# Adult Attention Deficit-Hyperactivity Disorder & Smoking: An Overview of Epidemiological Data, a Review of Current Studies and the Need for Future Research in Northwestern Ontario

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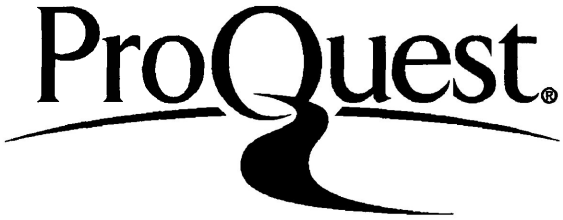

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*Executive Summary*

This research project was designed to provide a summary of the studies related to adult ADHD and smoking, and utilize these findings to improve future research about adult ADHD and smoking in Northwestern Ontario. The project is split into three main sections: 1) The Epidemiology of ADHD, Smoking, and Substance Abuse Among the United States, Canada, Ontario and Thunder Bay; 2) Adult ADHD & Smoking: A Review of the Literature; and, 3) Paving the Way for Research in ADHD and Smoking in NW Ontario. A literature review was conducted for each particular section including a search of relevant English databases as well as the grey literature. A more detailed explanation of the methods used can be found in the beginning of each section.

*Overview of Section 1: The Epidemiology of ADHD, Smoking, and Substance Abuse Among the United States, Canada, Ontario and Thunder Bay*

The section entitled "The Epidemiology of ADHD, Smoking, and Substance Abuse Among the United States, Canada, Ontario and Thunder Bay" provided prevalence rates for ADHD, smoking, and substance use/abuse, across different age groups, genders and geographical locations. This section yielded a number of important findings:

the prevalence of ADHD tends to be higher in children than adults, males than females, and whites/non-hispanics than other ethnic backgrounds

the prevalence of smoking tends to be highest in Thunder Bay compared to the United States, Canada, and Ontario

smoking prevalence decreases with age and is higher among males than females

individuals with ADHD smoke at a much higher rate than individuals without ADHD

individuals with ADHD are much more likely to develop some form of substance abuse/dependence, including alcohol abuse/dependence and illicit drug use/dependence

*Overview of Section 2: Adult ADHD & Smoking: A Review of the Literature*

The "Adult ADHD & Smoking: A Review of the Literature" section provides a summary of the studies related to adult ADHD and smoking. The findings showed that individuals with ADHD smoke at a greater rate and have a more difficult time quitting smoking than individuals without ADHD. In particular, the nicotine from the cigarettes helps to alleviate adult ADHD symptoms that, to this point, have not been equaled by any other treatment.

Additionally, the adult ADHD & smoking review section explores some considerations relative to interventions for smokers with adult ADHD, as well as effective alternatives to nicotine for treating adult ADHD. This section emphasizes the need to understand the difference between a smoker with and without adult ADHD, and the potential risks involved when prescribing smoking cessation medication for smokers with adult ADHD. Also, it is noted that a great deal of research still needs to be done to establish the most effective method of treating adult ADHD.

*Overview of Section 3: Paving the Way for Research in ADHD and Smoking in NW Ontario*

The "Paving the Way for Research in ADHD and Smoking in NW Ontario" section provides a table summarizing the screening tools/rating scales used to measure adult ADHD, including psychometric properties and criticisms of the tools/scales. It was found that while the rating scales are a relatively inexpensive and effective way to

measure adult ADHD, they introduce problems of recall bias, self-reflection, and self-evaluation.

This section also explores particular considerations of an adult ADHD and smoking study, a stimulant drug study in Northwestern Ontario, and an adult ADHD study in Northwestern Ontario. It was noted that a study about adult ADHD and smoking should include such topics as smoking history and habits, smoking motivation, history of stimulant medication, and history of substance use and abuse. This section concludes that a stimulant drug study is not worthwhile in Northwestern Ontario as the magnitude of the problem of ADHD & smoking in Northwestern Ontario is unknown at this time. Based on the high smoking rates in Northwestern Ontario and the high smoking rates of adults with ADHD, it is necessary to first determine the prevalence rate of adult ADHD in Northwestern Ontario.

*Conclusion*

It is clear that adults suffering from ADHD smoke at a higher rate than individuals without ADHD, and that the proper treatment for adult ADHD has not yet been established. With the high rates of smoking and the lack of adult ADHD research in Northwestern Ontario, it is necessary to establish an initial prevalence rate of adult ADHD in Northwestern Ontario.

## *Section 1: The Epidemiology of ADHD, Smoking, and Substance Abuse Among the United States, Canada, Ontario and Thunder Bay*

### *Introduction*

This section reports current epidemiological data relative to ADHD, smoking, and substance abuse. This section aims to answer six specific questions: 1) What is the prevalence of ADHD in Northwestern Ontario, Ontario, Canada, and the United States by age, gender, and race/ethnicity? 2) What is the prevalence of smoking in Northwestern Ontario, Ontario, Canada, and the United States by age and gender? 3) What is the prevalence of ADHD among smoking populations? 4) What is the prevalence of smoking among ADHD populations? 5) What is the prevalence of substance abuse/dependence in Ontario, Canada, and the United States by age and sex? 6) What is the relationship between substance use and abuse among ADHD populations?

### *Method*

A literature review was done on the prevalence of ADHD, smoking, ADHD and smoking, substance use and abuse, and ADHD and substance use and abuse. The review included a search of English databases – Pubmed, ERIC, and the Cochrane Library. The grey literature search included professional associations and government websites – American Psychiatric Association, Centers for Disease Control and Prevention, Health Canada, and Statistics Canada, as well as google.ca and scholar.google.ca. Keywords for the search included ADHD, smoking, nicotine, tobacco use, substance use/abuse/disorder, prevalence, rate, national, adult, adolescent, youth and child. Searching was limited to 1995 to 2008. Most research published prior to 1995 would not be relevant to informing the current prevalence rates today, but needed to go back to 1995

due to the dearth of literature on ADHD and smoking, and ADHD and substance use and abuse. Subject/MESH headings or keywords, depending upon the database's indexing system, were used to retrieve citations.

## *Results*

### *Research Question 1: Prevalence Rates of ADHD*

This section explores the prevalence rates of Attention-Deficit Hyperactivity Disorder (ADHD) among children, youth and adults. The rates of ADHD in children, youth and adults are compared by age, gender and race/ethnicity.

According to the American Psychiatric Association (2000), a clinical diagnosis of childhood ADHD requires six or more symptoms of either inattention of hyperactivity-impulsivity present for at least 6 months to a point that is disruptive and inappropriate for developmental level. A clinical diagnosis of adult ADHD requires six or more symptoms of either inattention of hyperactivity-impulsivity present for at least 6 months (criterion A), at least two criterion A symptoms before age 7 (criterion B), some impairment in at least two areas of living during the past 6 months (criterion C), and clinically significant impairment in at least one of these areas (criterion D; Kessler et al., 2006).

The only nationally representative literature related to ADHD came from studies within the United States (Froehlich et al., 2007; Kessler et al., 2006). While ADHD rates have been noted in Canadian literature, none of the studies provided nationally representative data to properly compare to the United States data. Since ADHD rates in Canadian literature show a great deal of parity to ADHD rates in the United States literature, it was acceptable to only use the United States data in this section.

The ADHD prevalence rates presented in this section are adapted from two different sources. The child/youth ADHD prevalence rates were adapted from a nationally representative study by Froehlich et al. (2007). This study used a cross-sectional survey entitled: National Health and Nutrition Examination Survey, sampling 3082 children between the ages of 8-15 years old (Froehlich et al., 2007). The adult ADHD prevalence rates were adapted from a nationally representative study by Kessler et al. (2006). This study included a screen for adult ADHD in a probability subsample (N=3,199) of 18-44 year old respondents in the National Comorbidity Survey Replication (Kessler et al., 2006). While the two studies vary slightly in methodology, they are each based on current, nationally representative ADHD data in the United States.

*Prevalence of Child/Youth ADHD.* The overall ADHD prevalence among children & youth aged 8-15 years is 8.7% (Froelich et al., 2007; Table 1).

*Prevalence of Child/Youth ADHD by Age.* There were two age categories sampled among children and youth for the prevalence of ADHD: 8-11 years of age and 12-15 years of age. Individuals 8-11 years of age had higher rates of ADHD than individuals 12-15 years of age (10% vs. 7.5%, respectively; Froelich et al., 2007; Table 1).

*Prevalence of Child/Youth ADHD by Gender.* The prevalence of ADHD was more than double for males compared to females (11.8% vs. 5.4%, respectively) among those aged 8-15 years (Froelich et al., 2007; Table 1).

*Prevalence of Child/Youth ADHD by Race/Ethnicity.* ADHD rates were higher in non-Hispanic white children (9.8%) than African American children (8.7%), Mexican

American children (6.0%) and children of "other race/ethnicity" (5.2%; Froelich et al., 2007; Table 1).

Table 1: Child/Youth ADHD Prevalence (2007)

| Characteristic | Percentage (%) | 95% CI* |
|---|---|---|
| *Age* | | |
| 8-11 years | 10 | (8-12) |
| 12-15 years | 7.5 | (6-9) |
| *Gender* | | |
| Male | 11.8 | (10-14) |
| Female | 5.4 | (4-7) |
| *Race/Ethnicity* | | |
| White/Non-Hispanic | 9.8 | (7-12) |
| African American | 8.7 | (6-11) |
| Mexican American | 6 | (4-8) |
| Other | 5.2 | (2-9) |
| Children/Youth 8-15 Years (Total) | 8.7 | (7-10) |

Adapted From: Froelich et al., 2007.
* Denotes Confidence Interval (95%)

*Prevalence of Adult ADHD.* The overall ADHD prevalence among adults aged 18-44 years is 4.4% (Kessler et al., 2006; Table 2). An important limitation for determining rates of ADHD among adults is that the DSM-IV criteria for ADHD were developed with children in mind and offer only minimal guidance regarding diagnosis among adults (Kessler et al., 2006). According to Kessler et al. (2006), clinical studies make it clear that symptoms of ADHD are more heterogeneous and subtle in adults than children, leading some clinical researchers to suggest that assessment of adult ADHD requires an increase in the variety of symptoms assessed, a reduction in the severity threshold, or a reduction in the DSM-IV requirements for six of nine symptoms. To the extent that such changes would lead to a more valid assessment than in the current study, the prevalence estimates presented in Table 2 are conservative.

*Prevalence of Adult ADHD by Age*. There were three age categories sampled among adults for the prevalence of ADHD in the Kessler study: 18-24 years of age, 25-34 years of age, and 35-44 years of age. There were no data about the prevalence of ADHD for adults aged 45 years and older. Among the three sampled age categories, adults 35-44 years of age had the highest rate of ADHD (4.6%), followed by adults 18-24 years of age (4.5%), and adults 25-34 years of age (3.8%; Kessler et al., 2006; Table 2).

*Prevalence of Adult ADHD by Gender*. Rates of meeting DSM-IV criteria for ADHD were higher for males as opposed to females (5.4% vs. 3.2%, respectively) among those aged 18-44 years (Kessler et al., 2006; Table 2).

