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MEDICINE & DENTISTRY

# ADHD, Alcohol, Drugs and Driving: Population-Based Examination in a Canadian Sample

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# Adult ADHD

- Many see ADHD:
  - “firmly as a biological disorder”  
with
  - “such a profound effect on brain function that every aspect of the life of an affected individual may be permanently compromised”  
(Comings *et al.*, 2005).
- ~ 30-66% of ADHD children continue to meet full criteria for ADHD as adults (Barkley 2002; Biederman 1998; Biederman *et al* 2000; Weiss 1985; Weiss & Hechtman, 1992; Manuzza *et al.* 1993).

# Comorbidities

In young people, ADHD found to co-occur with

- anxiety disorders in 25-35% of cases,
- mood disorders in 20% of cases, and
- oppositional defiant disorder (ODD) and conduct disorder (CD) in 25-50% of cases.

(Steele, Jensen & Quinn, 2006)

# Other problems

- Those with ADHD less likely to enter college, to graduate, 2 years less of schooling. (Barkley, 2002; Mannuzza et al., 1997).
- Less likely to be employed, lower occupational ranks (Barkley, 2002; Biederman, 2006; Mannuzza et al., 1997).
- Lower SES, lower household income (Biederman, 2006; Weis & Hechtman, 1993).
- Higher crash rates, e.g. 4 times higher (Barkley et al., 1996) but Vaa (2014) meta-analysis OR =1.23, .

# Poor quality research

Methodological problems:

- referral bias, self-reporting,
- inappropriate or undefined comparison groups,
- non-blinded test administrators,
- use of non-validated measures,
- participant attrition,
- lack of adjustment for multiple comparisons,
- small sample sizes,
- lack of statistical controls for age, sex and driving exposure,
- lack of control for ADHD medication use and comorbidities.

# Poor quality research

- Conduct (CD), oppositional defiant (ODD) or antisocial personality (ASPD) disorders, may partially or fully explain driving-related outcomes (Barkley & Cox, 2007; Fried et al., 2006; Thompson et al., 2007).
- Mixed results for studies examining drinking driving of ADHD adults.
- Some evidence for improved driving with ADHD meds, but some simulator studies find no differences (e.g. Barkley et al 2005).

# Purpose

To explore relationships among self-reported screening measures of ADHD, other psychiatric problems, substance use/abuse and driving-related outcomes among a provincially representative sample of adults 18 years and older living in Ontario, Canada.

# Caveats

We are using a screener, not comprehensive clinical examination.

Interpretation of findings needs to be mindful of this.

# Methods: CAMH Monitor

- An ongoing cross-sectional telephone survey.
- Target population - non-institutionalized adults aged 18 and older residing in Ontario households in 2011-2012 (24 months).
- Administered using computer-assisted telephone interviewing (CATI) by the Institute for Social Research at York University.
- Sampling frame includes landline and cell phones.

# CAMH Monitor

- Sampling design: 2-stage probability selection procedure from a sampling of all active area codes and exchanges in Ontario.
- Stage 1: random sample of telephone numbers selected from within each of the six regional strata.
- Stage 2: one respondent ( $\geq 18$  yrs) able to complete interview in English selected without replacement based on most recent birthday of all household members (Ialomiteanu & Adlaf, 2012).

# CAMH Monitor

- Final annualized weight used in the current study is a function of the selection weight and a post stratification adjustment.

# Adult ADHD Self-Report Scale (ASRS) Screener

(Kessler *et al.*, 2007)

- 6-item checklist to assess ADHD symptoms based on DSM-IV criteria for ADHD, developed by WHO.
- Items scored: 0 'never', 1 'rarely', 2 'sometimes', 3 'often', and 4 'very often'.
- Scores  $\leq 13$  = ADHD negative.
- Scores  $\geq 14$  = ADHD positive.

# Previous ADHD Diagnosis and Medication Use

- Have you ever been diagnosed with Attention Deficit Disorder (ADD) or Attention Deficit Hyperactivity Disorder (ADHD) by a doctor or health care professional?
  - If yes, before age 18?
- Have you ever been treated with MEDICATION for ADHD or ADD by a doctor or health care professional?
  - Currently using?

