



RESEARCH ARTICLE

Childhood ADHD and Addictive Behaviours in Adolescence: A Canadian Sample

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Abstract

Objective: To compare rates of early addictive behaviours in a clinic sample of youth with childhood attention-deficit/hyperactivity disorder (ADHD) with those in community populations. **Method:** We surveyed 142 adolescents (14.1 ± 1.14 years), diagnosed with ADHD before age 12, about early substance use and problem gambling using questions from two cross-sectional population studies: the Canadian National Longitudinal Survey of Children and Youth, Ontario subsample, (N=1,317; 10-15 years) and the Ontario Student Drug Use and Health Survey (N=9,288; 12-18 years). **Results:** The ADHD sample reported using cigarettes, 17.8% (95% CI 12.1-25.5), alcohol, 27.1% (20.1-35.5), cannabis, 14.2% (8.9-21.7), at a similar or lower rate than the NLSCY (cigarettes, 28.3% (25.8-30.9), alcohol, 28.6% (26.0-31.3), cannabis, 16.5% (14.0-19.4), and OSDUHS samples (cigarettes, 21.9% (20.2-23.7), alcohol, 58.6% (56.0-61.2), cannabis, 26.0% (23.9-28.2). With regards to gambling, there is a non-significant trend for ADHD youth to report gambling more frequently than the provincial average, 7.9% (3.3-17.9) vs. 4.3% (2.9-6.3). **Conclusions:** Our findings support the emerging literature that youth diagnosed with ADHD in childhood may not be at greater risk for onset of substance use in early adolescence. The study identified two areas that warrant further investigation in this population; the possible increased risk for substance use among females and a trend toward early onset of gambling behaviours.

Key Words: attention deficit/hyperactivity disorder, substance use, gambling behaviour

Résumé

Objectif: Comparer les taux des comportements de dépendance précoces dans un échantillon clinique d'adolescents souffrant du trouble de déficit de l'attention/hyperactivité (TDAH) avec ceux de populations communautaires. **Méthode:** Nous avons interrogé 142 adolescents (14,1 ans ± 1,14 an), ayant reçu un diagnostic de TDAH avant l'âge de 12 ans, au sujet de l'utilisation de substances précoce et du jeu problématique à l'aide des questions de deux études transversales dans la population: l'Enquête longitudinale nationale sur les enfants et les jeunes (ELNEJ), sous-échantillon de l'Ontario (N=1 317; 10-15 ans), et le Sondage sur la consommation de drogues et la santé des élèves de l'Ontario (SCDSEO) (N=9 288; 12-18 ans). **Résultats:** L'échantillon du TDAH déclarait utiliser des cigarettes; 17,8% (IC à 95% 12,1-25,5), de l'alcool; 27,1% (20,1-35,5), du cannabis; 14,2% (8,9-21,7), à un taux semblable ou inférieur à celui de l'ELNEJ [cigarettes, 28,3% (25,8-30,9), alcool, 28,6% (26,0-31,3), cannabis, 16,5% (14,0-19,4)], et des échantillons du SCDSEO [cigarettes, 21,9% (20,2-23,7), alcool, 58,6% (56,0-61,2), cannabis, 26,0% (23,9-28,2)]. En ce qui concerne le jeu, il y a une tendance non significative pour les adolescents du TDAH à déclarer le jeu plus fréquemment que la moyenne provinciale, 7,9% (3,3-17,9) contre 4,3% (2,9-6,3). **Conclusions:** Nos résultats soutiennent ce qu'affirme la nouvelle littérature, soit que les adolescents ayant reçu un diagnostic de TDAH dans l'enfance ne sont pas à risque accru de commencer l'utilisation de substances au début de l'adolescence. L'étude a identifié deux domaines qui nécessitent plus de recherche dans cette population; le risque accru possible d'utilisation de substances chez les filles et une tendance au début précoce de comportements de jeu problématique.