*Prevalence of ADHD by Race/Ethnicity*. ADHD rates were higher in non-Hispanic white adults (5.4%) than non-Hispanic black adults (1.9%), Hispanic adults (2.1%), and adults of "other race/ethnicity" (3.6%; Kessler et al., 2006; Table 2).

Table 2: Adult ADHD Prevalence (2006)

| Characteristic | Percentage (%) | SE* |
|---|---|---|
| *Age* | | |
| 18-24 years | 4.5 | 1 |
| 25-34 years | 3.8 | 0.8 |
| 35-44 years | 4.6 | 0.9 |
| *Gender* | | |
| Male | 5.4 | 0.9 |
| Female | 3.2 | 0.6 |
| *Race/Ethnicity* | | |
| Non-Hispanic White | 5.4 | 0.8 |
| Non-Hispanic Black | 1.9 | 0.6 |
| Hispanic | 2.1 | 0.8 |
| Other | 3.6 | 1.8 |
| Adults 18-44 Years (Total) | 4.4 | 0.6 |

Adapted From: Kessler et al., 2006.
* Denotes Standard Error

*Prevalence of Child/Youth ADHD vs. Adult ADHD.* The prevalence of ADHD was higher among children and youth (8.7%) than among adults (4.4%) according to national data for the United States (Froelich et al., 2007; Kessler et al., 2006; Table 1, Table 2).

*Prevalence of Child/Youth ADHD vs. Adult ADHD by Age.* The prevalence of ADHD is highest among young children and lowest among middle-aged adults, with rates of 10.0% for 8-11 year olds, 7.5% for 12-15 year olds, 4.5% for 18-24 year olds, 3.8% for 25-34 year olds, and 4.6% for 35-44 year olds (Froelich et al., 2007; Kessler et al., 2006; Table 1, Table 2).

*Prevalence of Child/Youth ADHD vs. Adult ADHD by Gender.* The prevalence of ADHD is higher for males than females among children, youth, and adults. While the rates are more than double for males compared to females among children and youth (11.8% and 5.4%, respectively), the gender difference is less pronounced among adults (5.4% and 3.2%, respectively; Froelich et al., 2007; Kessler et al., 2006; Table 1, Table 2).

*Prevalence of Child/Youth ADHD vs. Adult ADHD by Race/Ethnicity.* The prevalence rate of ADHD is highest among white, non-hispanic individuals compared to other racial/ethnic backgrounds, in both the child/youth population and the adult population (Froelich et al., 2007; Kessler et al., 2006; Table 1, Table 2).

*Research Question 2: Prevalence of Cigarette Smoking*

This section explores the prevalence rates of cigarette smoking in the United States, Canada, Ontario, and Thunder Bay. The rates of cigarette smoking are compared by age and gender among these four populations.

Cigarette smoking is defined differently between the United States and Canada. In the United States, "current cigarette smokers" are defined as ever smoking 100 cigarettes in their lifetime and smoking now every day or on some days (Centers for Disease Control and Prevention [CDC], 2007a). In Canada, Ontario and Thunder Bay, "current smokers" include daily smokers and non-daily/occasional smokers, determined from the response to the question "At the present time do you smoke cigarettes every day, occasionally, or not at all?" (Health Canada, 2007; Statistics Canada, 2005).

The cigarette smoking rates presented in this section are adapted from a variety of sources, including: Centers for Disease Control and Prevention (2007a); Health Canada (2007); and Statistics Canada (2005). While the different sources vary slightly in the methodology used to determine smoking prevalence, they are all based on nationally representative data in the United States and Canada. It should be noted that the data have been adapted to develop a clear picture of smoking prevalence rates by age and gender among the four populations. However, due to the different sources and adapted information used in this section, the figures should be interpreted with caution.

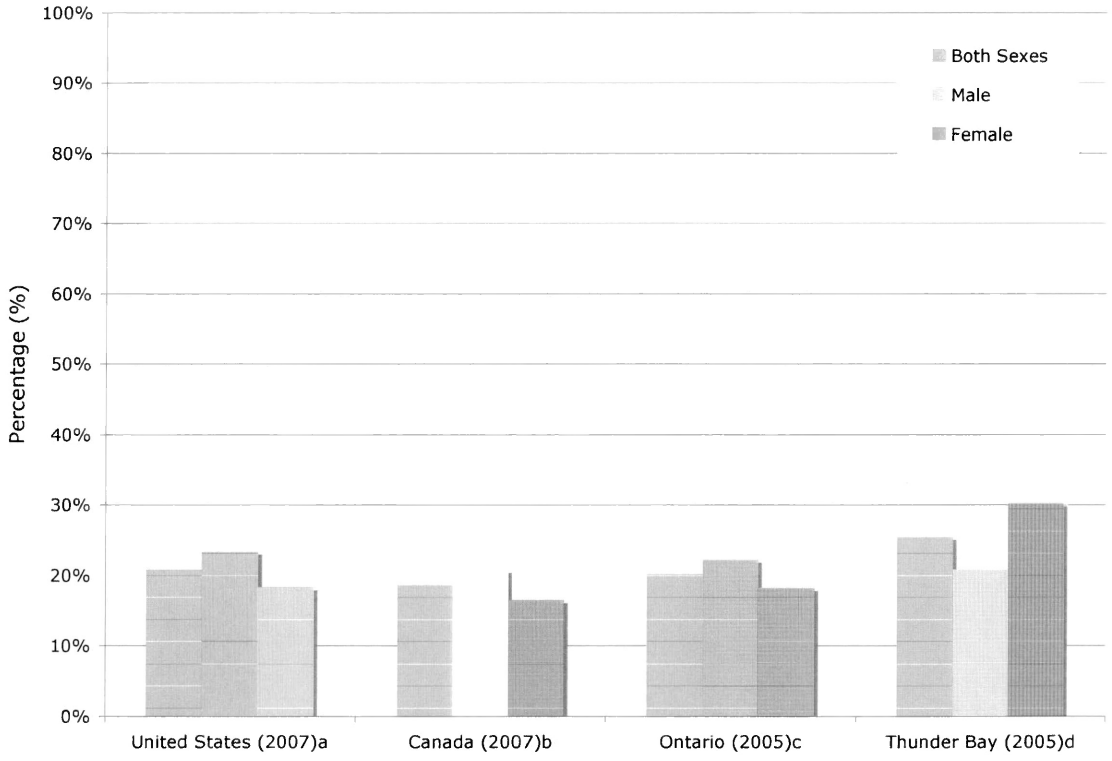
*Overall Smoking Prevalence.* The overall smoking rates for the United States, Canada, Ontario, and Thunder Bay are 20.8%, 18.6%, 20.2%, and 25.5%, respectively (CDC, 2007a; Health Canada, 2007; Statistics Canada, 2005; Figure 1).

*Smoking Prevalence by Gender.* A higher percentage of males versus females smoke according to national data for Canada (Health Canada, 2007) and the United States (CDC, 2007a), and provincial data for Ontario (Statistics Canada, 2005). The smoking rates for males are quite similar for the US, Canada, and Ontario, ranging from 20.8% to

23.4%, respectively, with rates being 4-5% higher than that reported for females (16.5% to 18.2%; Figure 1).

Data for the Thunder Bay District Health Unit, however, show quite a different pattern—more females (30.2%) than males (20.8%) smoke, and the absolute smoking prevalence for Thunder Bay District females is 12-14% higher than that reported for their counterparts in the US, Canada, and Ontario, which ranged from 16.5% to 18.3% (Statistics Canada, 2005; Figure 1).

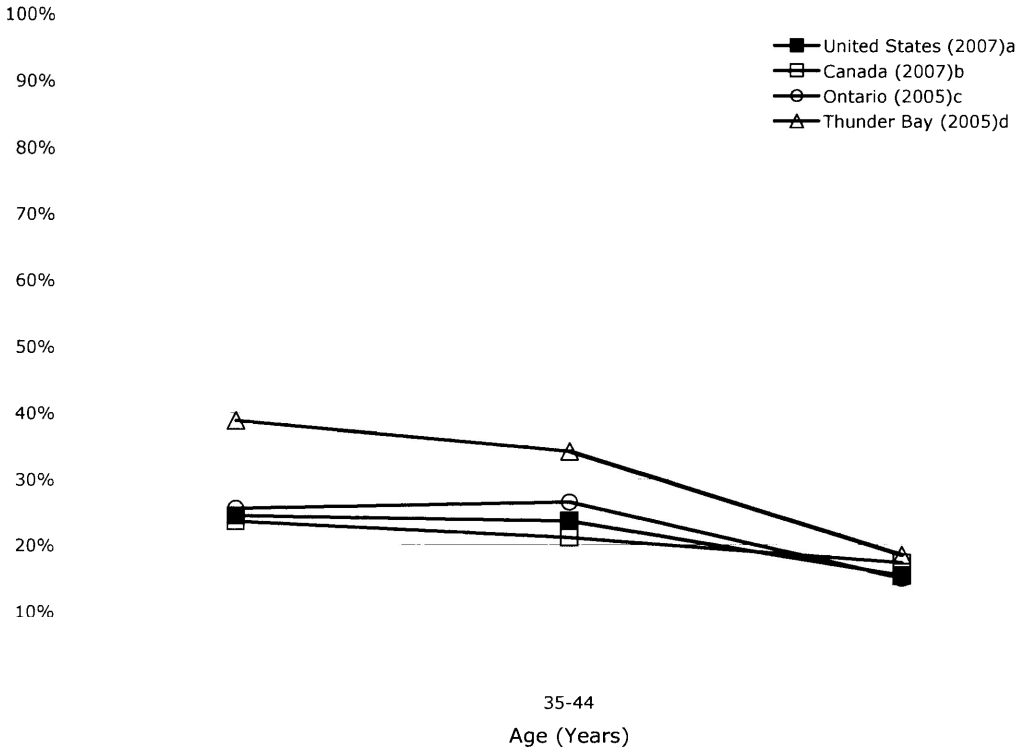
Figure 1: Percentage of Smokers by Gender in United States, Canada, Ontario and Thunder Bay District*




Adapted From:
[a] Centers for Disease Control and Prevention, National Center for Health Statistics, 2007
[b] Canadian Tobacco Use Monitoring Survey, February – June, 2007
[c,d] Statistics Canada, Canadian Community Health Survey (CCHS 3.1), January – June, 2005
* Thunder Bay District refers to the population of the city of Thunder Bay and surrounding area as sampled by the Thunder Bay District Health Unit

*Smoking Prevalence by Age*. According to United States and Canadian national data, Ontario provincial data, and Thunder Bay District Health Unit data, smoking rates are highest for young adults and lowest for older adults, ranging from 23.6% to 38.8% for 20-34 year olds, 21.1% - 34.2% for 35-44 year olds, and 15.0% to 18.5% for 45+ years (CDC, 2007a; Health Canada, 2007; Statistics Canada, 2005). As with the overall prevalence rates, the smoking rates for Thunder Bay District Health Unit are higher at each age range than that for the United States, Canada, and Ontario, especially for adults 20-34 years old and 35-44 years old, with rates for those 45+ years being relatively similar in Thunder Bay District to the rest of the province, country, and United States (Figure 2).