# Psychiatric Distress

- General Health Questionnaire (GHQ12) is a 12-item, 4-point widely used screening instrument for current psychiatric distress.
- Captures depression/anxiety and problems with social functioning with a score  $\geq 3$  = positive screen.

# Antisocial Behaviour

- Mini-International Neuropsychiatric Interview – Antisocial Personality Disorder.
- Dichotomous scale to assess delinquencies (truancy, cheating/lying/stealing, bullying, hurting animals/people) before and after age 15.
- Score  $\geq 3$  on last 6 questions = positive ASB screen.

# Substance Use/Abuse Measures

- **Binge drinking:** 5+ drinks at same sitting at least once in year.
- **Alcohol Use Disorders Identifications Test (AUDIT):** developed by WHO to identify the presence or absence of an alcohol use disorder. Score  $\geq 8$  = hazardous alcohol use.
- **Lifetime Used Cocaine:** Have you ever in your lifetime used COCAINE?

# Substance Use/Abuse Measures

- **Lifetime Used Cannabis:** Have you ever in your lifetime used CANNABIS, MARIJUANA or HASH?
- **Alcohol, Smoking and Substance Involvement Screening Test (ASSIST), cannabis subscale:** 6-item screening instrument to assess risk of experiencing health and other problems (social, financial, legal, relationship) from their current pattern of cannabis use, score  $\geq 4$  = moderate or high risk of problems.

# Medication use

- Have you ever been treated with medication for ADHD or ADD by a doctor or health care professional?
- Anti-anxiety medication taken in last 12 months?
- Anti-depressant medication taken in last 12 months?
- Anti-pain medication taken in last 12 months?

# Driving Questions

- In past 12 months,

**Collisions:** Involved in collision of any kind while you were driving?

**Drinking & Driving:** Have you driven a motor vehicle after having two or more drinks in the previous hour?

**Cannabis Driving:** Have you driven a motor vehicle within an hour of using cannabis, marijuana or hash?

# Driving Questions

- In past 12 months,

**Racing:** Driven car, truck, SUV in a street race?

**Mild road rage:** Cursed, shouted made rude gestures?

**Serious road rage:** Threatened to hurt driver/passenger, threatened to damage vehicle?

# Socio-Demographic Questions

**Age:** 18-24, 25-44, 45-64, 65+

**Sex:** Male, Female

**Driving Exposure - Kilometers driven:** On average, about how many kilometers or miles do you drive in a typical week?

# Statistical Analysis

- Chi-square and t-tests were used for bivariate analyses, Bonferroni adjustment for 18 comparisons = .0028
- 2 sequential logistic regressions performed considering self-reported 1) crashes and 2) street racing, or 5) serious road rage, as the dependent variable
  - Controlling for age, sex, driving exposure in 1<sup>st</sup> block; ADHD in 2<sup>nd</sup> block; ASB and distress in 3<sup>rd</sup> block; ASSIST, cannabis use ever, cocaine use ever.

# Results

- Overall,
  - 215 (6.1%, CI: 5.31, 11.41 ) of all respondents reported they “were in an accident or crash involving any kind of damage or injury while they were driving in the past year”.
  - 105 (3.0%, CI: 2.53, 5.63) of all respondents screened positively for ADHD.
  - 12.4% of those who screened positively for ADHD reported a crash, compared to 5.6% of those who screened negatively for ADHD.

# Weighted Frequencies and Proportions for Age by Collision Status

|       | Collision in past yr |     | Total |
|-------|----------------------|-----|-------|
| Age   | N                    | %   | N     |
| 18-24 | 34                   | 9.0 | 377   |
| 25-44 | 91                   | 7.4 | 1226  |
| 45-64 | 66                   | 5.2 | 1266  |
| 65+   | 17                   | 3.1 | 554   |
| Total | 208                  | 6.1 | 3423  |

$p < .000^{**}$

$^{**}$ Bonferroni adjustment for 18 comparisons = .0028

# Weighted Frequencies and Proportions for Gender by Collision Status

|           | Collision in past yr |     | Total |
|-----------|----------------------|-----|-------|
| Gender    | N                    | %   | N     |
| Female    | 108                  | 5.1 | 2103  |
| Male      | 107                  | 6.2 | 1723  |
| Total     | 215                  | 5.6 | 3826  |
| $p = .47$ |                      |     |       |