Mots clés: trouble de déficit de l'attention/hyperactivité, utilisation de substances, comportement de jeu problématique

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Numerous studies have identified childhood attention-deficit/hyperactivity disorder (ADHD) as a potential risk factor for alcohol, cigarette, cannabis and illicit drug use disorders (Barkley, Fischer, Edelbrock, & Smallish, 1990; Biederman et al., 1997; Charach, Yeung, Climans, & Lillie, 2011; Lee, Humphreys, Flory, Liu, & Glass, 2011; Molina & Pelham, 2003) and for problem gambling (Faregh & Derevensky, 2011). It is argued that the difficulties with impulse control that are often present in adolescents with ADHD increase their susceptibility for developing other disorders that are characterized by impulse dysregulation, such as addictive behaviours (Faregh & Derevensky, 2011). Among adults, rates of substance use disorders among those with ADHD are high, at 15.2% (Kessler et al., 2006); however, prospective studies note the association between childhood ADHD and subsequent substance use disorders to be more modest. Meta-analyses comparing the risk of early ADHD and subsequent substance use disorders identified that the odds of developing an alcohol use disorder is 1.35 (95% confidence interval, CI 1.11-1.64) and cannabis use disorder during young adulthood is 1.51 (95% CI 1.02-2.24; Charach et al., 2011). The link between ADHD and adolescent use of cigarettes is greater than for alcohol or cannabis ($OR = 2.36$, 95% CI 1.71-3.27; Charach et al., 2011; Lee et al., 2011). Although evidence exists to support the association between ADHD and substance use disorders, recent research has highlighted that the direct associations with ADHD symptoms are not that strong and may actually be mediated by other factors such as conduct disorder, and social and cultural environments. In fact, Loo-ly (2008) found that the risk for early use of alcohol and cannabis in ADHD adolescents may be mediated through conduct problems and affiliation with deviant peer groups. Consequently, more research is warranted to further examine the degree of risk conferred by childhood ADHD.

To date, addiction research within the context of ADHD has focused primarily on substance use. There is much less research documenting an association between childhood ADHD and subsequent problem gambling. Youth gambling problems are becoming an increasingly recognized public health concern, especially among boys (Huang & Boyer, 2007); half of all youth with a gambling problem surveyed in Ontario and Quebec screened positive for ADHD (Faregh & Derevensky, 2011). However, our understanding is limited with regards to the prevalence of gambling behaviours among those diagnosed with ADHD. This is especially concerning since future gambling disorders usually begin during adolescence (Gupta & Derevensky, 1998), and the online opportunities for easy access to gambling have increased dramatically (Griffiths & Wood, 2000; Messerlian, Byrne, & Derevensky, 2004). Moreover, problem gambling is associated with numerous consequences, including substantial financial, legal and social/vocational difficulties, and increased prevalence of other mental health problems (Petry & Armentano, 1999).

The overlap between ADHD and addiction problems is a growing area of clinical and research interest, as well as public health concern (Faregh & Derevensky, 2011; Wilens, 2006). Considerable effort is put into the prevention, recognition and early intervention of substance use problems for Canadian youth. Relatedly, problem gambling is a growing concern, which has not yet received much research focus, especially among youth with ADHD. An important initial step is to compare the risk for addictive behaviours in adolescents who receive a diagnosis of ADHD in childhood with the risk in their same-aged peers in the general population. To address this question, the present paper reports the prevalence of common precursors of addictive behaviours (i.e., early substance use and gambling) in an early adolescent sample of Canadian children from a large urban center in Ontario who were previously diagnosed with ADHD in primary school. We compared this sample with two age-matched community population samples; the Canadian National Longitudinal Survey of Children and Youth (NLSCY), Ontario subsample, and the Ontario Student Drug Use and Health Survey (OSDUHS). Comparison with these epidemiological samples provides information about the unique risk of adolescent-onset addictive behaviours in an adolescent ADHD population.

Method

Participants

Our clinic sample consisted of 142 adolescents (75.4% male), 12 to 16 years old, out of 179 children previously diagnosed with DSM IV TR ADHD between the ages of 6 and 12 years, and invited to participate in a follow up study. At baseline the children were referred to a pediatric hospital in a large urban center in Ontario, Canada, for attention, learning, and behavioural difficulties. The comprehensive initial baseline evaluation conducted in childhood included semi-structured clinical psychiatric interviews with the parent, the Parent Interview for Child Symptoms (Ickowicz et al., 2006). In addition, the child underwent an assessment of cognition and academic achievement, and completed self-report questionnaires to identify internalizing symptoms. Information was also gathered from the teacher using standardized questionnaires. Functional impairment was assessed using parent and teacher ratings on the Ontario Child Health Survey Scale (Boyle et al., 1993), whereby parents and teachers rated each participant on items concerning the impact of behaviour problems on functioning at home, school, or in the community. Children met the following inclusion criteria: absence of significant hearing or visual impairment, Full Scale IQ above 79, no history of recent abuse or parental separation, no history of traumatic brain injury, birth weight above 2 kg, and the absence of medical or psychiatric disorders that would interfere with initiating interventions for ADHD. See Table 1 for the demographic characteristics of the clinic and population samples.