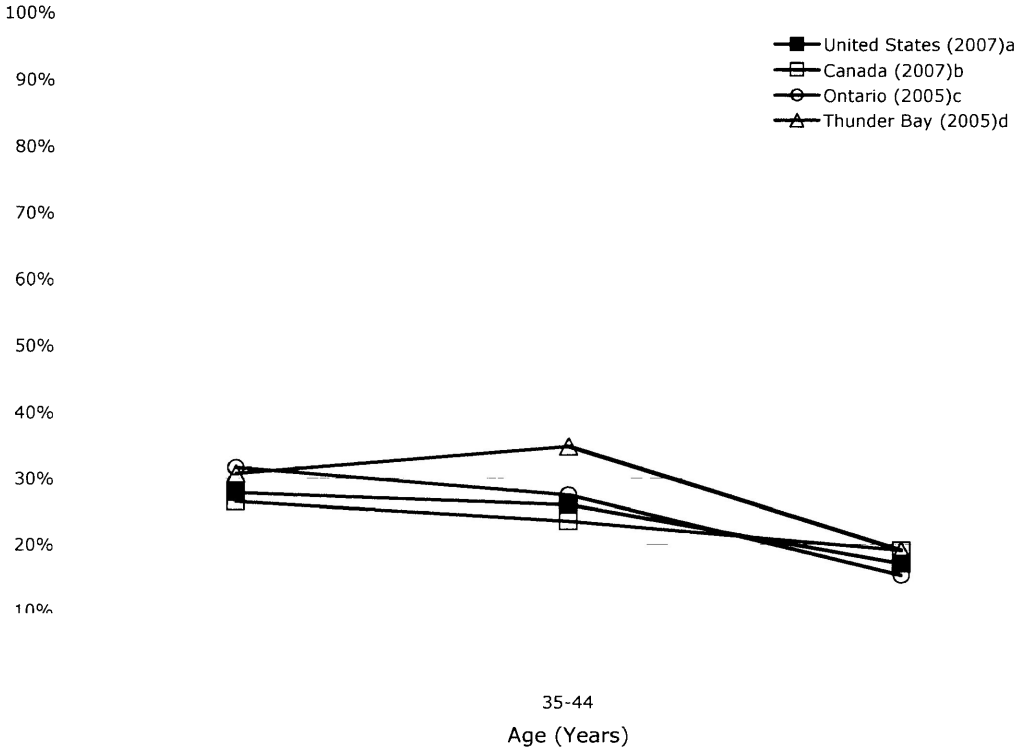
Figure 2: Percentage of Smokers by Age in United States, Canada, Ontario and Thunder Bay District*




Adapted From:
[a] Centers for Disease Control and Prevention, National Center for Health Statistics, 2007
[b]Canadian Tobacco Use Monitoring Survey, February – June, 2007
[c,d] Statistics Canada, Canadian Community Health Survey (CCHS 3.1), January – June, 2005
* Thunder Bay District refers to the population of the city of Thunder Bay and surrounding area as sampled by the Thunder Bay District Health Unit

*Smoking Prevalence Among Males by Age.* According to United States and Canadian national data and Ontario provincial data, smoking rates among males are highest for young adults and lowest for older adults, ranging from 26.5% to 31.6% for 20-34 year olds, 23.5% - 27.5% for 35-44 year olds, and 15.4% to 19.1% for 45+ years (CDC, 2007a; Health Canada, 2007; Statistics Canada, 2005). Data for the Thunder Bay District Health Unit, however, show a different pattern—more 35-44 year old males smoke (34.8%) compared to 20-34 year old males (30.7%; Figure 3).

Figure 3: Percentage of Male Smokers by Age in United States, Canada, Ontario, and Thunder Bay District*

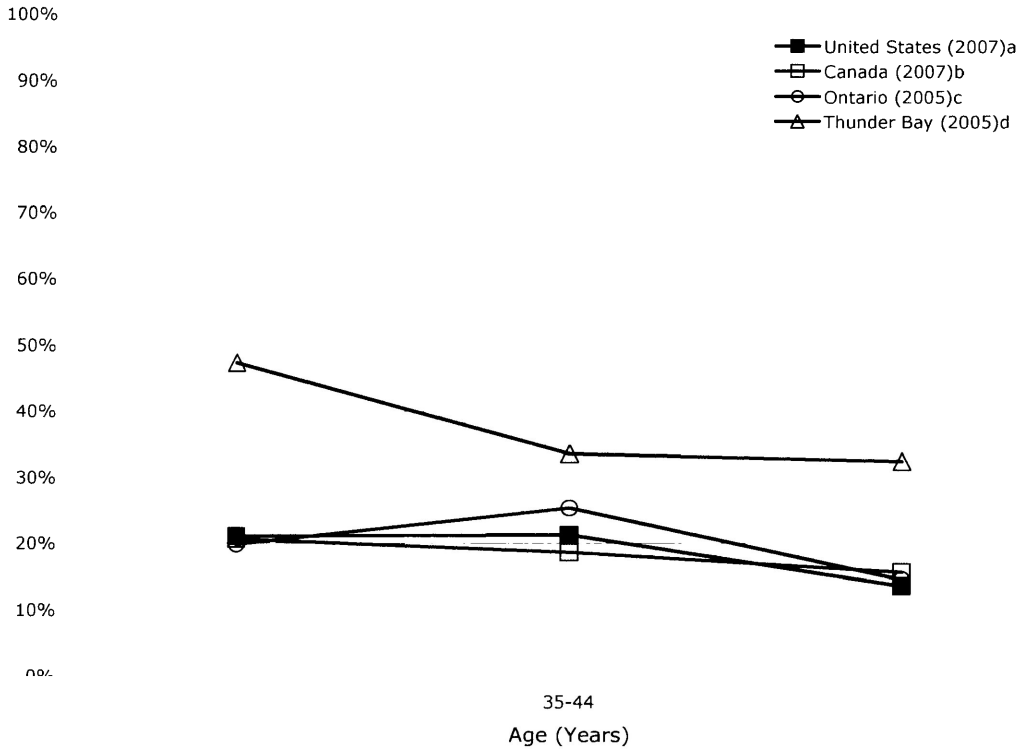



Adapted From:
[a] Centers for Disease Control and Prevention, National Center for Health Statistics, 2007
[b] Canadian Tobacco Use Monitoring Survey, February – June, 2007
[c,d] Statistics Canada, Canadian Community Health Survey (CCHS 3.1), January – June, 2005
* Thunder Bay District refers to the population of the city of Thunder Bay and surrounding area as sampled by the Thunder Bay District Health Unit

*Smoking Prevalence Among Females by Age.* According to United States and Canadian national data and Ontario provincial data, smoking rates among females are highest for young to middle-aged adults and lowest for older adults, ranging from 19.9% to 21.1% for 20-34 year olds, 18.7% - 25.4% for 35-44 year olds, and 13.6% to 15.7% for 45+ years (CDC, 2007a; Health Canada, 2007; Statistics Canada, 2005). However, data from the Thunder Bay District Health Unit show a different pattern among females. The smoking rates are higher at each age range for Thunder Bay females than that for the United States, Canada, and Ontario. The 33.6% rate for 35-44 year old females in Thunder Bay is relatively close to the United States, Canada, and Ontario, which ranges

from 18.7% to 25.4%. In contrast, the 47.3% rate for 20-34 year old females in Thunder Bay is 26%-28% higher than the 19.9% to 21.1% range of the United States, Canada, and Ontario, while the 32.4% rate for 45+ years is 17% to 19% higher than the 13.6% to 15.7% range of the United States, Canada, and Ontario (Figure 4). The elevated smoking rates of Thunder Bay females, particularly at the 20-34 year-old range and the 45 year-old plus range, likely contribute to Thunder Bay's overall higher rate of smoking compared to the United States, Canada and Ontario.

Figure 4: Percentage of Female Smokers by Age in United States, Canada, Ontario and Thunder Bay District*




Adapted From:
[a] Centers for Disease Control and Prevention, National Center for Health Statistics, 2007
[b] Canadian Tobacco Use Monitoring Survey, February – June, 2007
[c,d] Statistics Canada, Canadian Community Health Survey (CCHS 3.1), January – June, 2005
* Thunder Bay District refers to the population of the city of Thunder Bay and surrounding area as sampled by the Thunder Bay District Health Unit

*Research Question 3: Prevalence of ADHD Among Smoking Populations*

There was no literature on ADHD prevalence among smoking populations.

*Research Question 4: Prevalence of Smoking Among ADHD Populations*

The majority of literature on smoking prevalence and ADHD came from studies within the United States. However, there have been very few studies that have specifically looked at the relationship between smoking prevalence and ADHD. In fact, many studies of ADHD have examined the elevated prevalence of substance use disorders (SUD's), often grouping smoking into the category of SUD's. As a result, there are few studies that examine the prevalence of smoking among ADHD populations and no studies at all that examine the prevalence of ADHD among smoking populations.

*Prevalence of Smoking Among ADHD Populations: Adolescents vs. Adults.* According to a nationally representative study by Fuemmeler et al. (2007), the prevalence of smoking is higher among ADHD adults than ADHD adolescents. However, the prevalence rates of smoking between these two populations have varied in terms of consistency. The smoking rates among adolescents with ADHD vary considerably, while the smoking rates among adults with ADHD are quite consistent. This finding is noted by Fuemmeler et al. (2007), who summarized a number of studies and reported rates of smoking among ADHD adolescents (19.0-46% vs. 10-24% for ADHD and non-ADHD, respectively), and among ADHD adults (41-42% vs. 26% for ADHD and non-ADHD, respectively).

*Smoking Prevalence Across the Lifespan Among ADHD Populations.* The first group to really examine the relationship between smoking prevalence and ADHD over the lifespan was Lambert and Hartsough (1998). Four of their key findings were: 1) Individuals with ADHD initiate and begin regular smoking at an earlier age than individuals without ADHD; 2) In childhood and adolescence, individuals with ADHD are

two times as likely to have smoked cigarettes daily compared to individuals without ADHD; 3) In adulthood, there is a greater prevalence of smoking among individuals with ADHD (42%) compared to individuals without ADHD (26%); and, 4) Individuals with ADHD have twice the lifetime tobacco dependency rates of individuals without ADHD.

*Smoking Prevalence Among ADHD and Non-ADHD Adults.* The most important finding from the Lambert and Hartsough (1998) study is that 42% of adults with ADHD smoke compared to 26% of adults without ADHD. This finding replicated earlier results published by Pomerleau et al. (1995), who established that adults with ADHD have higher rates of nicotine dependence than the general population (40% vs. 26%, respectively). The rates produced by Pomerleau et al. (1995) and Lambert & Hartsough (1998) have remained consistent over time and are often cited in studies examining adult ADHD and smoking.

*Research Question 5: Prevalence of Substance Use & Dependence*

This section explores the prevalence rates of substance use and dependence (other than tobacco) in the United States, Canada, and Ontario. The substance use and dependence rates were unavailable for Thunder Bay. The rates of substance use and dependence are compared by age and gender among these populations.