# Weighted Frequencies and Proportions for Positive for ADHD Screener by Collision Status

|               | Collision in past yr |      | Total |
|---------------|----------------------|------|-------|
|               | N                    | %    | N     |
| ADHD + screen | 13                   | 12.4 | 105   |
| No            | 183                  | 5.6  | 3256  |
| Total         | 196                  | 5.8  | 3361  |
| $p = .007$    |                      |      |       |

# Weighted Frequencies and Proportions for Distress by Collision Status

|                              | Collision in past yr |            | Total       |
|------------------------------|----------------------|------------|-------------|
|                              | N                    | %          | N           |
| <b>Distress (GHQ)</b>        | <b>42</b>            | <b>9.0</b> | <b>469</b>  |
| <b>No</b>                    | <b>172</b>           | <b>5.7</b> | <b>3026</b> |
| <b>Total</b>                 | <b>214</b>           | <b>6.1</b> | <b>3495</b> |
| <b><math>p = .006</math></b> |                      |            |             |

# Weighted Frequencies and Proportions for Antisocial Behaviour Screen by Collision Status

|                                                  | Collision in past yr |      | Total |
|--------------------------------------------------|----------------------|------|-------|
|                                                  | N                    | %    | N     |
| ASB screen                                       | 2*                   | 22.2 | 9*    |
| No                                               | 203                  | 6.0  | 3380  |
| Total                                            | 214                  | 6.3  | 3389  |
| <p><math>p = .14</math><br/>*Small cell size</p> |                      |      |       |

# Weighted Frequencies and Proportions for Binge Drinking by Collision Status

|                       | Collision in past yr |     | Total |
|-----------------------|----------------------|-----|-------|
|                       | N                    | %   | N     |
| Binge (5+) in past yr | 108                  | 7.4 | 1452  |
| No                    | 70                   | 5.4 | 1283  |
| Total                 | 178                  | 6.5 | 2735  |
| $p = .008$            |                      |     |       |

# Weighted Frequencies and Proportions for Hazardous Drinking (AUDIT) by Collision Status

|           | Collision in past yr |     | Total |
|-----------|----------------------|-----|-------|
|           | N                    | %   | N     |
| AUDIT(8+) | 28                   | 6.2 | 450   |
| No        | 173                  | 5.8 | 2958  |
| Total     | 206                  | 6.0 | 3408  |
| $p = .41$ |                      |     |       |

# Weighted Frequencies and Proportions for Cocaine Use Ever by Collision Status

|                  | Collision in past yr |      | Total |
|------------------|----------------------|------|-------|
|                  | N                    | %    | N     |
| Cocaine use ever | 25                   | 10.3 | 242   |
| No               | 190                  | 5.8  | 3250  |
| Total            | 215                  | 6.2  | 3492  |
| $p = .006$       |                      |      |       |

# Weighted Frequencies and Proportions for Cannabis Use Ever by Collision Status

|                          | Collision in past yr |            | Total       |
|--------------------------|----------------------|------------|-------------|
|                          | N                    | %          | N           |
| <b>Cannabis use ever</b> | <b>114</b>           | <b>7.9</b> | <b>1443</b> |
| <b>No</b>                | <b>100</b>           | <b>4.9</b> | <b>2038</b> |
| <b>Total</b>             | <b>214</b>           | <b>6.1</b> | <b>3481</b> |
| <i>p</i> < .000**        |                      |            |             |

# Weighted Frequencies and Proportions for Cannabis Use Problems (ASSIST-C) by Collision Status

|                      | Collision in past yr |             | Total       |
|----------------------|----------------------|-------------|-------------|
|                      | N                    | %           | N           |
| <b>ASSIST-C (4+)</b> | <b>25</b>            | <b>15.2</b> | <b>162</b>  |
| <b>No</b>            | <b>190</b>           | <b>5.7</b>  | <b>3327</b> |
| <b>Total</b>         | <b>215</b>           | <b>6.2</b>  | <b>3489</b> |
| <i>p</i> < .000**    |                      |             |             |

