



Associations between traumatic brain injuries and substance use among Ontario youth

Presenter:

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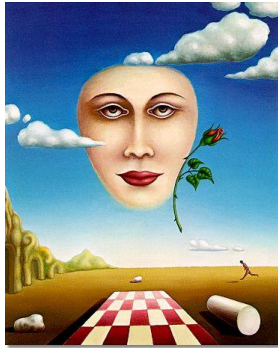
Dr. Gabriela Ilie, Dr. Robert Mann, Dr. Ed Adlaf, Angela Boak, Dr. Heyley Hamilton, Dr. Jurgen Helm, Dr. Mark Asbridge

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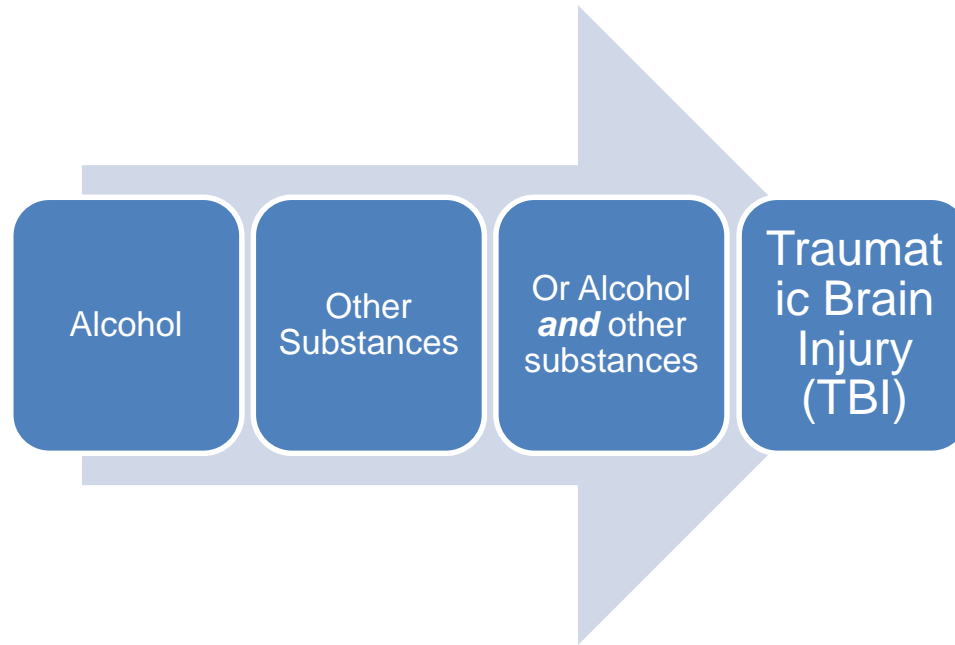


Disclosure

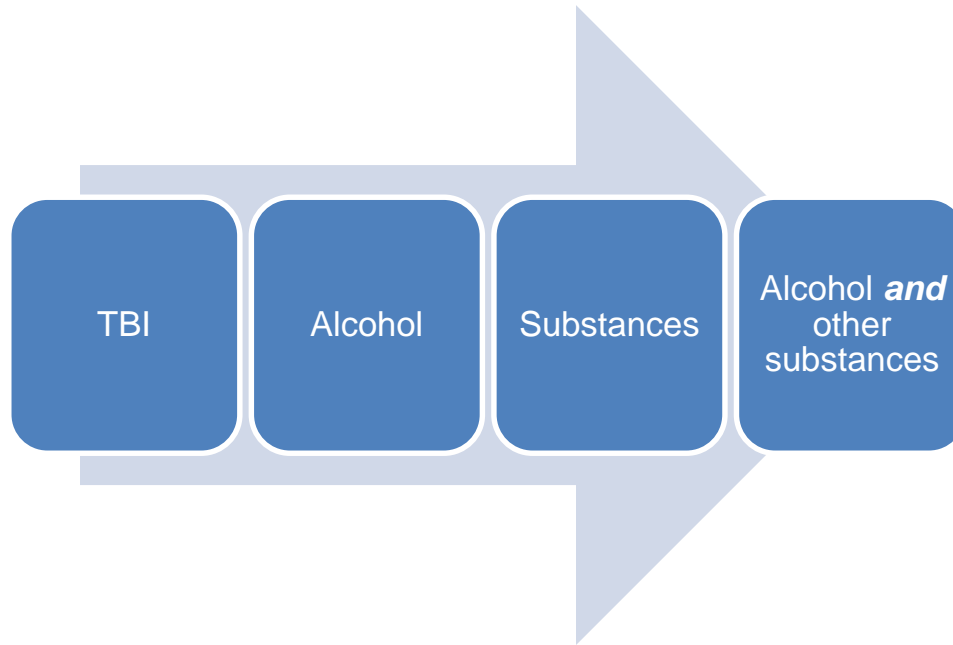
- Neurosurgeon who wishes all brain injuries would be prevented



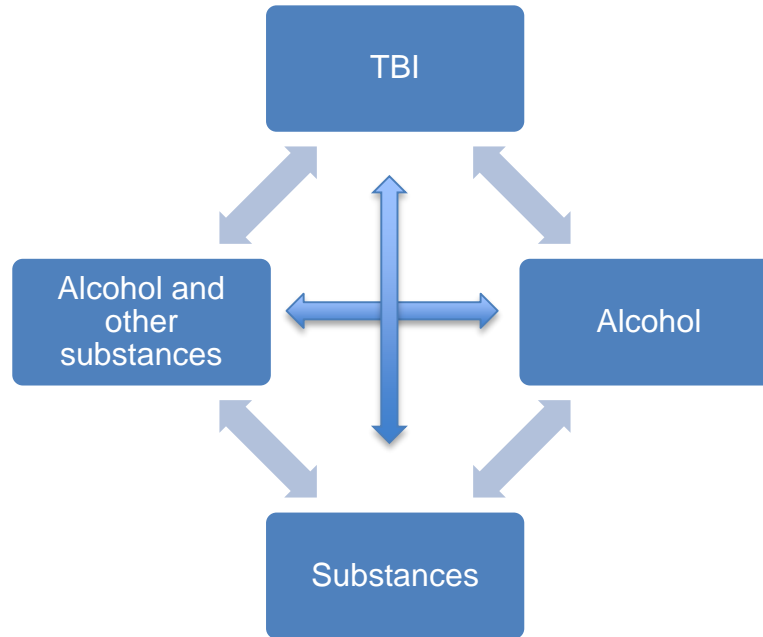
A complex relationship between substances and TBI