Alcohol dependence is measured differently between the United States and Canada. In the United States, "heavy alcohol use" is defined as drinking five or more drinks on the same occasion on each of five or more days in the past 30 days (CDC, 2007b). In Canada and Ontario, individuals who reported having had five drinks or more on one occasion at least once during the previous 12 months, and those who reported having had five drinks or more during another 12 month period in their lives were

administered "alcohol dependence" questions. Respondents who endorsed three (or more) of seven symptoms, within 12 months prior to the interview, were classified as displaying "alcohol dependence". The seven symptoms include: being drunk at work/school, or while taking care of a child; tolerance (need for markedly increased amounts of alcohol to achieve desired effect); withdrawal; drinking larger amounts than was intended; spending a great deal of time in activities necessary to obtain, use, or recover from effects of drinking; giving up social, occupational, or recreational activities because of drinking; and continued drinking despite knowledge of having physical or psychological problem that is likely to have been caused or exacerbated by alcohol (Statistics Canada, 2004).

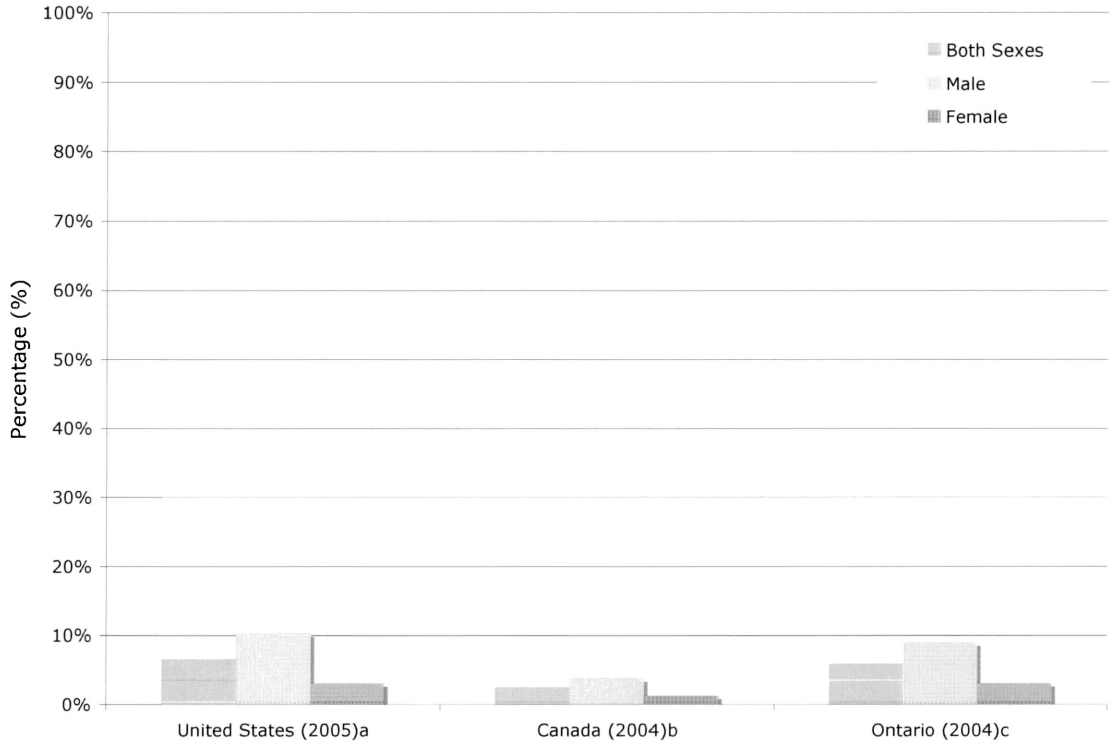
The substance use and dependence rates presented in this section are adapted from a variety of sources, including: CDC, 2007b; Gadalla and Piran, 2007; and Statistics Canada, 2004. While the different sources vary slightly in the methodology used to determine rates of substance use and dependence, they are all based on current, nationally representative data in the United States and Canada. It should be noted that the data have been adapted to develop a clear picture of substance use and dependence rates by age and gender among the populations. Thus, due to the different sources and adapted information used in this section, the figures should be interpreted with caution.

*Prevalence of Alcohol Dependence.* Alcohol dependence was highest overall among the United States (6.6%), followed by Ontario (6.0%), and Canada (2.6%; CDC 2007b; Statistics Canada, 2004; Figure 5).

*Alcohol Dependence by Sex.* Alcohol dependence was approximately three times higher among males than females in the United States (10.3% and 3.1%, respectively),

Ontario (9.0% and 3.0%, respectively), and Canada (3.8% and 1.3%, respectively; CDC, 2007b; Statistics Canada, 2004; Figure 5).

Figure 5: Percentage of Alcohol Dependence by Sex in United States, Canada and Ontario




Adapted From:
[a] Substance Abuse and Mental Health Services Administration, Office of Applied Studies, National Survey on Drug Use & Health, 2007
[b,c] Statistics Canada, Canadian Community Health Survey, Mental Health and Well-being, 2002 (updated in September 2004)

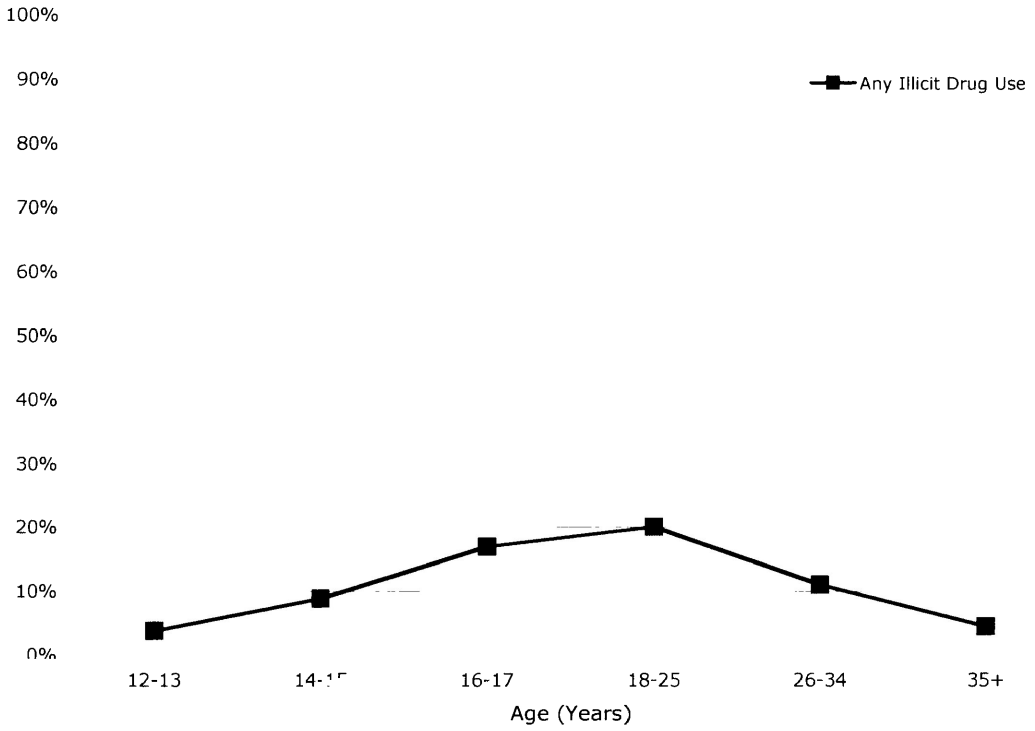
*Prevalence of Drug Use and Dependence.* Drug use and dependence are measured differently between the United States and Canada. According to the Centers for Disease Control and Prevention (2007), any illicit drug includes marijuana/hashish, cocaine (including crack), heroin, hallucinogens (including LSD and PCP), inhalants, or any prescription-type psychotherapeutic drug used nonmedically. According to Statistics Canada (2004), there are two different measures of drug use in Canada (cannabis drug use and illicit drug use) and one measure of drug dependence in Canada (illicit drug

dependence). Cannabis drug use indicates whether respondents use marijuana, cannabis or hashish in their lifetime and in the past year, excluding one time use in a lifetime (Statistics Canada, 2004). Illicit drug use indicates whether respondents use marijuana/cannabis/hashish, cocaine/crack, glue/gasoline/other solvents, amphetamines (speed), MDMA (ecstasy), hallucinogens/PCP/LSD, heroin, or steroids (lifetime as well as in the past year). Illicit drug dependence assessed whether the respondent met the criteria for illicit drug dependence in the year prior to the interview. Respondents were classified as "drug dependent" if they reported three (or more) of six symptoms, all exhibited within the same 12 month period. The six symptoms include: tolerance; withdrawal; taking larger amounts than was intended; spending a great deal of time in activities necessary to obtain, use, or recover from the drug effects; reduced important activities because of drug use; and continued drug use despite knowledge of having physical or psychological problem that is likely to have been caused or exacerbated by the drug (Statistics Canada, 2004).

*Illicit Drug Use in United States.* Rates of substance use in the United States are derived from the Centers for Disease Control and Prevention (CDC, 2007). The overall prevalence of any past month illicit drug use in the United States is 8.1% (CDC, 2007b; Figure 6).

*Illicit Drug Use in United States by Age.* Illicit drug use prevalence was highest among young adults and lowest among young children and middle to older age adults, with rates of 3.8% for 12-13 years old, 8.9% for 14-15 years old, 17.0% for 16-17 years old, 20.1% for 18-25 years old, 11.0% for 26-34 years old, and 4.5% for 35+ years (CDC, 2007b; Figure 6).

Figure 6: Past Month Illicit Drug Use by Age in the United States




Adapted From: Substance Abuse and Mental Health Services Administration, Office of Applied Studies, National Survey on Drug Use & Health, 2007

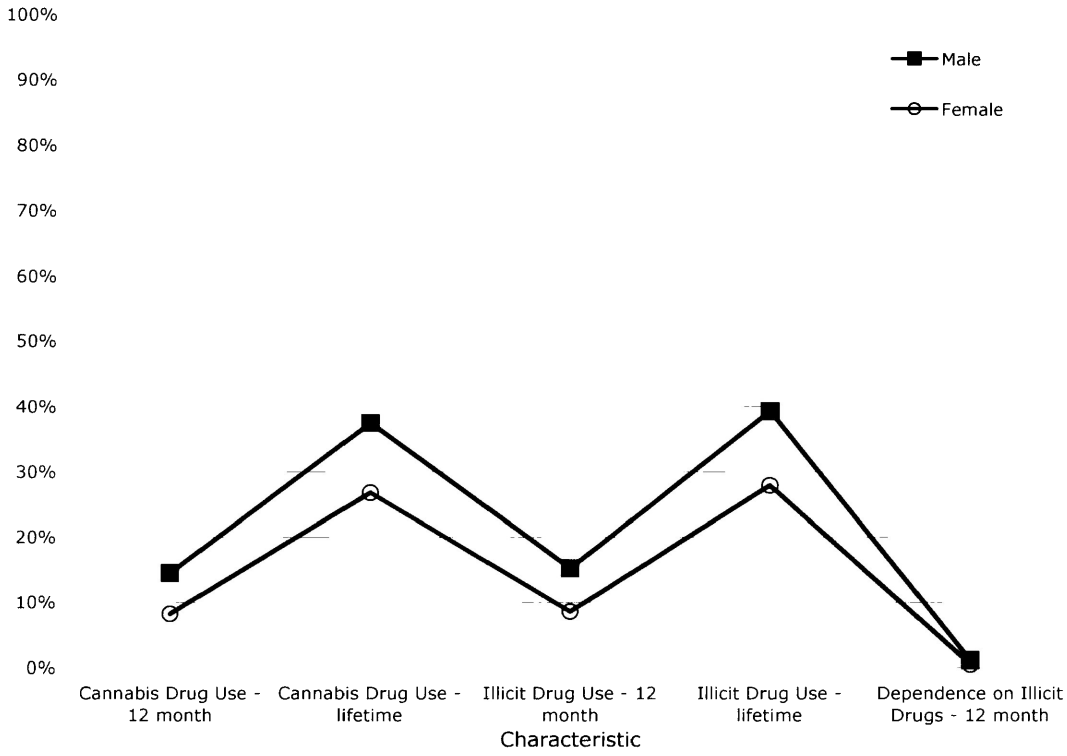
*Drug Use and Dependence in Canada.* Rates of substance use in Canada are derived from the Canadian Community Health Survey [CCHS] (Statistics Canada, 2004). The CCHS is a nationally representative survey of individuals aged 15 years and older in Canada.