# Weighted Frequencies and Proportions for ADHD Medication Taken by Collision Status

|                                | Collision in past yr |     | Total |
|--------------------------------|----------------------|-----|-------|
|                                | N                    | %   | N     |
| ADHD meds                      | 1*                   | 2.0 | 50    |
| No                             | 212                  | 6.1 | 3438  |
| Total                          | 213                  | 6.1 | 3488  |
| $p = .180$<br>*Small cell size |                      |     |       |

# Weighted Frequencies and Proportions for Anti-anxiety Medication Taken by Collision Status

|                   | Collision in past yr |     | Total |
|-------------------|----------------------|-----|-------|
|                   | N                    | %   | N     |
| Anti-anxiety meds | 24                   | 9.2 | 261   |
| No                | 187                  | 5.8 | 3225  |
| Total             | 211                  | 6.1 | 3486  |
| $p = .23$         |                      |     |       |

# Weighted Frequencies and Proportions for Anti-depressant Medication Taken by Collision Status

|                      | Collision in past yr |     | Total |
|----------------------|----------------------|-----|-------|
|                      | N                    | %   | N     |
| Anti-depressant meds | 15                   | 6.7 | 223   |
| No                   | 200                  | 6.1 | 3266  |
| Total                | 215                  | 6.2 | 3489  |
| $p = .40$            |                      |     |       |

# Weighted Frequencies and Proportions for Anti-pain Medication Taken by Collision Status

|                | Collision in past yr |     | Total |
|----------------|----------------------|-----|-------|
|                | N                    | %   | N     |
| Anti-pain meds | 56                   | 7.8 | 719   |
| No             | 153                  | 5.6 | 2750  |
| Total          | 209                  | 6.0 | 3469  |
| $p = .018$     |                      |     |       |

# Weighted Frequencies and Proportions for Drinking Driving by Collision Status

|                  | Collision in past yr |     | Total |
|------------------|----------------------|-----|-------|
|                  | N                    | %   | N     |
| Drinking driving | 8*                   | 4.2 | 192   |
| No               | 206                  | 6.2 | 3303  |
| Total            | 214                  | 6.1 | 3495  |

$p = .156$

\*Small cell size

# Weighted Frequencies and Proportions for Cannabis Use and Driving by Collision Status

|                                                                        | Collision in past yr |             | Total       |
|------------------------------------------------------------------------|----------------------|-------------|-------------|
|                                                                        | N                    | %           | N           |
| <b>Cannabis &amp; Driving</b>                                          | <b>7*</b>            | <b>10.4</b> | <b>67</b>   |
| <b>No</b>                                                              | <b>208</b>           | <b>6.1</b>  | <b>3406</b> |
| <b>Total</b>                                                           | <b>215</b>           | <b>6.2</b>  | <b>3473</b> |
| <p><math>p = .118</math><br/>                     *Small cell size</p> |                      |             |             |

# Weighted Frequencies and Proportions for Street Racing by Collision Status

|                                                                                | Collision in past yr |      | Total |
|--------------------------------------------------------------------------------|----------------------|------|-------|
|                                                                                | N                    | %    | N     |
| Street Racing                                                                  | 9*                   | 25.7 | 35    |
| No                                                                             | 205                  | 5.9  | 3450  |
| Total                                                                          | 214                  | 6.1  | 3485  |
| <p><math>p &lt; .000^{**}</math><br/>                     *Small cell size</p> |                      |      |       |

# Weighted Frequencies and Proportions for Mild Road Rage by Collision Status

|                | Collision in past yr |     | Total |
|----------------|----------------------|-----|-------|
|                | N                    | %   | N     |
| Mild Road Rage | 100                  | 6.6 | 1515  |
| No             | 114                  | 5.9 | 1937  |
| Total          | 214                  | 6.2 | 3452  |
| $p = .387$     |                      |     |       |

# Weighted Frequencies and Proportions for Serious Road Rage by Collision Status

|                                                                        | Collision in past yr |     | Total |
|------------------------------------------------------------------------|----------------------|-----|-------|
|                                                                        | N                    | %   | N     |
| Serious Road Rage                                                      | 4*                   | 7.7 | 52    |
| No                                                                     | 209                  | 6.1 | 3438  |
| Total                                                                  | 213                  | 6.1 | 3490  |
| <p><math>p = .630</math><br/>                     *Small cell size</p> |                      |     |       |