At follow-up, 142 adolescents (79% of the original sample) were re-assessed using semi-structured clinical interviews with parent and youth, and standardized questionnaires from parent and youth self-report questionnaires. The assessment measures and survey items are described below. Comparison of those participants who were followed versus those who were not revealed few significant group differences on demographic and clinical variables. Group differences were noted for clinician-rated impairment (Child Global Assessment Scale (CGAS); Shaffer et al., 1983) ($p = 0.010$), which was higher for those who were followed ($M = 51.3$, $SD = 9.08$) than those who were not ($M = 56.3$, $SD = 10.5$), and number of parent-reported oppositional-defiant disorder symptoms ($p = 0.011$), higher among those who were not followed ($M = 3.49$, $SD = 2.41$) than those in the clinic sample ($M = 2.55$, $SD = 1.96$). Information regarding medication use for ADHD was available for 107 out of 142 participants (75%) in the clinic sample and suggested that 53.5%, or approximately half of the sample used stimulant medication at some point in their lives, with 52.1%, currently still using medication.

Comparison samples

Two cross-sectional population-based samples were used for comparing rates of substance use among young Canadian adolescents. The research design for the clinical participants included questionnaires using items from both population surveys in order to facilitate comparisons. The first sample is the Canadian National Longitudinal Survey of Children and Youth (NLSCY), a Canadian national longitudinal survey that investigates the development of Canadian children from birth to adulthood (Michaud, 2001). We chose the Ontario subsample, Cycle 3, 1998/1999 cohort of 10-15 year-olds (mean age not available; 51.2% male; actual $N = 1,317$ youth; weighted $N = 1,005,076$ youth) as our comparison group because it provides a representative Ontario sample of participants similar in age to our early adolescent clinic youth. The NLSCY has been used in numerous publications (Hotton & Haans, 2004; Michaud, 2001).

The second population-based comparison sample was the 2011 Ontario Student Drug Use and Health Survey (OSDUHS), used both to identify community prevalence of substance use and of gambling behaviours. As a sample collected closely in time to the follow-up assessments among the clinic sample, these data address the possibility of cohort effects, both geographic and temporal. OSDUHS is an Ontario-based survey of elementary and secondary school students that has collected data to examine patterns in student substance use, physical and mental health, and risk behaviours on a biennial basis since 1977. This comparison group included youth in grades 7 to 12 (mean age not available; 51.8% male), enrolled in publically funded Ontario schools (actual $N = 9,288$ students; weighted $N = 1,009,900$ students). Data reflect information collected from anonymous self-report questionnaires completed from October

2010 to June 2011. Similar to the NLSCY data, OSDHUS findings are reliable and valid, reported in scientific publications, and have been used globally to understand trends in important adolescent health issues (Paglia-Boak, Adlaf, & Mann, 2011).

Measurement

All 142 follow-up participants underwent diagnostic re-assessments for psychiatric disorders, including ADHD, using the Kiddie-SADS-Present and Lifetime Version (Kaufman et al., 1997). Symptoms were counted if endorsed by either the parent or youth. Information regarding addictive behaviours was obtained from clinical participants using self-report questionnaire items from the NLSCY (National Longitudinal Survey of Children and Youth: Survey Instruments Catalogue No.89F0077XPE) and from the OSDHUS (Centre for Addiction and Mental Health: 2011 Ontario Student Survey).

Substance use: Information regarding cigarette smoking, drinking and illicit drug use, including cannabis, was collected using questionnaire items chosen from those administered in the NLSCY, e.g.: (1) Have you ever tried cigarette smoking, even just a few puffs? (yes or no); (2) Have you ever had a drink of alcohol? (Yes, at least one drink or I have only had a few sips/no); and, (3) Have you ever tried marijuana and cannabis products (also known as a joint, pot, grass, hash)? (yes or no). Questions also inquired about the use of hallucinogens, solvents, medicinal drugs without a prescription, and other illegal substances. Participants were identified to have experience with any of the substances if they reported past use.