According to Statistics Canada (as cited in Gadalla & Piran, 2007), rates of illicit drug use are higher than rates of cannabis drug use for both lifetime and past year use (Figure 7).

*Drug Use and Dependence in Canada by Sex.* Reported substance use rates were higher for males than females among lifetime and 12 month use of illicit drugs and cannabis, as well as illicit drug dependence (Statistics Canada, as cited in Gadalla & Piran, 2007). Rates of lifetime use of illicit drugs and cannabis for males (39.3% and

37.5%, respectively) were 11-12% higher than females (27.9% and 26.8%, respectively), and rates of past year use of illicit drugs and cannabis for males (15.2% and 14.5%, respectively) were 6-7% higher than females (8.6% and 8.2%, respectively). Also, reported rates of illicit drug dependence were more than double among males (1.1%) than females (0.5%; Gadalla & Piran, 2007; Figure 7).

Figure 7: Prevalence of Drug Abuse and Dependence in Canada by Sex




Adapted From: Eating Disorders and Substance Abuse in Canadian Men and Women: A National Study, 2007

*Research Question 6: Substance Use and Abuse Among ADHD Populations*

This section explores substance use and abuse among children and adults diagnosed with ADHD. The relationship between substance use and abuse and ADHD is discussed among children, while prevalence rates between substance use disorder and ADHD are explored among adults.

*Substance Use Among Children and Adolescents With ADHD*

According to Wilson and Levin (2005), ADHD is a major risk factor for the development of substance use disorder (SUD). In fact, children with ADHD are four times more likely to develop SUD by adulthood compared to children without ADHD.

ADHD alone does not appear to increase the rates of substance use and abuse among children. In a recent study by Barkley et al. (2004), children with ADHD did not differ on any types of drug or alcohol use compared to children without ADHD. However, when ADHD and conduct disorder were combined, the reported rates of marijuana and alcohol use increased significantly among children compared to the ADHD only group (Barkley et al., 2004). Marijuana was used an average of 89 times over three months among the ADHD only group, while it was used an average of 510 times over three months among the ADHD and conduct disorder group (Barkley et al., 2004). Also, individuals in the ADHD group reported an average of 6.8 alcoholic drinks per week, while the individuals in the ADHD and conduct disorder group reported an average of 15.4 drinks per week (Barkely et al., 2004). A similar finding was noted by Wilson and Levin (2005), who found that the presence of both ADHD and conduct disorder increased the risk for SUD in children.

*Substance Use Among Adults With ADHD.* According to nationally representative data presented by Kessler et al. (2006), adults with ADHD have an elevated prevalence of substance use disorders. In fact, nearly three times as many adults with ADHD (15.2%) have a substance use disorder compared to adults without ADHD (5.6%; Table 3). Substance use disorders were assessed in the survey by using the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI)

version 3.0 (Kessler et al., 2006). The substance abuse section of the CIDI includes alcohol abuse, alcohol dependence, drug abuse and drug dependence (Kessler & Ustun, 2004).

*Alcohol Use Among Adults with ADHD.* The prevalence of alcohol abuse and alcohol dependence was more than double among adults with ADHD (5.9% and 5.8%, respectively), compared to adults without ADHD (2.4% and 2.0%, respectively; Kessler et al., 2006; Table 3).

*Drug Use Among Adults with ADHD.* The prevalence of drug abuse and drug dependence was higher among adults with ADHD (2.4% and 4.4%, respectively), compared to adults without ADHD (1.4% and 0.6%, respectively; Kessler et al., 2006; Table 3).

*ADHD Among Adults with Substance Use Disorders.* According to nationally representative data presented by Kessler et al. (2006), adults with substance use disorders have an elevated prevalence of ADHD. In fact, nearly three times as many adults with substance use disorders (10.8%) have ADHD compared to adults without substance use disorders (3.8%; Table 3).

*ADHD Among Adults With Alcohol Use.* The prevalence of ADHD was more than double among individuals with alcohol abuse and alcohol dependence (9.5% and 11.1%, respectively), compared to individuals without alcohol abuse and alcohol dependence (4.0% and 4.0%; Kessler et al., 2006; Table 3).

*ADHD Among Adults With Drug Use.* The prevalence of ADHD was much higher for individuals with drug abuse and drug dependence (25.4% and 10.8%,

respectively), compared to individuals without drug abuse and drug dependence (4.0% and 3.8%, respectively; Kessler et al., 2006; Table 3).

Table 3: Comorbidity of Adult ADHD With Substance Use Disorders (2006)

| | Prevalence of ADHD (%)[a] | | Prevalence of Substance Use Disorders (%)[b] | |
|---|---|---|---|---|
| | Among Respondents With Substance Use Disorders | Among Respondents Without Substance Use Disorders | Among Respondents With ADHD | Among Respondents Without ADHD |
| *Substance Use Disorders* | | | | |
| Alcohol Abuse | 9.5 | 4.0 | 5.9 | 2.4 |
| Alcohol Dependence | 11.1 | 4.0 | 5.8 | 2.0 |
| Drug Abuse | | | 2.4 | |
| Drug Dependence | 25.4 | 4.0 | 4.4 | 0.6 |
| Any Substance Use Disorder | 10.8 | 3.8 | 15.2 | 5.6 |

Adapted From: Kessler et al., 2006.

[a] - These numbers can be interpreted as, for example, 9.5% of individuals with alcohol abuse have ADHD and 4% of those without alcohol abuse have ADHD.

[b] - These numbers can be interpreted as, for example, 5.9% of individuals with ADHD have alcohol abuse and 2.4% of those wihout ADHD have alcohol abuse.

## *Conclusion*

The epidemiological data reported in this section provides answers to many questions related to ADHD, smoking and substance abuse. The prevalence of ADHD is higher among children than adults, and is higher among males than females at all ages. Overall, Thunder Bay has the highest rate of smoking, followed by the United States,

Ontario, and Canada. Also, a higher percentage of males smoke than females in the United States, Canada, and Ontario, although a higher percentage of females smoke than males in Thunder Bay. Furthermore, smoking rates are highest for young adults and lowest for older adults among all four populations. While there were no studies that examine the prevalence of ADHD among smoking populations, it was noted that the prevalence of smoking among ADHD populations is very high – especially among adults.

Alcohol dependence and drug dependence are the major forms of substance abuse for the United States, Canada, and Ontario. Despite the different forms of measurement used to gather substance abuse prevalence data, alcohol dependence was consistently three times higher among males than females in the United States, Canada, and Ontario. Drug use and dependence rates were also higher for males than females in Canada. In the United States, illicit drug use was highest for young adults and lowest for youth and middle to older age adults.

Substance abuse was not found to be higher among children and adolescents with ADHD than children and adolescents without ADHD. However, an interesting finding was that the substance abuse rates were higher in this cohort when ADHD was combined with conduct disorder. For adults with ADHD, substance abuse was much more prevalent compared to adults without ADHD.

## *Section 2: Adult ADHD & Smoking: A Review of the Literature*

### *Introduction*

This section provides a summary of the existing studies related to ADHD and smoking, and the answers to a number of questions related to these studies. The questions covered in this section include: 1) What types of research have been conducted to explore questions related to ADHD and smoking? 2) What research questions have been explored relative to ADHD and smoking? 3) What populations have been studied and what ones are clearly lacking? 4) How was ADHD measured in the studies? 5) How was smoking measured in the studies? 6) What were the findings and what do they mean? 7) Why do people with ADHD smoke, and how do they differ from those who smoke but do not have ADHD? 8) What considerations are there when developing an intervention for smokers with adult ADHD? 9) What considerations should be made for the future of smoking and ADHD?

### *Method*

A literature review was conducted to provide a summary of all the available studies relating adult ADHD and smoking. The review included a search of English databases – Pubmed, ERIC, and the Cochrane Library. The grey literature search included professional associations and government websites – Centers for Disease Control and Prevention, Health Canada, and Statistics Canada, as well as google.ca and scholar.google.ca. Keywords for the search included ADHD, adult ADHD, smoking, nicotine. Searching was limited to 1995 to 2007. Most research published prior to 1995 would not be relevant to informing the current relationship between ADHD and smoking, but needed to go back to 1995 due to the dearth of literature in this area. Subject/MESH

headings or keywords, depending upon the database's indexing system, were used to retrieve citations.

Selections were thoughtfully chosen to include scholarly evidence from research studies, systematic reviews as well as descriptive articles and editorials that identified issues of concern. Most of the literature dates from the last 5-10 years.

## *Results*

### *Research Question 1: Types of Research Related to ADHD and Smoking*

The literature search yielded 33 articles, several of which did not meet sufficient criteria for inclusion. Articles needed to include studies about smoking and ADHD. Many of the articles were in relation to ADHD and substance use/abuse, often grouping smoking into the category of substance use/abuse or neglecting smoking entirely. These types of studies were excluded from the search, yielding nine that met sufficient criteria for inclusion – five experimental studies (Conners et al., 1996; Gehricke et al., 2006; Lerman et al., 2001; Levin et al., 2001; and, Ohlmeier et al., 2007; Table 4; Table 5), three longitudinal studies (Kollins et al., 2005; Lambert and Hartsough, 1998; and, Wilens et al., 2007; Table 4; Table 5), and one cross-sectional study (Pomerleau et al., 1995; Table 4, Table 5).

The study by Conners et al. (1996) examined the effect of nicotine on adults with ADHD (n = 22). Gehricke et al. (2006) examined the effect of nicotine on particular symptoms of ADHD (n = 10). Lerman et al. (2001) examined the relationship between ADHD symptoms and smoking behaviour (n = 226). Levin et al. (2001) examined the effect of nicotine when used to treat adult ADHD (n = 40). Ohlmeier et al. (2007) examined the relationship between nicotine dependence and adult ADHD (n = 91).

The study by Kollins et al. (2005) examined ADHD symptoms in relation to smoking (n = 13,852); Lambert and Hartsough (1998) examined smoking rates among ADHD and non-ADHD adults (n = 400); and, Wilens et al. (2007) looked at whether or not individuals with ADHD use substances to self-medicate (n = 214).

The cross-sectional study by Pomerleau et al. (1995) was the first study to look at smoking rates among adults with ADHD (n = 71; Table 4, Table 5).