# What correlates with crashes? (Sequential Logistic Regression)

| Block 4                   |           | $\beta$ | Wald    | Sig. | Exp ( $\beta$ ) |
|---------------------------|-----------|---------|---------|------|-----------------|
| Age Group                 | 18-24     |         | 14.099  | .003 |                 |
|                           | 25-44     | .185    | .496    | .481 | 1.203           |
|                           | 45-64     | -.369   | 1.749   | .186 | .692            |
|                           | $\geq 65$ | -.745   | 3.838   | .050 | .475            |
| Male                      |           | .008    | .003    | .959 | 1.009           |
| Wkly Driving km           |           | .000    | 5.846   | .016 | 1.000           |
| ADHD+ Status              |           | -.126   | .080    | .777 | .882            |
| ASB (+)                   |           | 1.024   | 1.456   | .228 | 2.784           |
| GHQ (3+)                  |           | .108    | .228    | .633 | 1.114           |
| ASSIST                    |           | .567    | 3.248   | .071 | 1.763           |
| Used Cannabis in Lifetime |           | .339    | 3.659   | .056 | 1.404           |
| Used Cocaine in Lifetime  |           | -.005   | .000    | .987 | .995            |
| Constant                  |           | -2.987  | 126.622 | .000 | .050            |

Model  $X^2=38.317$ ,  $df=11$ ,  $P<.000$     -2 Log likelihood=1229.741;  
Hosmer and Lemeshow Test  $X^2=3.296$ ,  $df=8$ ,  $P=.914$

# What correlates with street racing?

| Block 4                   |           | $\beta$ | Wald   | Sig. | Exp ( $\beta$ ) |
|---------------------------|-----------|---------|--------|------|-----------------|
| Age Group                 | 18-24     |         | 13.855 | .003 |                 |
|                           | 25-44     | -1.635  | 7.673  | .006 | .195            |
|                           | 45-64     | -2.388  | 10.714 | .001 | .092            |
|                           | $\geq 65$ | -3.115  | 2.720  | .099 | .044            |
| Male                      |           | .481    | .846   | .358 | 1.618           |
| Wkly Driving km           |           | .000    | 1.034  | .309 | 1.000           |
| ADHD+ Status              |           | -.380   | .180   | .671 | .684            |
| ASB (+)                   |           | 2.308   | 3.987  | .046 | 10.053          |
| GHQ (3+)                  |           | 1.075   | 4.366  | .037 | 2.931           |
| ASSIST                    |           | -.091   | .016   | .898 | .913            |
| Used Cannabis in Lifetime |           | .941    | 2.238  | .135 | 2.563           |
| Used Cocaine in Lifetime  |           | 1.239   | 3.776  | .052 | 3.452           |
| Constant                  |           | -4.979  | 57.359 | .000 | .007            |

Model  $X^2=43.691$ ,  $df=11$ ,  $P<.000$     -2 Log likelihood=185.951;  
Hosmer and Lemeshow Test  $X^2=6.554$ ,  $df=8$ ,  $P=.585$

# Conclusions

- First Canadian population-based study of prevalence of adult ADHD symptoms at 3.5%.
- Correlates of collision involvement in past year:
  - Age
  - Binge drinking
  - Cocaine use ever
  - Cannabis use ever
  - ASSIST- Cannabis

# Conclusions

- 12.4% with ADHD positive screen reported previous yr crash, but not statistically significant.
- 9% with distress reported previous yr crash, but not statistically significant.
- 22.2% with ASB reported previous yr crash, but not statistically significant.

# Conclusions

- In multivariate sequential logistic regressions:
  - **Collisions:**
    - old age least likely,
    - km driven
  - **Street racing:**
    - younger ages most likely,
    - ASB,
    - distress

- **Limitations –**
  - **Screeners,**
  - **Self-report survey data,**
  - **Small cell sizes**
- Future research with larger sample sizes needs to re-examine the relationships between the ADHD screener status, other variables and driving outcomes.
- Further research is required to assess the sensitivity and specificity of the screener with actual ADHD diagnosis.

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