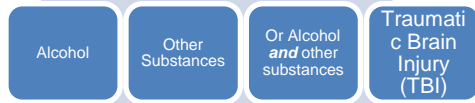
A complex relationship between substances and TBI



A complex relationship between substances and TBI



Alcohol intoxication and TBI



- From *one third to one half* of persons incurring a TBI are *intoxicated* at the time of injury.^{14–16}
- Among those treated for injuries in EDs and TCs, the likelihood of a concurrent TBI increases significantly as blood alcohol content increases.¹⁷

Table 2: Percent Tested and Percent Intoxicated

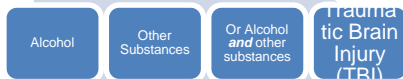
	Tested (%)	Found (%)
Rimel ¹³	85	47
Sparadeo ¹²	83	51
Gurney ¹⁰	75	37
Kaplan ¹⁷	68	38
Gordon ¹⁵	62	51
Ruff ¹⁴	61	36
Kraus ¹¹	43	49

Corrigan J: Arch Phys Med Rehabil Vol 76, April 1995

Parry-Jones BL, et al *Neuropsychol Rehabil.* 2006;16:537–560.



Alcohol and drugs pre-TBI



1: Intoxication and Substance Abuse Associated With TBI

Authors	Sample	BAL 100 mg/dL (%)	BAL Tested (%)	History of Substance Abuse (%)
Gurney ¹⁰	520 trauma center admits (≥ 18 years old, CHI only, hospital stay > 1 day)	37%	(75%)	Not reported
Kraus ¹¹	2,649 residents of an urban county hospitalized for, or died of, TBI in 1981 (≥ 15 years old)	49%	(43%)	Not reported
Sparadeo ¹²	85 trauma center admits (18 to 60 years old, not DOA)	51%	(83%)	Alcohol 25% (reported in medical record)
Rimel ¹³	737 trauma center admits (not severe, CHI only, not SCI, 93% ≥ 11 years old)	47%	(85%)	Alcohol 16% (patient or family interview on admission)
Ruff ¹⁴	664 cases in the Traumatic Coma Data Bank (≥ 15 years old, not GSW, not DOA)	36%	(61%)	Alcohol 44%, Drug 13% ("regular" or "excessive" used reported by a relative)
Gordon ¹⁵	325 cases in the TBI Model Systems database (≥ 16 years old)	51%	(62%)	Not reported
Kaplan ¹⁷	129 consecutive admits to a TBI rehabilitation unit (15 to 55 years old)	38%	(68%)	Not reported
Drubach ¹⁶	322 consecutive admits to a TBI rehabilitation unit (average age 34.7 years)	Not reported		Alcohol 62%, Drug 37% (clinical interview)
Wong ¹⁸	498 consecutive admits to a TBI rehabilitation unit (≥ 18 years old)	Not reported		Alcohol 37%, Drug 9% (reported in medical record)
Kreutzer ¹⁹	74 clients referred for supported employment (average age 30.9 years, average time post 6.4 years)	Not reported		Alcohol 66% Pre-injury, 28% Postinjury (Moderate/Heavy QFVI) Drug 36% Pre-injury, 40% Postinjury ("yes" to "use" on GHHQ)
Kreutzer ²⁰	87 patients seen in outpatient medical clinic (average age 31.6 years, average time post 4.0 years)	Not reported		Alcohol 58% Pre-injury, 20% Postinjury (Moderate/Heavy QFVI)

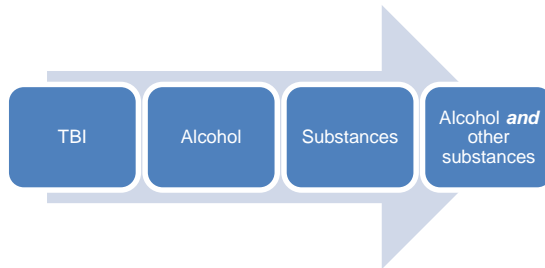
Abbreviations: CHI, closed head injury; DOA, dead on arrival; SCI, spinal cord injury; BAL, blood alcohol level; GSW, gunshot wound; QFVI, Quantity Frequency Variability Index.

Corrigan J: Arch Phys Med Rehabil Vol 76, April 1995



Alcohol and Substances After TBI

- 30% of hospitalized TBI survivors consume moderate or heavy levels of alcohol 1-year postinjury
- 48% report at least one incidence of binge drinking per month.¹²
- This binge rate is 50% higher than in the age- and gender-matched general population.¹²
- Among adults who experienced moderate or severe TBI and received rehabilitation, 18% are misusing substances 1 year after injury and 11% report at least one incident of binge drinking per month.¹³



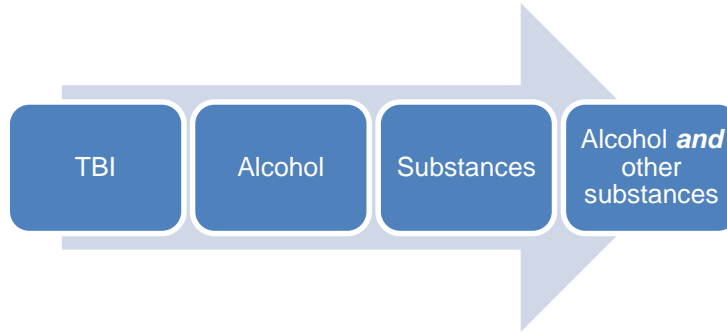
Horner MD, et al . *J Int Neuropsychol Soc.* 2005;11:322–330.
Traumatic Brain Injury Model Systems National Data and Statistical Center. *Traumatic Brain Injury Model Systems National Database Update.* 2008. Available at: www.tbindsc.org.



