j.apmr.2026.03.009

Okrah, A. K., Tharrington, S., Shin, I., Wagoner, A., Woodsmall, K. S., & Jehu, D. A. (2025). Risk factors for fall-related mild traumatic brain injuries among older adults: A systematic review highlighting research gaps. *International Journal of Environmental Research and Public Health*, *22*(2), 255. https://doi.org/10.3390/ijerph22020255

Oliverio, R., Karelina, K., & Weil, Z. M. (2020). Sex, drugs, and TBI: The role of sex in substance abuse related to traumatic brain injuries. *Frontiers in Neurology, 11*, Article 546775. https://doi.org/10.3389/fneur.2020.546775

Olsen, C. M. & Corrigan, J. D. (2022). Does traumatic brain injury cause risky substance use or substance use disorder? *Biological Psychiatry, 91*(5), 421–437. https://doi.org/10.1016/j.biopsych.2021.07.013

Passman, J. N., Cleri, N. A., Robertson, J., Saadon, J. R., Polizu, C., Zheng, X., … Mikell, C. B. (2025). Severe traumatic brain injury outcomes in patients with premorbid psychiatric illness. *World Neurosurgery, 194*, Article 123367. https://doi.org/10.1016/j.wneu.2024.10.096

Patel, P. R., Armistead-Jehle, P., Eltman, N. R., Heath, K. M., Cifu, D. X., & Swanson, R. L. (2023). Brain injury: How dietary patterns impact long-term outcomes. *Current Physical Medicine and Rehabilitation Reports*, *11*, 367–376. https://doi.org/10.1007/s40141-023-00413-7

Pearce, S. & Boyd, J. (July 17, 2025). Brain injuries: A frontline perspective on strategies to support PWUD in community. [Webinar]. https://www.catie.ca/understanding-brain-injury-strategies-for-ontario-harm-reduction-programs

Perrin, P. B., Krch, D., Sutter, M., Snipes, D. J., Arango-Lasprilla, J. C., Kolakowsky-Hayner, S. A. … Lequerica, A. (2014). Racial/ethnic disparities in mental health over the first 2 years after traumatic brain injury: A model systems study. *Archives of Physical Medicine and Rehabilitation, 95*, 2288–2295. https://doi.org/10.1016/j.apmr.2014.07.409

Public Health Agency of Canada. (2025). Key findings: Opioid- and stimulant-related harms in Canada. https://health-infobase.canada.ca/substance-related-harms/opioids-stimulants/

Russolillo, A., Ramsay, S., & Goodyear, T. (2025). Anoxic brain injury among people with mental health and substance use concerns: A commentary. *Canadian Journal of Addiction 16*(3)*,* 7–9. https://doi.org/10.1097/CXA.0000000000000249

Schifano, F., Martinotti, G., & Scherbaum, N. (2024). Navigating the complex intersection of substance use and psychiatric disorders: A comprehensive review. *Journal of Clinical Medicine, 13*(4), 999. https://doi.org/10.3390/jcm13040999

Scofield, D. E., Proctor, S. P., Kardouni, J. R., Hill, O. T., & McKinnon, C. J. (2017). Risk factors for mild traumatic brain injury and subsequent post-traumatic stress disorder and mental health disorders among United States army soldiers. *Journal of Neurotrauma*, *34*(23), 3249–3255. https://doi.org/10.1089/neu.2017.5101

Shah, M. K., Al-Adawi, S., Dorvlo, A. S. S., & Burke, D. T. (2004). Functional outcomes following anoxic brain injury: A comparison with traumatic brain injury. *Brain Injury*, *18*(2), 111–117. https://doi.org/10.1080/0269905031000149551

Simpson, G. & Tate, R. (2007). Suicidality in people surviving a traumatic brain injury: prevalence, risk factors and implications for clinical management. *Brain Injury*, *21*(13–14), 1335–1351. https://doi.org/10.1080/02699050701785542

Swift, T. L. & Wilson, S. L. (2001). Misconceptions about brain injury among the general public and non-expert health professionals: An exploratory study. *Brain Injury*, *15*(2), 149–165. https://pubmed.ncbi.nlm.nih.gov/11260765/

Teasell, R., Mehta, S., Faltynek, P., Duffy, T., Bayley, M., & Mackenzie, H. (2018). Epidemiology and long-term outcomes following acquired brain injury. *Evidence-Based Review of Moderate to Severe Acquired Brain Injury*. https://erabi.ca/wp-content/uploads/2018/12/Module-2_V12_epiandlongterm.pdf