*Research Question 2: Research Questions Related to ADHD and Smoking*

Many research questions have been explored related to ADHD and smoking. The research questions can be classified into four categories, including: smoking rates among adults with ADHD, smoking and ADHD symptoms, effects of nicotine, and the role of stimulant medication. Studies on smoking rates among adults with ADHD include the smoking rate, the smoking quit rate and the smoking intensity rate of individuals with adult ADHD, compared to the general population (Lambert & Hartsough, 1998; Pomerleau et al., 1995; Wilens et al., 2007). Studies on smoking and ADHD symptoms include the role smoking plays among inattention symptoms and hyperactivity and impulsivity symptoms related to adult ADHD (Kollins et al., 2005; Lerman et al., 2001). Studies on the effects of nicotine include nicotine dependence and the beneficial effects of nicotine among adults with ADHD (Conners et al., 1996; Levin et al., 2001; Ohlmeier et al., 2007). Studies of the role of stimulant medication explore whether or not stimulant medication can aid in tobacco cessation, can potentiate the effects of nicotine, can be administered safely, and can be considered the most effective treatment to aid in tobacco cessation among the adult ADHD population (Gehricke et al., 2006; Kollins et al., 2005; Wilens et al., 2007; Wilens et al., 2008).

*Research Question 3: Populations Studied and Populations Lacking*

In the literature, the bulk of information regarding smoking and ADHD is targeted towards children, adolescents and young adults (Kollins et al., 2005; Lambert & Hartsough, 1998; Wilens et al., 2007). Adult ADHD data are more difficult to find, especially when it particularly involves smoking/nicotine. In addition to a general lack of adult ADHD and smoking data in the literature, there is literally nothing for older adults (in the 55 or older range). Of the limited adult ADHD and smoking studies, many are longitudinal in type, focus on males as opposed to females, reflect populations from the United States and build on previous work of ADD/ADHD children studied previously (Kollins et al., 2005; Lambert & Hartsough, 1998; Wilens et al., 2007).

*Research Question 4: How ADHD is Measured in the Studies*

In the ADHD and smoking studies, ADHD was measured using three ADHD scales, including the Wender Utah Rating Scale (61 items, 5-point scale; Wender, 1995), the Connors/Wells Adolescent/Adult Self-Report Scale (87 items, 4-point scale; Conners & Wells, 1985), and the Conners Adult ADHD Rating Scale (30 items, 4-point scale; Conners et al., 1999; Table 5). Some studies used more than one measure to assess ADHD. Also, ADHD was measured differently among the experimental/RCT studies (Conners et al., 1996; Gehricke et al., 2006; Lerman et al., 2001; Levin et al., 2001; and, Ohlmeier et al., 2007; Table 4; Table 5), the longitudinal studies (Kollins et al., 2005; Lambert and Hartsough, 1998; and, Wilens et al., 2007; Table 4; Table 5), and the cross-sectional study (Pomerleau et al., 1995; Table 4, Table 5).

*Meausrement of ADHD in Experimental/RCT Studies.* ADHD was primarily measured using adult ADHD self-report scales for the experimental/RCT studies (Table

5). The Wender Utah Rating Scale was used in three of the five experimental/RCT studies to measure ADHD (Conners et al., 1996; Gehricke et al., 2006; Levin et al., 2001). The Connors/Wells Adolescent/Adult Self-Report Scale was used in both Conners et al. (1996), and Levin et al. (2001), and the Connors Adult ADHD Rating Scale (long version) was used by Ohlmeier et al. (2007).

In addition to the adult ADHD self-report scales, the experimental and RCT studies used other methods to measure ADHD among study participants (Table 5). Barkley's Adult ADHD Semi-Structured Interview was used by Conners et al. (1996) in addition to using self-report scales. Also, self-report questions on a four-point Likert scale were used by Lerman et al. (2001), in order to explore ADHD symptoms among smoking behaviour.

*Measurement of ADHD in Longitudinal Studies.* ADHD was measured in three unique ways for the longitudinal studies (Table 5). Kollins et al. (2005) had participants retrospectively report two categories of ADHD symptoms (hyperactivity/impulsivity and inattention) from childhood on a Likert scale. Based on the answers to the questions, the researchers assessed the severity of ADHD.

The study by Lambert and Hartsough (1998), measured ADHD in a fashion unique to the other studies (Table 5). Since the original sample was measured in 1974, Lambert and Hartsough (1998) used the Children's Attention and Adjustment Survey (CAAS). The behaviour of the participants in the survey actually helped develop the DSM-III guidelines for ADHD, as the criteria for ADHD were still evolving at the time (Lambert & Hartsough, 1998).

Wilens et al. (2007) measured ADHD in three stages of assessment (Table 5):

1) initial referral to a clinic for ADHD diagnosis as children; 2) supplemental confirmation of ADHD via telephone questionnaire; and, 3) final clinical interview for DSM-IV ADHD for participants aged 18 and older.

*Measurement of ADHD in the Cross-Sectional Study.* The semi-structured interview by Pomerleau et al. (1995) measured adult ADHD by means of a behaviour checklist regarding the presence of DSM-III ADHD symptoms (Table 5).

*Research Question 5: How Smoking is Measured in the Studies*

In the ADHD and smoking studies, smoking was measured using the Fagerstrom Test for Nicotine Dependence (Kollins et al., 2005; Pomerleau et al., 1995; Ohlmeier et al., 2007) and a variety of study-specific measures that often included smoking history and smoking habits. Smoking was measured differently among the experimental/RCT studies, the longitudinal studies, and the semi-structured interview study.

*Measurement of Smoking in Experimental/RCT* Studies. There were five experimental/RCT studies included in the adult ADHD and smoking section (Table 5). One of the studies did not include any smokers at all. Of the other four experimental/RCT studies, all included some aspect of smoking history and smoking habits (Table 5). Both Conners et al. (1996) and Ohlmeier et al. (2007) used the Fagerstrom Test for Nicotine Dependence. The Fagerstrom Test for Nicotine Dependence is a self-report scale that measures an individuals' dependence level on nicotine in addition to the amount an individual smokes (Heatherton, 1991).

Gehricke et al. (2006) assessed smoking history and smoking habits by self-report measures developed specifically for their study (Table 5). Lerman et al. (2001) developed smoking measures as well, focusing on four smoking categories, including:

smoking history (i.e., smoking initiation and daily use), smoking motives, smoking urges and nicotine dependence.

*Measurement of Smoking in Longitudinal Studies.* The longitudinal studies explored a great deal of self-report smoking measures tailored specifically towards the nature of the study (Table 5). Kollins et al. (2005) examined a number of measures related to smoking history, including: 1) having ever tried smoking; 2) having taken only 1 or 2 puffs but having never smoked an entire cigarette; 3) number of cigarettes smoked over the last 30 days; and, 4) age of onset of regular smoking.

Lambert and Hartsough (1998) looked at participants' use of tobacco as adults, as well as their attitudes and opinions regarding smoking, using the California Smoking Baseline Survey (CSBS) and the Quick Diagnostic Interview Schedule (Table 5). Wilens et al. (2007) used the Drug Use Screening Inventory to explore frequency of tobacco use over the last month, motivation for initiation and continued use, and problems associated with use.

*Measurement of Smoking in the Cross-Sectional Study.* Pomerleau et al. (1995) measured smoking using the Fagerstrom Tolerance Questionnaire (Fagerstrom, 1978). The Fagerstrom Tolerance Questionnaire was the precursor to the Fagerstrom Test for Nicotine Dependence (Heatherton, 1991).

*Research Question 6: Findings and Meaning of Findings*

*Smoking Rates Among Adults with ADHD.* The smoking rate is higher in adults with ADHD compared to those without ADHD (Lambert & Hartsough, 1998; Pomerleau et al., 1995; Table 4). This finding was initially noted by Pomerleau et al. (1995) who reported that 42% of ADHD males and 38% of ADHD females were current smokers,

compared to non-ADHD males and females (28.1% and 23.5%, respectively). A similar finding was later reported by Lambert and Hartsough (1998), who stated that the proportion of participants with ADHD who are current smokers (42%) continues to exceed that of the age-mate controls (26%). Furthermore, adults with ADHD have a greater proportion of daily smokers and smoke at a greater intensity than adults without ADHD (Lambert & Hartsough, 1998; Wilens et al., 2007; Table 4). Lambert and Hartsough (1998) found that the rates of daily smoking among the adult smokers was 35% for the participants with ADHD in contrast to 16% for the age-mate controls. Also, Wilens et al. (2007) reported twice as much heavy cigarette use among adults with ADHD (47%) compared to adults without ADHD (21%). Heavy cigarette use included participants who engaged in smoking more than 20 times in the past 30 days according to the Drug Use Screening Inventory (DUSI; Wilens et al., 2007).

*Smoking Cessation Among Adults with ADHD.* Adults with ADHD have a more difficult time quitting smoking than adults without ADHD (Pomerleau et al., 1995; Table 4). Pomerleau et al. (1995) reported a 29% quit ratio in their sample, compared to a 48.5% quit ratio in the general population. The relatively high cessation rates may be attributed to the low sample size (n = 71) of the semi-structured interview study by Pomerleau et al. (1995).

*Smoking and ADHD Symptoms.* It is unclear exactly what ADHD symptoms are associated with smoking (Kollins et al., 2005; Lerman et al., 2001; Table 4). The literature provides conflicting findings between smoking and a) hyperactivity/impulsivity symptoms, and b) inattention symptoms, of adult ADHD. Lerman et al. (2001) reported that smoking is associated with inattention symptoms and not hyperactivity/impulsivity

symptoms of adult ADHD. In fact, the participants may be using the nicotine to help self-medicate the inattention symptoms of adult ADHD (Lerman et al., 2001). In contrast, Kollins et al. (2005) suggest that smoking is associated with hyperactivity/impulsivity symptoms, stating that the hyperactivity/impulsivity symptoms were found to be a better predictor of lifetime regular smoking than inattention symptoms. The documented debate in the literature suggests a need to further explore the relationship between smoking and ADHD symptoms.

*Effects of Nicotine on Adults with ADHD.* Nicotine dependence is significantly higher in adults with ADHD than the rest of the population (Ohlmeier et al., 2007; Table 4). According to Ohlmeier et al. (2007), 76.2% of adult ADHD patients had 'average to high' nicotine dependence compared to patients without adult ADHD (45.7%).

Adults with ADHD tend to smoke due to the beneficial effects involved with nicotine (Conners et al., 1996; Levin et al., 2001; Table 4). Conners et al. (1996) reported a number of positive effects associated with the use of nicotine on adults with ADHD. The most notable findings were that nicotine improved self-rated vigor, improved concentration, and improved performance on measures of attention and timing accuracy among adult with ADHD (Conners et al., 1996). Similarly, Levin et al. (2001) reported that acute nicotine significantly reduced the severity of clinical symptoms of ADHD. These results indicate that nicotine provides some relief for many adults with ADHD, and suggest that nicotine may be used as a form of self-medication.

*Role of Stimulant Medication for Adults with ADHD.* Stimulant medication has been shown to aid in tobacco cessation for individuals with adult ADHD (Gehricke et al., 2006; Table 4). In fact, Gehricke et al. (2006) suggest that smokers may be able to

significantly reduce their nicotine intake by taking stimulant medication. However, stimulant medication has not proven as effective at treating symptoms of ADHD as nicotine, among adults with ADHD (Gehricke et al., 2006). Gehricke et al. (2006) suggest that administering higher doses of stimulant medication might equal the treatment effects of nicotine among adults with ADHD.