Alcohol and Substances After TBI

As with injuries in general, substance misuse initially *declines* after experiencing TBI but then begins to *increase*, at least during the first two years postinjury.¹⁸

Individuals with a *history of substance use disorder before injury* may be as much as **10 times** more likely to exhibit *problematic substance use postinjury*, when compared with those without such history.¹⁹

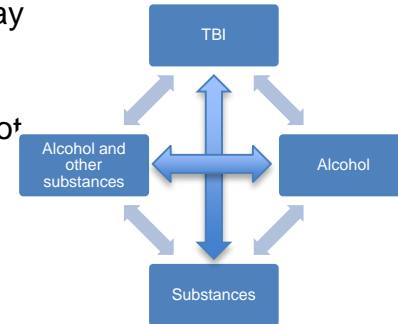


Corrigan JD, Smith-Knapp K, Granger CV. Outcomes in the first 5 years after traumatic brain injury. *Arch Phys Med Rehabil.* 1998;79:298–305.



A complex relationship between substances and TBI

- Thus, previous TBI increases the likelihood of intoxication, which increases the likelihood a TBI will be incurred.
- Neuropsychological deficits in alcoholics cannot be accounted for solely by the extent of their alcohol abuse, suggesting that TBI may interact with abuse to cause neuropsychological impairment.
- *However, post-injury drug abuse rates among TBI survivors did not differ from patients treated for other bodily traumas (Kolakowsky-Hayner et al., 2002).*
- *This is not surprising given that the hallmark injury in TBI effects frontal-temporal lobes and white matter*
 - *- functions important in complex social behavior, particularly the ability to inhibit emotion, plan goal-directed behavior, and manage thinking skills*
- **Implications for Treatment, Rehabilitation AND Legal actions**



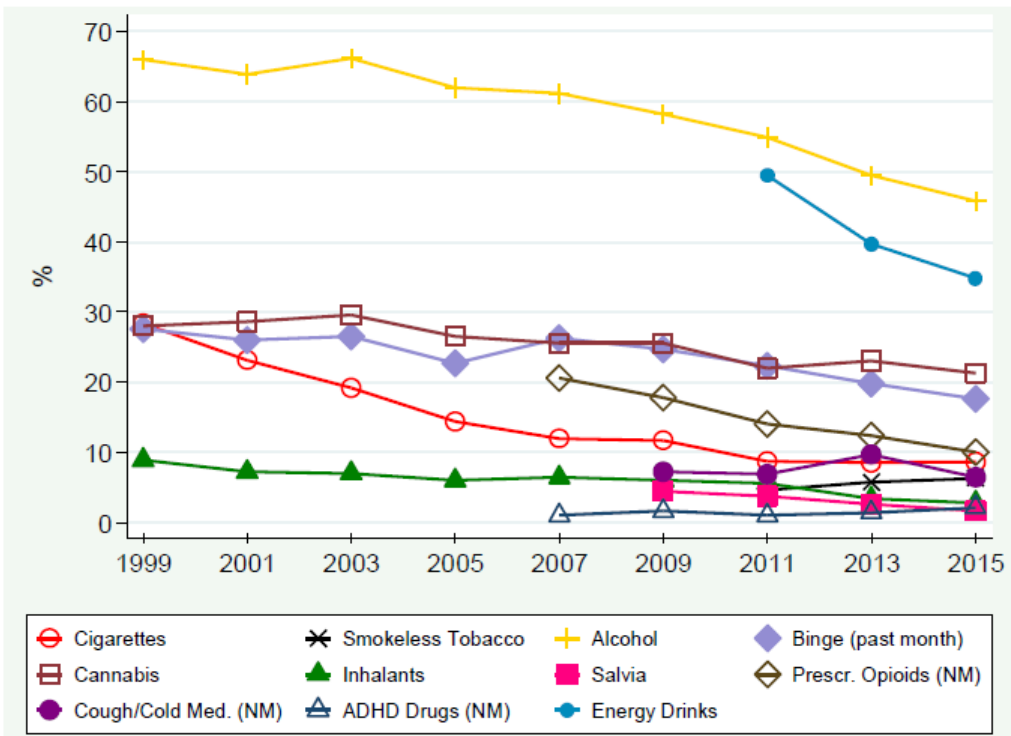
Corrigan et al J Trauma. 2010;69: 722–726



- Most of what we understand is from adults
- We understand very little about children and youth – Substances and TBI
- However, we do know a fair amount about youth use of alcohol and drugs...



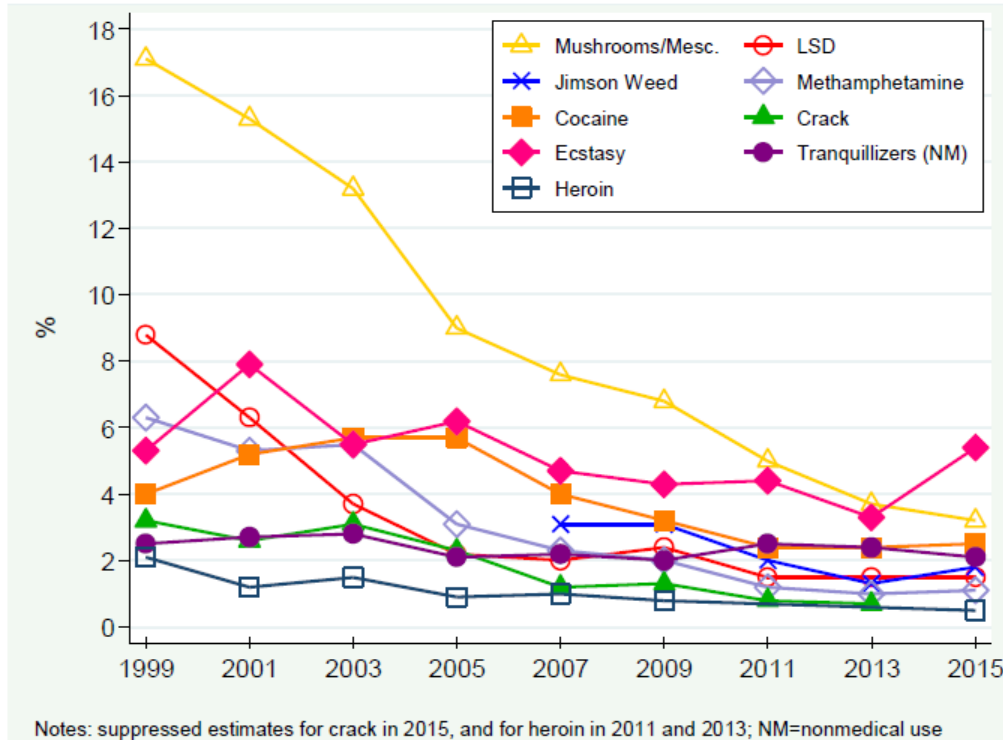
Figure 3.2.2a
 Overview of Past Year Drug Use Trends, 1999–2015 OSDUHS (Grades 7–12)