Gambling: Information regarding past gambling was collected using items matching those in the OSDUHS, including the South Oaks Gambling Screen Revised for Adolescents (SOGS-RA). Adolescents who reported gambling, even just once, subsequently completed the SOGS-RA. The SOGS-RA is the most frequently used measure to evaluate adolescent gambling problems, and has been used to provide population estimates of gambling behaviour (Wiebe, Cox, & Mehmel, 2000). The definition of problem gambling was that used in the OSDUHS (Paglia-Boak et al., 2012).

The demographic variables included age and sex. Education level of the person most knowledgeable about the child (PMK), in most cases the youth's mother, was obtained as a proxy for socio-economic status from participants in the clinic for the purposes of comparison with the NLSCY sample (see Table 1).

Statistical analysis

To provide estimates of substance use and gambling behaviour in our clinic sample, missing or incomplete data was removed prior to calculating rates. Out of the 142 follow-up participants who completed the survey, 13 did not respond to

Table 1. Demographics of clinic sample participants vs. NLSCY vs. OSDUHS population samples

| Time-point | Age (year \pm SD) | Sex (%males) | PMK's education level | | | |
|---------------|-----------------------------|-----------------|---------------------------------------|--|--------------------------------------|---|
| | | | % completed less than secondary | % completed second- ary school graduation | % completed beyond high school | % completed college or university degree |
| Clinic sample | 12-16 (14.07 \pm 1.14) | 75.4 | 4.1 | 8.2 | 19.7 | 68.0 |
| NLSCY | 10-15 | 51.3 | 13.0 | 17.4 | 27.4 | 42.2 |
| OSDUHS | 12-18 | 51.8 | N/A | N/A | N/A | N/A |

PMK = Person most knowledgeable about the child.
PMK for NLSCY participants, 92.4% are the child's mother; for the clinic sample, 88.5% are the child's mother

or had missing/incomplete information regarding cigarettes and alcohol, 22 had missing data regarding experience with marijuana, hallucinogens, glue/solvents, and drugs without prescription, and 23 had missing/incomplete information regarding use of other drugs like crack, cocaine, speed or ecstasy. With regards to disclosure of gambling behaviour, nine participants had missing or incomplete data.

All values obtained from the NLSCY and OSDUHS data reflect weighted estimates that were statistically corrected for the sampling design. OSDUHS substance use rates reflect lifetime estimates. To evaluate whether the rates were statistically different we examined whether the 95% confidence intervals overlapped or not, with non-overlapping confidence intervals indicating a significant difference.

Logistic regression analyses were conducted to address the possibility that risk for substance use and for gambling may vary with level of functional impairment and number of parent reported ADHD symptoms described during baseline clinical assessment. All predictors were entered independently into each of the logistic regression analyses, with the outcome variable either any substance use or report of gambling with money, even just once. Similarly, logistic regression analyses were done to examine the possibility that early experience with substance use or gambling was associated with any past or current use of medication for ADHD.

Results

In comparison to the provincial averages, our sample of ADHD youth did not report using cigarettes, alcohol and cannabis at higher rates than their age-mates. Further, our clinical sample did not report greater experience with any other substances. Table 2 shows the substance use and gambling rates for our sample and the weighted NLSCY and OSDUHS values. Examination of gender differences in substance use revealed that in the ADHD clinical sample, females reported using nearly all substances to a greater extent than their male clinical counterparts, although these

differences did not reach statistical significance (see Table 2). Furthermore, there was a trend toward females from the clinic sample reporting more alcohol and cannabis use than females in the community, with usage being much closer to that of males in the community. This finding is converse to the pattern in the NLSCY Ontario subsample, where males reported greater experience with all substances. Finally, the reported substance use rates differed between the two population samples, reflecting a known temporal cohort effect (changes in substance use patterns; Jager, Schulenberg, O'Malley, & Bachman, 2013; Paglia-Boak et al., 2011; Reid, Hammond, Burkhalter, & Ahmed, 2012), and also may reflect differences in age or in data collection methods.