There is an underlying risk that stimulant medication can become addictive when used to treat ADHD (Kollins, 2007). In a review of medications used to treat adult ADHD by Kollins (2007), it was reported that stimulant drugs exhibit the potential for abuse. Another recent study reported similar findings to Kollins (2007) regarding the abuse potential of stimulant drugs. Wilens et al. (2008) reported that despite the well-documented safety profile of the stimulants used in the treatment of ADHD, consistent evidence of misuse of stimulants in older adolescents and young adults exists. Although the potential abuse of stimulant medications continues to be highly debated in the literature, it is important to consider the findings by Kollins (2007) and Wilens et al. (2007), when developing interventions for adults with ADHD.

There does not appear to be a more effective treatment than stimulant medication to aid in tobacco cessation among the adult ADHD population at the moment. While there has been more widespread use of non-stimulant drugs for treating ADHD in children, the effectiveness of these drugs is still relatively unknown, and requires further testing (Kollins, 2007). Preliminary results have shown that non-stimulant drugs used to treat ADHD have not demonstrated significant abuse potential (Kollins, 2007).

*Research Question 7: Difference Between Smokers and Non-Smokers with Adult ADHD*

*Why People with ADHD Smoke.* The studies related to adult ADHD and smoking indicate that adults with ADHD smoke at a greater rate, and have a more difficult time quitting smoking, than adults without ADHD (Lambert & Hartsough, 1998; Pomerleau et al., 1995; Wilens et al., 2007). While it is still uncertain exactly which types of ADHD symptoms the increased smoking is associated with, it is clear that smoking helps to alleviate at least some of these symptoms in adults (Kollins et al., 2005; Lerman et al., 2001). In particular, the nicotine from cigarettes has been shown to provide several beneficial effects to adults with ADHD that, to this point, have not been equaled by any other treatment (Gehricke et al., 2006).

*Key Difference Between ADHD Smokers and Non-ADHD Smokers.* The adult ADHD and smoking studies suggest that the key difference between adults with ADHD who smoke and adults without ADHD who smoke is nicotine dependence (Ohlmeier et al., 2007). Adults with ADHD are generally undiagnosed, having to cope with a number of ADHD symptoms in their day-to-day lives. Many of these individuals develop a dependence on nicotine as it is an effective, and quite possibly, the only means to help alleviate the symptoms of ADHD. Adults without ADHD do not have clinically disabling symptoms related to inattention and hyperactivity/impulsivity, and thus, do not develop nicotine dependence at the same rate as adults with ADHD.

*Research Question 8: Intervention Considerations for Adult Smokers with ADHD*

The adult ADHD and smoking studies touch on a number of important issues to consider when developing an intervention for smokers with adult ADHD. Initially, individuals developing an intervention need to understand the differences between a

smoker with ADHD and a smoker without ADHD. Smokers with ADHD are generally much more dependent on nicotine than individuals without ADHD (Ohlmeier et al., 2007). Nicotine helps smokers with ADHD to cope with ADHD symptoms (Conners et al., 1996; Levin et al., 2001), and may also be the only coping mechanism available to smokers with ADHD. These findings suggest that nicotine replacement therapy might be really important in helping smokers with adult ADHD to quit.

Another consideration is deciding on a safe, effective treatment to help cope with ADHD symptoms. While Gehricke et al. (2006) have suggested many benefits associated with stimulant treatment, other researchers such as Kollins et al. (2007) and Wilens et al. (2008), have reported the underlying risks associated with stimulant medications. Adults with ADHD are individual people, with different backgrounds and potential contraindications. It is important to consider the particular characteristics of the individual when developing interventions and exercise caution when prescribing medications to potential high-risk groups. Also, individuals developing an intervention should provide as much information as possible regarding the abuse potential of medications. Otherwise, potential patients may be reluctant to initiate an effective treatment.

*Research Question 9: Future Considerations for Smoking and ADHD*

The adult ADHD and smoking studies suggest that further research is necessary to determine a safe, effective alternative to cigarette smoking for treating adult ADHD (Kollins et al., 2007; Wilens et al., 2008). At the moment, stimulant therapy and nicotine replacement therapy appear to be effective treatments for adult ADHD, although the risks associated with each type of treatment continue to be debated in the literature (Gehricke

et al., 2006; Kollins et al., 2007; Wilens et al., 2008). There is a continued need to further explore stimulant therapy, nicotine therapy, and other types of therapy among the adult ADHD population.

### *Conclusion*

The studies indicate that adults with ADHD have a greater prevalence of smoking and a harder time quitting smoking than adults without ADHD. While it is unclear exactly which types of ADHD symptoms that smoking is associated with, it is clear that the nicotine from cigarettes provides beneficial effects to adults who suffer from ADHD. These beneficial effects lead to the key difference between adults with ADHD who smoke and adults without ADHD who smoke: nicotine dependence.

There are important intervention considerations for adult smokers with ADHD. In addition to the difference in nicotine dependence for adult smokers with ADHD compared to adult smokers without ADHD, it is important to consider a treatment that is both effective and safe for the unique individual suffering from ADHD. In order to accomplish this, there is a need for more research into stimulant therapy, nicotine replacement therapy and other potential measures to treat adult ADHD.

Table 4: Review of Adult ADHD and Smoking Studies

| Reference | Nature of Study | Type of Study | Population | Results |
|---|---|---|---|---|
| Conners et al. (1996) | Nicotine effect on ADHD | Experimental-RCT | 18 male and 4 female participants with a mean age of 34 years (range - 20 to 51 years) | improved self-rated vigor and concentration; improved performance on measures of attention and timing accuracy |
| Gehricke et al. (2006) | Nicotine effect on adult ADHD symptoms | Experimental - RCT | 10 adults (50% male) with ADHD being treated with stimulant therapy, mean age of 25 +/- 6.2 years | nicotine and stimulant medication reduce self-reported symptoms of ADHD; stimulant medication did not potentiate the effects of nicotine in ADHD participants |
| Kollins et al. (2005) | ADHD symptoms in relation to smoking | Longitudinal Study | 13, 852 adolescents (49.5% male, 50.5% female), mean age of 21.94 years | hyperactivity/impulsivity symptoms found to be a better predictor of lifetime regular smoking than inattention symptoms |
| Lambert and Hartsough (1998) | Smoking rates among ADHD and non-ADHD adults | Prospective Longitudinal Study | adult data obtained from 400 of original 492 children in 1974 (77% of ADHD, 86% of controls) | 42% of adult ADHD participants current smokers compared to age-mate controls (26%); 35% of adult smokers smoke daily, compared to age-mate controls (16%) |
| Lerman et al. (2001) | ADHD symptoms and smoking behaviour | Experimental - RCT | 226 smokers (56% female), mean age of 45 +/- 12 years | smoking associated with ADHD inattention symptoms but not hyperactivity symptoms; nicotine may be used to help self-medicate inattention symptoms |
| Levin et al. (2001) | Nicotine treatment for ADHD | Experimental - RCT | Non-smoking ADHD adults aged 19-56 years (25 male, 15 female) | acute nicotine significantly reduced severity of clinical symptoms of ADHD |

| Reference | Nature of Study | Type of Study | Population | Results |
|---|---|---|---|---|
| Ohlmeier et al. (2007) | Nicotine dependence & adult ADHD | Experimental | 91 adults with alcohol dependence (59 male, 32 female), mean age of 46.8 +/- 9.8 years | 76.2% of ADHD patients had 'average to high' nicotine dependence when compared to those patients without ADHD (45.7%) |
| Pomerleau et al. (1995) | Adult ADHD smoking prevalence | Cross-Sectional | 71 adult patients (55 male, 16 female), mean age of 33.9 +/- 11.4 years | 42% of ADHD males and 38% of ADHD females were current smokers, compared to non-ADHD (28.1% and 23.5%, respectively); 29% quit ratio in sample compared to 48.5% in general population |
| Wilens et al. (2007) | Do ADHD individuals use substances to self-medicate | Longitudinal Study | 214 subjects mean age 19.7 +/- 2.7 year's | ADHD subjects reported more than twice as much heavy cigarette use as control subjects (47% compared to 21%) |

Note: ADHD = attention-deficit/hyperactivity disorder; RCT = randomized controlled trial.

Table 5: Review of ADHD/Smoking Characteristics of Adult ADHD and Smoking Studies

| Reference | Nature of Study | ADHD Measures | Smoking Measures |
|---|---|---|---|
| Conners et al. (1996) | Nicotine effect on ADHD | Wender Utah Rating Scale, Connors/Wells Adolescent/Adult Self-Report Scale, Barkley's Adult ADHD Semi-Structured Interview | Fagerstrom Test of Nicotine Dependency; smokers abstinent for 12 hours prior to testing |
| Gehricke et al. (2006) | Nicotine effect on adult ADHD symptoms | Wender Utah Rating Scale. Looked at current and past ADHD symptoms according to DSM – IV criteria. | Smoking history and habits assessed by self-report. Participants abstained from smoking in each of the 2-day recording sequences. |
| Kollins et al. (2005) | ADHD symptoms in relation to smoking | Participants retrospectively reported from childhood about the frequency of a symptom on a likert scale.. ADHD severity assessed based on responses to inattention and hyperactivity/impulsivity questions. | Self-report measures including: smoked at least 1 cigarette over the last 30 days, have they ever tried smoking, taken only 1 or 2 puffs but never smoked an entire cigarette, age of onset of regular smoking. |
| Lambert and Hartsough (1998) | Smoking rates among ADHD and non-ADHD adults | Children's Attention and Adjustment Survey (CAAS). ADHD was still evolving at the time as the participants in this survey helped develop the DSM - III guidelines for ADHD | Looked at participants' use of tobacco as adults, as well as their attitudes and opinions regarding smoking, derived from the California Smoking Baseline Survey (CSBS) and the Quick Diagnostic Interview Scheudle |
| Lerman et al. (2001) | ADHD symptoms and smoking behaviour | Participants rate their behaviour over 6 months on a four-point Likert scale regarding how often they experience symptoms of inattention (nine items) and hyperactivity-impulsivity (nine items). | Assessed four smoking categories including: smoking history (initiation, daily use), smoking motives, smoking urges, and nicotine dependence |
| Levin et al. (2001) | Nicotine treatment for ADHD | Wender's Utah Rating Scale, Connors/Wells Adolescent and Adult Self-Report | Non-smokers |

Table 5: (continued)

| Reference | Nature of Study | ADHD Measures | Smoking Measures |
|---|---|---|---|
| Ohlmeier et al. (2007) | Nicotine dependence & adult ADHD | Connors Adult ADHD Rating Scale (long version) | Fagerstrom Test for Nicotine Dependence |
| Pomerleau et al. (1995) | Adult ADHD smoking prevalence | A behaviour checklist regarding the presence of DSM - III ADHD symptoms | Fagerstrom Tolerance Questionnaire |
| Wilens et al. (2007) | Do ADHD individuals use substances to self-medicate | Three Stages of Assessment: referred to clinic for ADHD diagnosis as children; diagnoses confirmed via telephone questionnaire; participants 18 and over received clinical interview for DSM - IV | Drug Use Screening Inventory used. Frequency over last month, motivation for initiation and continued use, and problems associated with use. |

Note: ADHD = attention-deficit/hyperactivity disorder; DSM – III = diagnostic and statistical manual of mental disorders – third edition; DSM – IV = diagnostic and statistical manual of mental disorders – fourth edition.