Boak, A et al (2015). Drug use among Ontario students, 1977-2015: (CAMH Research Document Series No. 41).



Overview of Past Year Drug Use Trends, 1999–2015 OSDUHS (Grades 9–12 only)



Boak, A et al (2015). Drug use among Ontario students, 1977-2015: (CAMH Research Document Series No. 41).



TBI and substance use in youth



Collaboration

- St. Michael's and CAMH - Ontario Student Drug Use and Health Survey (OSDUHS)
- Measuring TBI in the OSDUHS
- Findings on the association of TBI with risk and antecedent health problems in Ontario adolescents



Methods

- Data presented here were derived from a subsample of the 2011 (and 2013) cycle of the Ontario Student Drug Use and Health Survey (OSDUHS)
- Study design: **a repeated cross-sectional probability survey of Ontario students enrolled in grades 7 through 12 (ages 11–20)** in publicly funded schools, representing about 93% of the province's adolescent population
- Survey **projects to nearly 1 million students** (excludes private, military and institutional schools, and special education)
- We employed **a stratified** (region and school type [elementary, secondary]), **two-stage** (school, class) **cluster sample design**. *Within each strata, schools were selected with probability-proportional-to-size, and within selected schools, classes were selected with equal probability.*



2011 Participation

- 40 public and Catholic school boards
- 181 schools
- 581 classes
- 9,288 students in grades 7–12
- student-level response rate was 62%



- The 2011 OSDUHS contained questions about head injuries students may have had in their life.
-

- *“We are interested in any head injury that resulted in you being unconscious (knocked out) for at least 5 minutes, or where you had to stay in the hospital for at least 1 night because of it”.*

- How many times IN YOUR LIFE have you had a head injury like this?

_____ times

“Did you have this type of head injury during the last 12 months?”

- *(1) Yes, I’ve had a head injury like this in the last 12 months.*
- *(2) Yes, I’ve had a head injury like this in my life, but not in the last 12 months.*
- *(3) No, I’ve never had a head injury like this in my life.”*



- The mechanism of injury was assessed with the following question:
-

- *“If you had this type of head injury in the last 12 months, what was the cause of it? (If this happened more than once, think about the last time it happened.)*
- *(1) I’ve not had a head injury like this in the last 12 months,*
- *(2) I’ve never had a head injury like this in my life,*
- *(3) Motor vehicle accident,*
- *(4) Other vehicle accident (such as snowmobile, ATV, tractor),*
- *(5) Bicycle accident,*
- *(6) Fight,*
- *(7) Sports injury (such as team sports, skate boarding, skiing, snow boarding),*
- *(8) Fell down,*
- *(9) Other causes not listed.”*



Methods

- Traumatic brain injury – loss of consciousness for 5 min or more, or overnight hospitalization due to symptoms (DSM-IV)
- Mental Health Indicators
 - Elevated Psychological Distress (12-item version of the General Health Questionnaire - GHQ12), Suicide ideation; Suicide attempt; Being prescribed medication for anxiety, depression or both;
 - Other related measures: calling a kids/teens help line to talk about a problem
- Conduct and Violent Behaviours:
 - Took car for ride without the owner's permission; Sold marijuana or hashish; Theft more than 50\$; Set fire; Run away from home;
 - Broken into locked building (not home; Beat up or hurt anyone (on purpose); Carried weapon (e.g., gun/knife); Got in a fight at school at least once; Damaged something on purpose that belonged to someone else;
- Bullying at School, Cyber-Bullying



Results: TBI in Ontario

Students

- 20.2% of Ontario adolescents reported experiencing TBI at least once in their lifetime
- 5.6% reported experiencing a TBI in the past 12 months
- 14.6% reported experiencing a TBI in their lifetime but not in the past 12 months
- Sports the most frequent mechanism of injury
- Rates of TBI did not differ by grade or by region of the province

JAMA 2013



TBI and Sex differences

The estimated prevalence of acquiring a lifetime TBI was greater for males than females (23.1% versus 17.1%).

Of the 13 pairwise cross-tabulations with significant TBI associations, **nine were significant for both males and females**, with *four being significant only for females* (elevated psychological distress, past year suicidal ideation, being bullied at school in the past year and past-year cigarette smoking).

In each instance the outcome were highest among adolescents who had sustained a TBI compared with those who had not.