In terms of gambling, there is a pattern toward greater self-report of gambling in the clinic sample of ADHD youth, relative to the provincial average (see Table 2), with males reporting having gambled more frequently than females. The prevalence rates provided by OSDUHS reflect aggregate data collected from grades 7 to 12. Examination of the OSDUHS rates show that gambling significantly increases with grade (i.e., grade 7 = 25.2%; grade 9 = 33.5%; vs. grade 12 = 47.6%), peaking in grades 11 and 12. In contrast, the mean age of our sample is younger, corresponding to grades 8 and 9. The difference between the peak in gambling prevalence observed in the community and the high rate in our clinic sample suggests that we may be observing an increase in gambling rates at a younger age in our sample of ADHD youth. Relatedly, similar to the OSDUHS findings, there is a non-significant trend for males in our sample to be more likely than females to have a self-reported gambling problem. This may contribute to the apparent higher rate of reported gambling in the clinic sample relative to the population sample. Closer examination of the six SOGS-RA items used to identify problem gambling revealed that the most frequently reported problems among the clinic sample were: 1) 'gambling more than having planned to'; and, 2) 'having someone criticize their betting or being told they had a gambling problem irrespective of whether they thought it was true.' The least cited problem was having

Table 2. Rates of substance use and gambling in youth diagnosed in childhood with adhd compared with youth in population cohort

| | | Clinic sample | | NLSCY (1998/1999) (Ontario-wide) | | OSDUHS (2011) (Ontario-wide) | |
|----------------------------------|--------|---------------|-----------|-------------------------------------|-----------|---|-------------------------------|
| | | % Yes | 95% CI | % Yes | 95% CI | % Yes | 95% CI |
| Tried cigarettes | Male | 16.8 | 10.5-20.5 | 30.6 ^a | 27.1-34.3 | -- | -- |
| | Female | 20.6 | 10.1-37.6 | 25.8 ^a | 22.4-29.5 | -- | -- |
| | Total | 17.8 | 12.1-25.5 | 28.3 ^a | 25.8-30.9 | 21.9 | 20.2-23.7 |
| Drink of alcohol | Male | 25.3 | 17.5-35.1 | 34.4 ^a | 30.7-38.4 | -- | -- |
| | Female | 32.4 | 18.8-49.7 | 22.6 ^a | 19.3-26.3 | -- | -- |
| | Total | 27.1 | 20.1-30.5 | 28.6 ^a | 26.0-31.3 | 58.6 | 56.0-61.2 |
| Tried cannabis | Male | 12.2 | 6.8-20.9 | 19.3 ^b | 15.6-38.4 | -- | -- |
| | Female | 20.0 | 9.2-38.2 | 13.8 ^b | 10.4-17.9 | -- | -- |
| | Total | 14.2 | 8.9-21.7 | 16.5 ^b | 14.0-19.4 | 26.0 | 23.9-28.2 |
| Tried hallucinogens | Male | 1.11 | 0.2-7.6 | 8.7 ^c | 5.4-13.5 | -- | -- |
| | Female | 3.33 | 0.5-20.6 | 7.0 ^c | 4.3-11.1 | -- | -- |
| | Total | 1.7 | 0.4-6.5 | 7.8 ^c | 5.6-10.8 | 1.8 (LSD) 4.8 (Mushrooms) | 1.2-2.7 3.8-6.0 |
| Tried glue/solvents | Male | 0 | -- | 1.9 ^b | 0.9-4.0 | -- | -- |
| | Female | 0 | -- | 1.1 ^b | 0.5-2.7 | -- | -- |
| | Total | 0 | -- | 1.5 ^b | 0.9-2.7 | 9.0 | 7.7-10.5 |
| Tried drugs without prescription | Male | 3.33 | 1.1-10.0 | 3.6 ^c | 1.7-7.4 | -- | -- |
| | Female | 0 | -- | 6.0 ^c | 3.5-9.9 | -- | -- |
| | Total | 2.5 | 0.8-7.6 | 4.8 ^c | 3.1-7.3 | 16.7 ^d | 15.1-18.4 |
| Tried other drugs (e.g., crack) | Male | 1.11 | 0.2-7.7 | 2.7 ^c | 1.2-6.0 | -- | -- |
| | Female | 6.67 | 1.6-23.4 | 2.9 ^c | 1.4-6.0 | -- | -- |
| | Total | 2.5 | 0.8-7.6 | 2.8 ^c | 1.6-4.8 | 2.8 (Cocaine) 1.0 (Crack) 4.2 (Ecstasy) | 2.3-3.4 0.8-1.4 3.4-5.2 |
| Tried gambling with money | Male | 55.1 | 45.1-64.7 | -- | -- | 47.3 ^d | N/A |
| | Female | 25.7 | 13.8-42.7 | -- | -- | 29.5 ^d | N/A |
| | Total | 47.4 | 38.9-56.0 | -- | -- | 38.4 ^d | 35.6-41.2 |
| 6 Item SOGS-RA score ≥2 | Male | 9.3 | 3.9-20.6 | -- | -- | 2.4 ^d | N/A |
| | Female | 0 | -- | -- | -- | 1.0 ^d | N/A |
| | Total | 7.9 | 3.3-17.9 | -- | -- | 4.3 ^d | 2.9-6.3 |