Todaro, D. R., Volkow, N. D., Langleben, D. D., Shi, Z., & Wiers, C. E. (2024). Collateral damage: Neurological correlates of non-fatal overdose in the era of fentanyl-xylazine. *Neuroscience Insights*, *19.* https://doi.org/10.1177/26331055241247156

Toledo-Fernández, A., Marín-Navarrete, R., Villalobos-Gallegos, L., Salvador-Cruz, J., Benjet, C., & Roncero, C. (2020). Exploring the prevalence of substance-induced neurocognitive disorder among polysubstance users, adding subjective and objective evidence of cognitive impairment. *Psychiatry Research*, *288*, Article 112944. https://doi.org/10.1016/j.psychres.2020.112944

Tunkel, A. & Pradhan, S. (2002). Central nervous system infections in injection drug users. *Infectious Disease Clinics of North America, 16(3),* 589–605. https://doi.org/10.1016/s0891-5520(02)00015-6

U.S. Centers for Disease Control and Prevention. (2025). Health disparities in TBI. https://www.cdc.gov/traumatic-brain-injury/health-equity/index.html

Vadalia, M. & Yadav, N. K. (2025). Neurophysiological and visual effects of cannabis, nicotine, and e-cigarettes on patients with TBI: A literature review. *Brain Injury*, *39*(12), 973–983. https://doi.org/10.1080/02699052.2025.2509162

Valera, E. M., Joseph, A.-L. C., Snedaker, K., Breiding, M. J., Robertson, C. L., Colantonio, A., … Bellgowan, P. S. F. (2021). Understanding traumatic brain injury in females: A state-of-the-art summary and future directions. *Journal of Head Trauma Rehabilitation*, *36*(1), E1–E17. https://doi.org/10.1097/htr.0000000000000652

Voelker, R. (2025). Harm reduction strategies for people who use drugs. *JAMA, 333*(13), 1184. https://doi.org/10.1001/jama.2025.0178

Vogler, J., Klein, A. M., & Bender, A. (2014). Long-term health-related quality-of-life in patients with acquired brain injury and their caregivers. *Brain Injury*, *28*(11), 1381–1388. https://doi.org/10.3109/02699052.2014.919536

Weil, Z. M., Corrigan, J. D., & Karelina, K. (2018). Alcohol use disorder and traumatic brain injury. *Alcohol Research: Current Reviews*, *39*(2), 171–180. https://doi.org/10.35946/arcr.v39.2.07

Winstanley, E. L., Mahoney, J. J., 3rd, Castillo, F., & Comer, S. D. (2021). Neurocognitive impairments and brain abnormalities resulting from opioid-related overdoses: A systematic review. *Drug and Alcohol Dependence*, *226*, Article 108838. https://doi.org/10.1016/j.drugalcdep.2021.108838

Wojtowicz, M., Silverberg, N. D., Bui, E., Zafonte, R., Simon, N., & Iverson, G. L. (2017). Psychiatric comorbidity and psychosocial problems among treatment-seeking veterans with a history of mild traumatic brain injury. *Focus, 15*(4), 384–389. https://doi.org/10.1176/appi.focus.20170028

Wu, C. H., Tsai, T. H., Su, Y. F., Zhang, Z. H., Liu, W., Wu, M. K., … Lin, C. L. (2016). Traumatic brain injury and substance related disorder: A 10-year nationwide cohort study in Taiwan. *Neural Plasticity*, Article 8030676. https://doi.org/10.1155/2016/8030676

Xie, E., Pellegrini, M., Chen, Z., Jolliff, L., Crotty, M., Ratcliffe, J., … Lannin, N. A. (2023). The influence of substance use on traumatic brain injury recovery and rehabilitation outcomes: The outcome-ABI study. *Archives of Physical Medical Rehabilitation, 104*, 1115–1123. https://doi.org/10.1016/j.apmr.2023.03.015

Yamaguchi, K., Takahashi, K., Jakob, D. A., Abe, T., Matsushima, K., & Demetriades, D. (2025). Pre-injury narcotic drug use in isolated severe traumatic brain injury: Effect on outcomes. *European Journal of Trauma Emergency Surgery, 51*, Article 50. https://doi.org/10.1007/s00068-024-02743-0

Zhu, G., Chen, F., Wang, L., Cui, W., Cai, Y., Yang, C., … Ge, S. (2024). Optimal range of systolic blood pressure in the emergent phase that reduces the negative outcomes of traumatic brain injury surgery. *Journal of Neurorestoratology*, *12*(2), Article 100118. https://doi.org/10.1016/j.jnrt.2024.100118

About CCSA

CCSA was created by Parliament to provide national leadership to address substance use in Canada. A trusted counsel, we provide national guidance to decision makers by harnessing the power of research, curating knowledge and bringing together diverse perspectives.

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