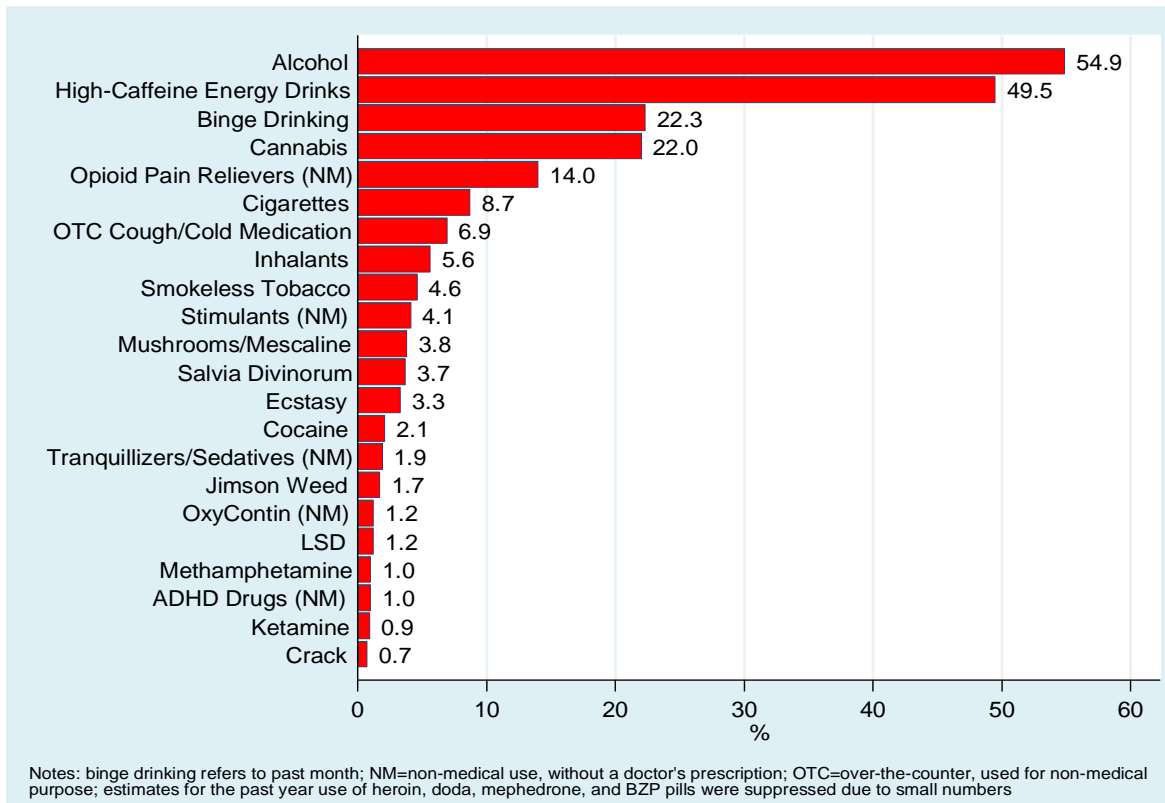
TBI and mental health issues in Ontario **adolescents**

Adolescents who had experienced one or more TBIs were **2-4 times more likely** to:

- Score positive for a mental health issue
- Contemplated suicide in the last year
- Attempted suicide in the last year (aOR=3.39)
- Called a crisis or help line for help last year
- Was prescribed medication for depression, anxiety or both in the last year

Ilie et al, PLoS One 2014

Percentage of Students in Grades 7–12 Reporting Using the Drug at Least Once in the Past Year, 2011 OSDUHS





Epidemiology of TBI among Ontario **Adolescents** (Ilie et al., 2013, JAMA)

- TBI is associated with *increased use of alcohol and cannabis*
- This relationship was *particularly strong among students who reported experiencing TBI in the past 12 months*
- There was an associated between *TBI and lower marks (below 60%)*
- This relationship was particularly strong *among students who reported experiencing TBI in the period before the past 12 months*

A closer look at TBI and substance use

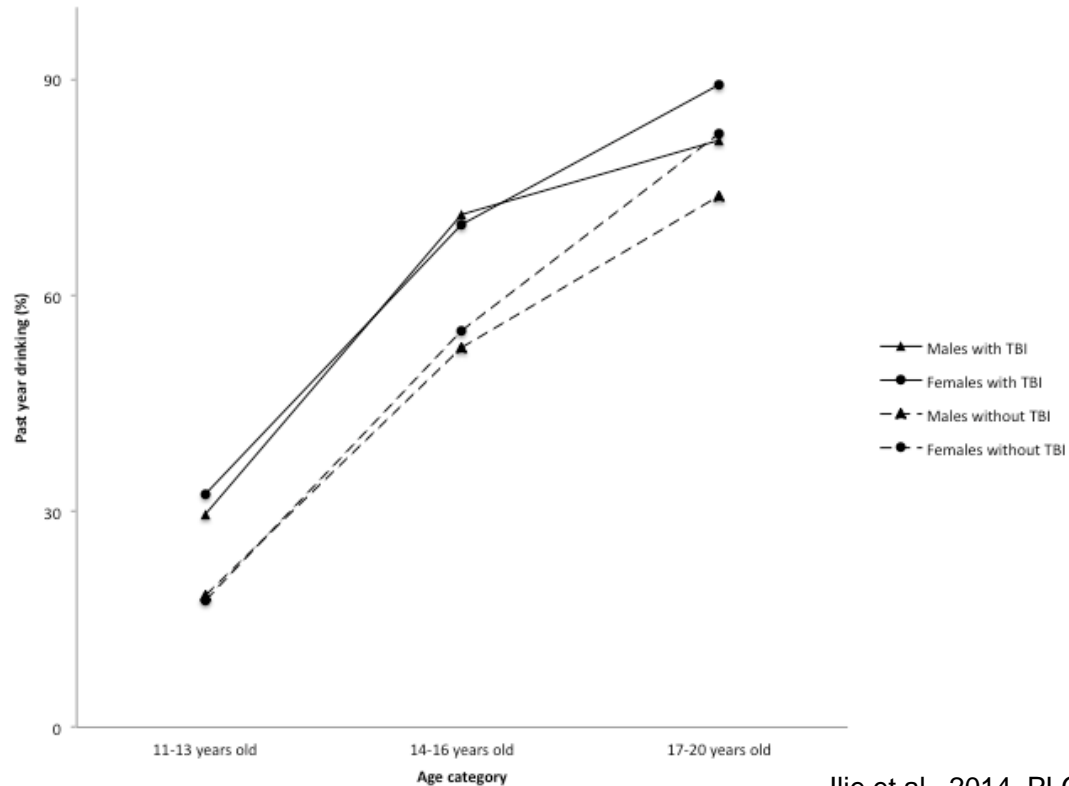
Students who had experienced one or more TBIs were **2-4 times more likely** to:

- Drink alcohol and binge drink
- Use tobacco
- Use cannabis
- Use LSD and other hallucinogens
- Use cocaine, ecstasy, methamphetamine and crystal meth
- Use sedatives and tranquilizers and opioid pain relievers

Ilie et al., 2014, JHTR

TBI and Sex difference

Figure 2. Past year drinking among adolescents with a history of TBI. Totals are based on N=8915, forms A and B of the survey.