^a Question asked of 10-15 year olds in the NLSCY sample

^b Question asked of 12-15 year olds only in the NLSCY sample

^c Question asked of 14-15 year olds only in the NLSCY sample

^d Past year use estimates provided by OSDUHS 2011

skipped or been absent from school or work due to betting activities. OSDUHS 2011 findings identified 'gambling more than one had planned to' as the most prevalent of the six SOGS-RA problems, as it was in the clinic sample, whereas arguing with family/friends about one's gambling was the least prevalent.

Logistic regression analyses were done to examine the relationships between level of impairment and number of ADHD symptoms measured at baseline and risk for substance use. This analysis revealed that neither parent rated

($OR = 1.102, p = 0.101$) nor teacher rated ($OR = 1.071, p = 0.284$) level of impairment were associated with substance use; nor was baseline number of parent reported symptoms of ADHD (inattention symptoms: $OR = 1.186, p = 0.097$; hyperactivity/impulsivity symptoms: $OR = 0.895, p = 0.149$). A similar logistic regression analysis evaluated the association between childhood impairment, ADHD symptoms and subsequent risk for gambling. Parent and teacher reported levels of impairment were not associated with gambling in our adolescent sample ($OR = 1.055, p = 0.331$;

and $OR = 1.032$, $p = 0.613$, respectively). Finally, report of gambling with money was not associated with severity of childhood parent-reported ADHD inattention symptoms ($OR = 0.984$, $p = 0.863$) or hyperactivity/impulsivity symptoms ($OR = 1.019$, $p = 0.797$).

In order to address the possibility that risk for substance use and gambling may vary with past or current use of medication for ADHD logistic regression analyses were conducted. These analyses ($N = 107$) revealed that neither any past use ($OR = 1.517$, $p = 0.377$) nor current use ($OR = 0.982$, $p = 0.967$) of medication was associated with early experience with substances. Similarly, neither past use ($OR = 0.846$, $p = 0.708$) nor current use ($OR = 0.982$, $p = 0.967$) of medication was significantly associated with experience of gambling with money.

Discussion

The present paper reports prevalence rates of substance use and experience with gambling in an adolescent sample of youth diagnosed with ADHD in childhood. Given that adolescence is a critical developmental period during which harms associated with addictive behaviours may lead to negative consequences later in life, monitoring of substance use and gambling in this at-risk sample is highly warranted. Our findings are consistent with an emerging literature suggesting that having ADHD in childhood does not increase an adolescent's susceptibility to early substance use (Charach et al., 2011). That is, our sample of adolescents previously diagnosed with ADHD did not report higher prevalence of cigarette, alcohol, marijuana and other drug use relative to their age-mates across the province. We noted a non-significant but potentially important pattern in our ADHD clinical sample; the reported substance use rates were higher for females than for males for nearly all substances. Furthermore, there was a trend toward females in the ADHD clinic sample reporting more alcohol and cannabis use than females in the community. Although strong generalizations are not warranted, the observed pattern suggests that a childhood diagnosis of ADHD might put females at a greater risk for substance use problems than their male counterparts. This finding is consistent with previous research findings (Dalsgaard, Mortensen, Frydenberg, Thomsen, 2014; Disney, Elkins, McGue, & Iacono, 1999), and may highlight the need to aim early identification and intervention of substance use problems efforts at females with ADHD.