TBI and tobacco, alcohol and other drug use, students in grades 9-12.

Table 2. Percentage of reported tobacco, alcohol and drug usage by Ontario high-school with or without TBI, 2011 OSDUHS (N=6288)

Problems associated with lifetime TBI	Students without TBI	Students with TBI	OR	95% CI
<i>Tobacco usage</i>				
Smoked 1+ cigarettes daily p12m**	3.9%	9.2%	2.48	1.45,4.25
<i>Alcohol usage</i>				
Alcohol p12m (excl sip)***	63.7%	77.0%	2.01	1.52,2.67
Binge drinking 5+ drinks p4wks***	26.4%	39.3%	1.84	1.45,2.34
<i>Illegal drugs usage</i>				
Cannabis p12m***	25.2%	39.5%	2.00	1.60,2.50
LSD p12m**	1.1%	3.0%	2.56	1.45,4.52
Hallucinogens p12m***	3.8%	9.6%	2.64	1.73,4.04
Cocaine p12m***	1.9%	4.6%	2.49	1.75,3.54
Ecstasy p12m***	3.3%	8.7%	2.82	1.73,4.58
Methamphetamine/ crystal meth p12m***	0.8%	2.9%	3.77	2.21,6.41
Sedatives/tranq. non medically p12m***	1.6%	5.9%	3.83	2.67,5.51
<i>Use of medical drugs that were not medically prescribed</i>				
ADHD drugs non medically p12m*	1.0%	2.1%	2.07	1.18,3.61
Opioid pain relief non medically p12m***	12.6%	27.2%	2.69	2.02,3.60

Notes: (1) odds ratios were all calculated in a logistic regression model controlling for the effect of grade and sex; (2) ** odds ratios are significant at $P < 0.01$; * odds ratios are significant at $P < 0.05$

A closer look at TBI and substance use

Students who had experienced one or more TBIs were **2-3 times more likely** to:

- Be identified with a potential alcohol problem by the Alcohol Use Disorders Identification Test (AUDIT) screening instrument
- Be identified with a potential cannabis problem by the Severity of Dependence Scale (SDS) screening instrument
- Be identified with a potential drug problem by the CRAFFT screening instrument

Ilie et al., 2014, JHTR

TBI and alcohol and other drug problems as assessed by screening instruments, grades 9-12

Table 4. Percentage of AUDIT (8+), CRAFFT(2+) and Cannabis Severity of Dependence Scale by Ontario high-school with or without TBI, 2011 OSDUHS (n=3358)

Problems associated with lifetime TBI	Students without TBI	Students with TBI	OR	95% CI
AUDIT (8+) ^{***}	20.5%	36.2%	2.25	1.76,2.88
CRAFFT (2+) ^{***}	13.9%	24.7%	2.01	1.53,2.64
Cannabis SDS [*]	2.1%	5%	2.25	1.01, 5.0

Notes: (1) odds ratios were all calculated in a logistic regression model controlling for the effect of grade and sex; (2) ^{***} odds ratios are significant at $P < 0.001$; ^{*} odds ratios are significant at $P < 0.05$

Ilie et al., 2014, JHTR

MEASURING TRAUMATIC BRAIN INJURY (TBI) and ***PROBLEM DRINKING*** IN ADOLESCENTS

- Purpose: To describe the impact of traumatic brain injury and ***hazardous drinking*** on mental health and behavioral issues among Ontario adolescents.
- In particular, to assess **the incremental co-occurrence** of hazardous drinking with history of TBI, *in comparison to experiencing **just one** of these conditions.*



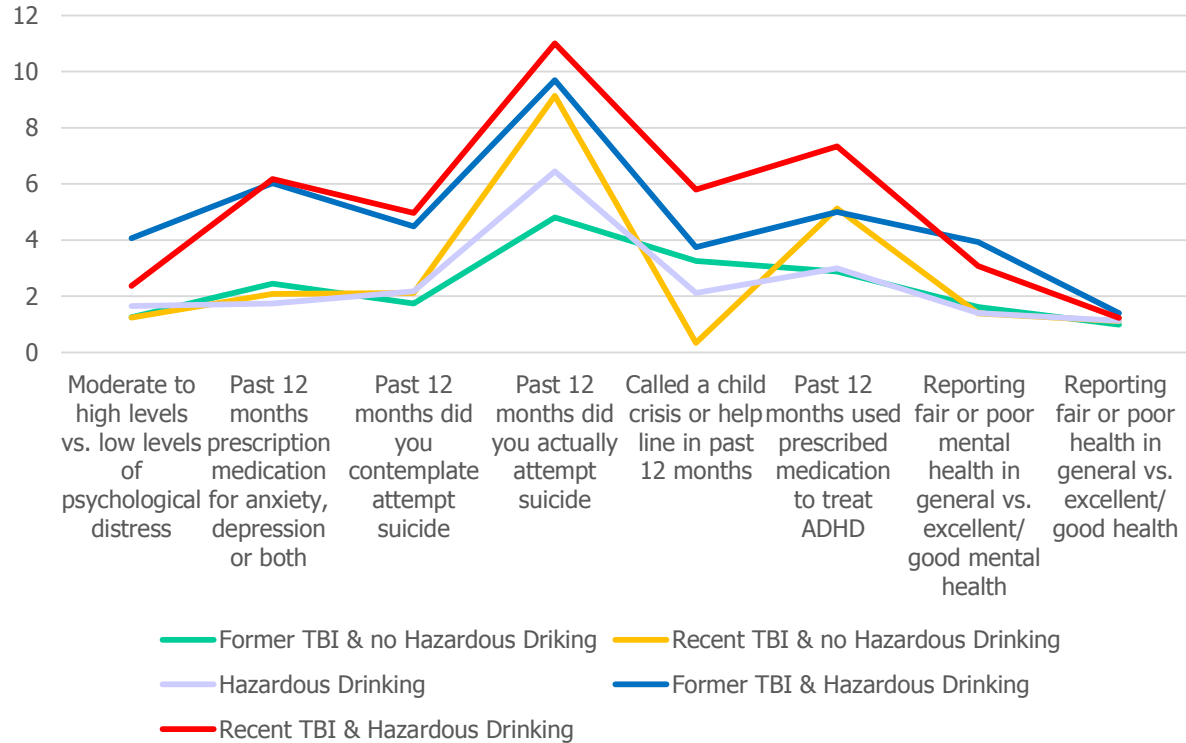
- The Alcohol Use Disorders Identification Test (AUDIT) is a 10-item screening tool developed by the World Health Organization (WHO) to assess alcohol consumption, drinking behaviors, and alcohol-related problems.
- A score of 8, or more, of 40, on the AUDIT indicates hazardous or harmful drinking (Carey et al., 2003; Reinert and Allen, 2002).