Problem gambling among youth is justly receiving greater attention from both the clinical and research communities, but the literature continues to be sparse. The findings from our study suggest a trend for adolescents diagnosed in childhood with ADHD to report having gambled with money more often than their typically developing age-mates and to exhibit serious patterns of problem gambling more frequently, especially among males. While not reaching statistical significance, as shown by the overlap in confidence

intervals (likely a reflection of the small sample size), the finding nevertheless is intriguing and may have both clinical and public health implications. These findings may provide support to previous reports that problem gambling may be associated with ADHD and therefore individuals with ADHD may be at risk of developing gambling problems at an earlier age (Faregh & Derevensky, 2011). Our results suggest that it may be clinically important to screen for problem gambling among adolescents previously identified with ADHD. Correspondingly, there is a growing need to address these concerning statistics in order to prevent the social, economical and psychological consequences of problem gambling. Future research on the prevalence and type of gambling problems among ADHD samples is warranted.

The fact that our reported substance use rates do not appear to be significantly different from the Ontario population rates may be surprising to some readers. In this context it is important to acknowledge the limitations inherent in comparing the clinical sample to the Ontario population sample regarding rates of substance use. Several notable differences warrant identification. The clinical sample is likely one with a higher overall socioeconomic status (SES) as suggested by the higher parental education level. The relationship between SES and the development of substance use behaviours is not necessarily protective, but varies across SES indicators and individual factors such as ethnicity (Goodman & Huang, 2002). It warrants closer consideration in future research.

Medication use in ADHD has been investigated and found in some studies to be protective against substance use behaviours (Barkley, Fischer, Smallish, & Fletcher, 2003; Dalsgaard et al., 2014; Groenman et al., 2013; Noguiera et al., 2013), while in other studies found to serve neither as a protective factor nor increase risk (Humphreys, Eng, & Lee, 2013; Molina et al., 2013). While a substantial proportion of the ADHD youth in our sample were taking medication at the time of the follow-up assessment, there was no association, positive or negative with substance use. Our results support the body of literature indicating that ADHD treatment with medication – in the past or concurrently – has no clear association with substance use behaviours or gambling. We also note that the children who returned for follow up showed fewer parent reported oppositional symptoms at baseline. We acknowledge that early oppositional behaviour may be associated with increased substance use (Noguiera et al., 2013), presumably through its increased association with conduct difficulties (Looby, 2008).

A discussion of limitations related to the differences between the clinic sample and the population samples would not be complete without reference to the possibility of a temporal cohort effect. Comparison with the same age NLSCY sample suggests less use among the clinic sample than among the same age community sample. A temporal

effect is possible as the 2011 OSDUHS findings showed cigarette, alcohol and illicit drug use (including marijuana) decreased between 1999 and 2011 (Paglia-Boak et al., 2011). Therefore it is important to also examine the recent population rates in the OSDUHS sample. Comparison of the clinic rates with the 2011 OSDUHS show essentially similar rates of use. Two final points of comparison are age and gender. The clinic group is younger than the OSDUHS sample, and therefore not all participants may have reached the age of risk for substance use and gambling, potentially biasing the clinic group toward low rates. In addition, the clinic sample also has more males, 75% vs 51%. Based on reported population comparisons, boys would be more likely than girls to use substances as well as to gamble. From these observations it might be expected that the clinic sample would show both increased rates of substance use as well as gambling (Human Resources and Skills Development and Statistics Canada, 2001; Paglia-Boak et al., 2011). Future research is needed to elucidate substance use trajectories over the course of adolescence and early adulthood among individuals with ADHD.

The current study adds to our understanding of substance use and gambling behaviour among ADHD youth. The study provides prevalence rates of substance use and gambling behaviour in a clinic sample of young adolescents previously diagnosed with ADHD. While the findings indicate that ADHD youth overall are not at increased risk, it does point to the potential for increased risk in females. Finally, the study highlights the need for a specific focus on the potential for problem gambling in youth previously diagnosed with ADHD. The risk for gambling is an important area that requires exploration.

Acknowledgements/Conflicts of Interest

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