TBI and Hazardous Drinking classifications among Ontario **adolescents**

- 11.8% (95% CI: 10.1, 13.8) of Ontario adolescents reported **former TBI**.
- 4.0% (95% CI: 2.9, 5.5) reported **recent TBI**
- **13.7%** (95% CI: 12.3, 15.3) were identified as **hazardous drinkers**
- 4.1% (95% CI: 2.9, 5.8) reported **former TBI with co-occurring hazardous drinking**
- 2.2% (95% CI: 1.6, 3.0) reported **recent TBI with co-occurring hazardous drinking**
- 64.1% (95% CI: 60.9, 67.2) were individuals who **never had a TBI and scored negative on the AUDIT**.

TBI and Hazardous drinking among Ontario adolescents – And mental health issues

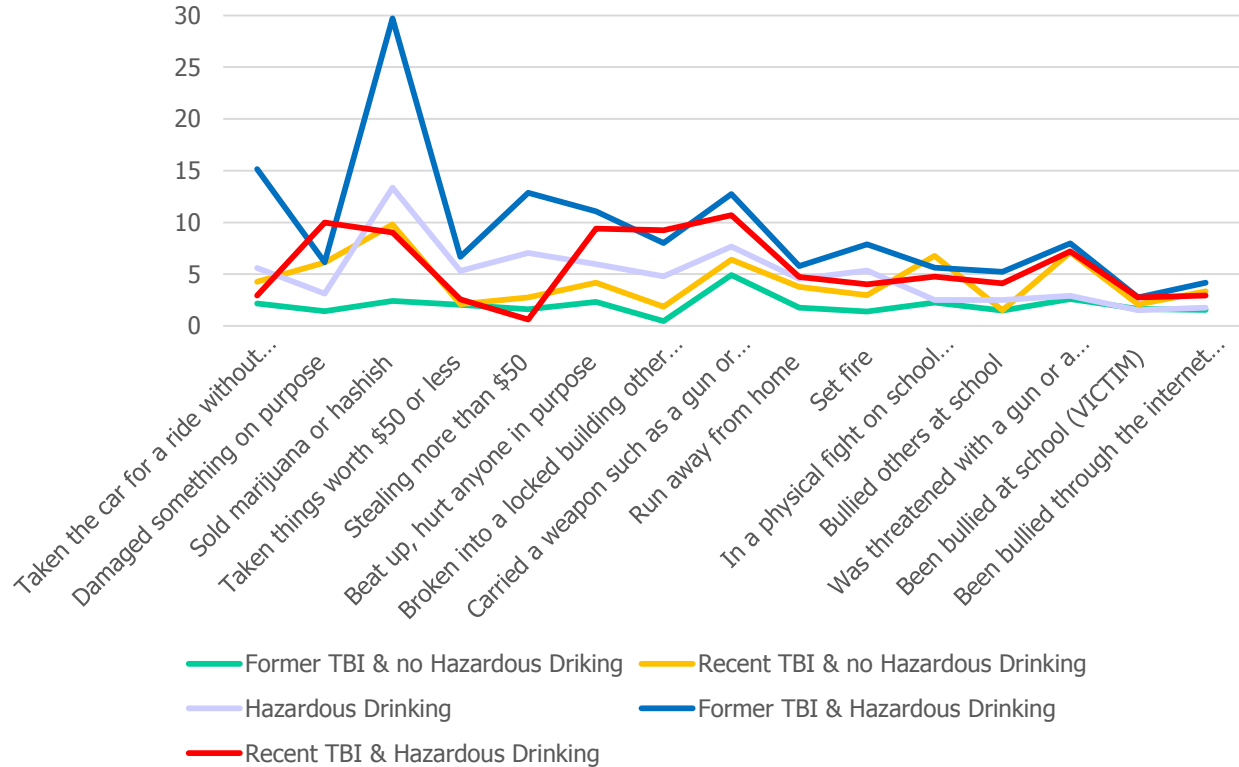


Ilie et al., 2016 under review

St. Michael's

Inspired Care.
Inspiring Science.

TBI and AUDIT classifications among Ontario adolescents - violence and conduct behaviours



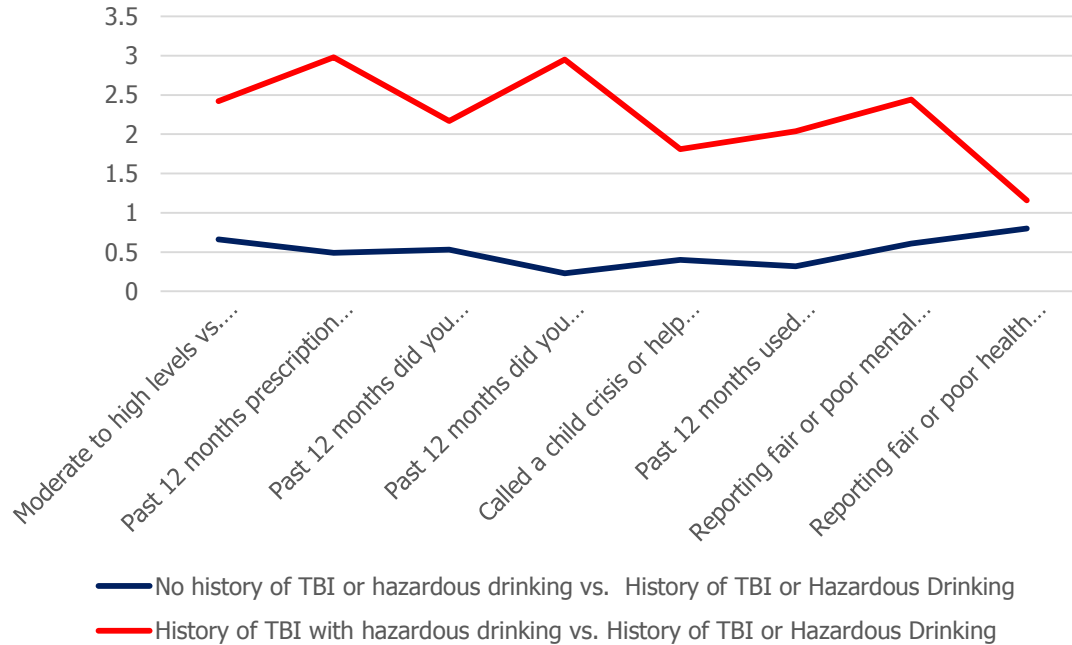
Ilie et al., 2016 under review



- The second set of analyses were based on the following 3 classifications:
 - 1. adolescents who did not report a TBI (former or recent) **nor** did they screen positive on the AUDIT;
 - 2. adolescents who reported either former or recent TBI, **or** who screened positive on the AUDIT (used as baseline)
 - 3. adolescents who screened positive on the AUDIT **and** also reported either former or recent TBI.

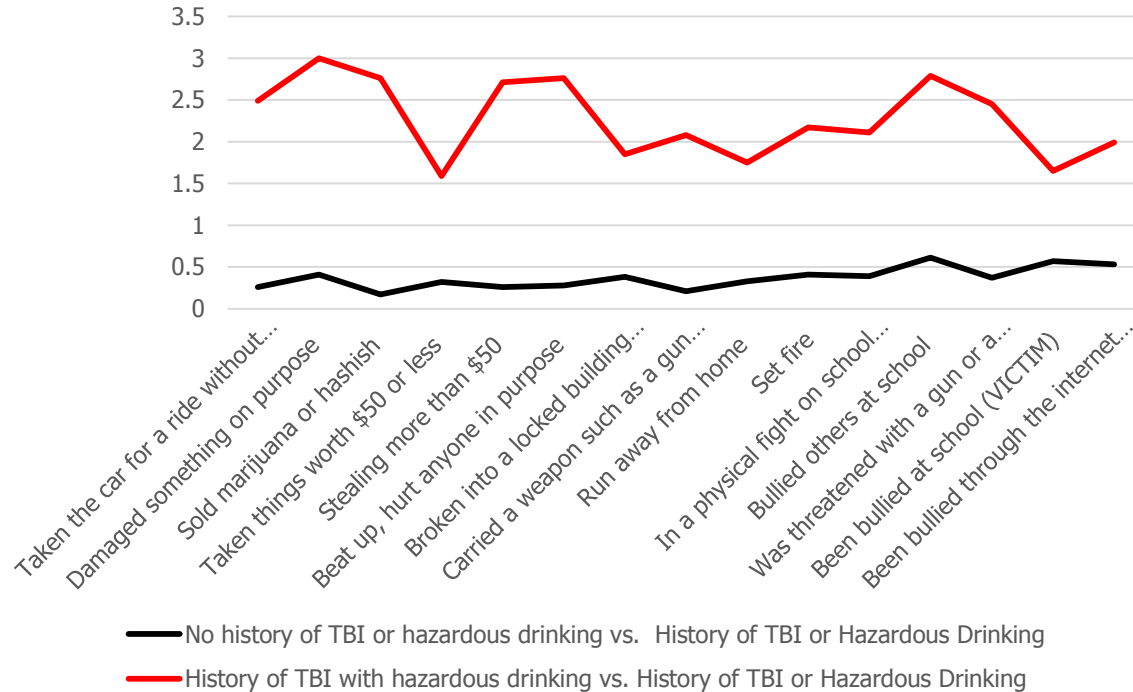
Ilie et al., 2016 under review

TBI and AUDIT classifications, independent or co-occurring - mental health



Ilie et al., 2016 under review

TBI and AUDIT classifications, independent and co-occurring violence and conduct behaviours



Ilie et al., 2016 under review

What about TBI and Energy Drinks?

Students who had experienced a TBI in *the past 12 months* were **6-10 times more likely** to:

- Report using energy drinks 5 or more times in the past 7 days
- Report using energy drinks mixed with alcohol more than 6 times in their lifetime

Ilie et al, 2015 Plos One.

Results: Energy drinks and TBI

- Teens who reported having **a TBI in the past year** were **seven times more likely** to report **drinking at least five energy drinks in the last week**, compared to teens who did not have a TBI.
- Teens who experienced a **TBI in the last 12 months** were at least **twice more likely** to report **drinking energy drinks mixed with alcohol**.
- Teens who got a **TBI while playing team sports like hockey** had, compared to teens who suffered a TBI from other injuries like fights or a car accident, **had double the odds of drinking energy drinks in the last year**

LIMITATIONS

Limitations of the study:

- preclusion of causal inferences,
- possible bias related to self-reports
- underestimation due to the exclusion of institutionalized delinquent adolescents.



Prevention of TBI is critical

- Everyone here has an important role to play
 - Education and awareness
 - Enforcement – legislative, rules
 - Engineering – equipment, environment
 - Economic – incentives and disincentives
 - Evaluation – surveillance and effectiveness

CONCLUSIONS

- TBI is:
 - Intricately associated with alcohol and other substances and vice versa
 - Related with mental health and high risk behaviors
 - Causal directions require further inquiry
 - TBI or substances may be a marker for one another so parents, caregivers, professionals and others ought to be aware



CONCLUSIONS: TBI and substances

- Specialized multidisciplinary approach makes sense for prevention
- Important implications for treatment, recovery and legal actions



MANY THANKS TO

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