## *Section 3: Paving the Way for Research in ADHD and Smoking in NW Ontario*

### *Introduction*

This section covers three questions related to adult ADHD: 1) What are the similarities, differences, psychometric properties, and criticisms of adult ADHD rating scales? 2) What are the particular considerations of an adult ADHD and smoking study, including smoking history and habits, smoking motivation, history of stimulant medications, and history of substance use and abuse? and, 3) What considerations are there for both a stimulant drug study and an adult ADHD study in Northwestern Ontario?

### *Method*

A literature review was conducted to provide a summary of the available rating scales and screening tools that exist to measure adult ADHD. The review included a search of English databases – Pubmed, ERIC, and the Cochrane Library. The grey literature search included professional associations and government websites – Health Canada and Statistics Canada, as well as google.ca and scholar.google.ca. Keywords for the search included ADHD, adult ADHD, rating scale, screening tool, psychometric property, validity, and reliability. Searching was limited to 1991 to 2008. Most research published prior to 1991 would not be relevant to adult ADHD rating scales, but needed to go back to 1991 due to the dearth of literature in this area. Subject/MESH headings or keywords, depending upon the database's indexing system, were used to retrieve citations.

Selections were chosen – based on their use in recent adult ADHD research – to include scholarly evidence from research studies, systematic reviews as well as

descriptive articles and editorials that identified issues of concern. Most of the literature dates from the last 5-10 years.

## *Results*

### *Research Question 1: Characteristics of Adult ADHD Rating Scales*

There are a number of different screening tools and rating scales that currently exist to measure adult ADHD. These scales include: Wender Utah Rating Scale (WURS; Ward et al., 1993); Conners' Adult ADHD Rating Scale (CAARS; Conners et al., 1999); Brown Attention-Deficit Disorder Rating Scale (BADDS) for Adults (Brown, 1996); Copeland Symptom Checklist for Adult ADHD (Copeland, 1991); WHO Adult ADHD Self-Report Scale (ASRS) - Version 1.1 (Kessler et al., 2005); and, Adult Self-Report Scale (ASRS) Screener (Kessler et al., 2005; Table 6).

*Similarities and Differences of Adult ADHD Scales.* The adult ADHD tools/scales were generally quite different from one another aside from using self-report administration and having a rating scale format (Table 6). The number of items vary from six (ASRS Screener) to 63 (Copeland Symptom Checklist). Similarly, the scales differ in estimated completion time, with a range of two minutes (ASRS Screener) to 20 minutes (Copeland Symptom Checklist, WURS). The format displayed some variation as well, consisting of 3, 4, and 5-point Likert scales that were frequency-based (Kooij et al., 2008; Table 6), severity-based (McCann et al., 2000; Copeland 1991; Kessler et al., 2005; Table 6) or both frequency & severity-based (Bowes, 2001; Table 6).

*Psychometric Properties of Adult ADHD Scales.* The literature related to the psychometric properties of adult ADHD scales was rather limited. Since the scales are relatively new in the literature, it was anticipated that validity and reliability information

would be difficult to find. Despite the difficulty experienced in the search for properties, psychometric evidence was obtained for each of the rating scales aside from the Copeland Symptom Checklist for Adult ADHD. The psychometric evidence was verified by clinically diagnosing the study participants after each scale was utilized. The adult ADHD clinical diagnosis results were subsequently compared to the ADHD scale results to determine the psychometric properties.

The psychometric properties were derived from a variety of studies and were operationalized when necessary to fit as either "sensitivity" or "specificity" (Table 6). The term "sensitivity" referred to how often the particular rating scale correctly identified the individuals with adult ADHD as having the disorder (expressed as a percentage), while the term "specificity" referred to how often the particular rating scale correctly identified the individuals without adult ADHD as not having the disorder (expressed as a percentage).

The Wender Utah Rating Scale (WURS) properties were reported by McCann et al. (2000; Table 6). The classification procedure correctly classified 64.5% of ADHD patients (sensitivity). Among those who did not have ADHD, only 57.5% were correctly classified (specificity; McCann et al., 2000).

The Conners' Adult ADHD Rating Scales (CAARS) properties were reported by Bowes (2001; Table 6). The CAARS produced a false-positive rate of about 13% (87% sensitivity) and a false-negative rate of 18% (82% specificity; Bowes, 2001).

The properties of the Brown Attention-Deficit Disorder Rating Scale (BADDS) for Adults were reported by Kooij et al. (2008; Table 6). Using a total score of 50 or

more on the BAADS, 84% were correctly diagnosed with adult ADHD (sensitivity; Kooij et al., 2008).

The WHO Adult ASRS – Version 1.1 properties and the ASRS Screener properties were both reported by Kessler et al. (2005; Table 6). According to this study, the unweighted six-question ASRS screener outperformed the unweighted 18-question ASRS in sensitivity (68.7% v. 56.3%, respectively) and specificity (99.5% v. 98.3%, respectively; Kessler et al., 2005).

*Criticisms of Adult ADHD Scales*. According to Kooij et al. (2008), the validity and accuracy of self-report information about symptoms of ADHD in adults have been considered questionable because they depend on the recall of childhood symptoms. Often this can lead to recall bias. Moreover, adolescents and adults with ADHD generally have problems with self-reflection and self-evaluation, and this may well lead to under-reporting (Kooij et al., 2008).

Another criticism of adult ADHD scales is that they cannot be used as stand-alone agents for diagnosis. According to one study, physicians also need to ask key questions about the patient's past and current impairment, take medical, educational, social, psychological, and vocational histories, and rule out other conditions before concluding that ADHD is the appropriate diagnosis (Murphy & Adler, 2004). While self-reporting scales/screening tools are a helpful starting point, they cannot replace an extensive clinical history and knowing when to refer the patient to a healthcare professional with adult ADHD expertise (Kessler et al., 2005).

*Research Question 2: Considerations of an Adult ADHD and Smoking Study*

There are a number of items to consider in a study of adult ADHD and smoking to elucidate why people smoke and to clarify what they might need in order to quit. Based on the adult ADHD and smoking studies reviewed, there are clear smoking topics to focus on in future studies, including: smoking history and habits, smoking motivation, history of stimulant medications, and history of substance use and abuse.

*Smoking Initiation.* The relationship between ADHD symptoms and smoking is linear, with a greater number of ADHD symptoms associated with earlier regular smoking (Kollins et al., 2005). In order to help an adult with ADHD quit smoking, it is important to record their smoking history as it may help to predict the strength of the relationship between ADHD and smoking (Kollins et al., 2005).

*Smoking Habits.* The Fagerstrom Test for Nicotine Dependence measures smoking habits to determine an individual's level of nicotine dependence (Heatherton, 1991). In addition to assessing the level of dependence on nicotine, the Fagerstrom Test for Nicotine Dependence addresses the amount and frequency of cigarette smoking (Heatherton, 1991). Clearly, the Fagerstrom Test for Nicotine Dependence should be included in any study looking at adult ADHD and smoking.

*Quit Attempts.* Another important aspect to consider is the history of quit attempts, as adults with ADHD have a more difficult time quitting smoking than adults without ADHD (Pomerleau et al., 1995). The questions related to quit attempts should focus on the number of quit attempts, success of previous quit attempts, use of nicotine replacement therapy (NRT), and withdrawal symptoms of previous quit attempts (Pomerleau et al., 1995).

*Smoking Motivation.* In addition to looking at the history and the habits of an individual smoker, it is also important to explore the reasons why an individual smokes. The best way to explore smoking motivation is to develop a "why do you smoke" questionnaire tailored specifically towards adults with ADHD (Lerman et al., 2001). The questionnaire should explore smoking as a form of self-medication and include questions related to specific inattention and hyperactivity/impulsivity symptoms of adult ADHD (Kollins et al., 2005).

*History of Stimulant Medications.* There are many risks associated with stimulant medication use, especially among individuals with ADHD (Kollins et al., 2007; Wilens et al., 2008). However, stimulant medication use has been shown to be effective for treating ADHD symptoms for certain individuals (Gehricke et al., 2006). It is important to obtain knowledge about an individual's history of stimulant medication use, as adequate information will help in the development of an appropriate cessation strategy that either includes, or does not include, stimulant therapy.

*History of Substance Use and Abuse.* According to Kessler et al. (2006), nearly three times as many adults with ADHD have a substance use disorder compared to adults without ADHD. Gathering information about substance use and abuse from childhood onward may help to explain the mechanism of the relationship between substance use disorders and ADHD.

### *Research Question 3: Considerations for a Drug Study and Adult ADHD Study in NW Ontario*

*Stimulant Drug Study in NW Ontario.* It is not worthwhile to consider a stimulant drug study for Northwestern Ontario at this point in time. Currently, there is far too much that is unknown about adult ADHD in Northwestern Ontario. While a stimulant

drug study may be beneficial to help solve the problem of adult ADHD in NW Ontario, it is first necessary to fully comprehend the magnitude of this problem.

*Adult ADHD Study in NW* Ontario. The rates of smoking among adults are higher in Northwestern Ontario than the United States, Canada, and Ontario (Health Canada, 2007; Statistics Canada, 2005). Also, adults with ADHD tend to smoke at a higher rate than adults without ADHD (Lambert & Hartsough, 1998; Pomerleau et al., 1995). Based on these two findings, it seems reasonable to assume that the prevalence of adult ADHD in Northwestern Ontario may be higher than the United States, Canada, and Ontario. However, at this point in time, no research has been done to explore the prevalence of adult ADHD in Northwestern Ontario. The lack of research is a concern, considering the 4.4% estimate of adult ADHD in the United States (Kessler et al., 2006). The relatively conservative estimate of 4.4% by Kessler et al. (2006) may very well be much higher in Northwestern Ontario. There is a definite need to conduct a population-based survey in Northwestern Ontario to establish baseline rates of adult ADHD. Once the rates of adult ADHD have been established, researchers can begin to focus on other unique issues that face adults with ADHD in Northwestern Ontario, such as the elevated prevalence of smoking in the region.

## *Conclusion*

While the adult ADHD rating scales/screening tools are a quick, relatively effective way to screen for adult ADHD, some research suggest that they cannot replace an extensive clinical history and the diagnoses of a qualified healthcare professional.

For Northwestern Ontario, the prevalence of adult ADHD is unknown and, considering the elevated rates of smoking in Northwestern Ontario, there is reason to

believe that the ADHD rate might exceed the conservative estimate in the literature. Future research on adult ADHD in Northwestern Ontario should focus on establishing an initial prevalence rate of adult ADHD before considering any other type of research.

Table 6: Review of Screening Tools/Rating Scales for Adult ADHD

| Reference | Screening Tool/Rating Scale | Administration Type | # of Items | Time to Complete | Format | Psychometric Properties | Content/Notable Features |
|---|---|---|---|---|---|---|---|
| McCann et al. (2000) | Wender Utah Rating Scale (WURS) | self-report | 61 | 20 minutes | 5-point severity rating scale | Sensitivity – 64.5%<br>Specificity – 57.5% | retrospective rating of childhood ADHD symptoms |
| Bowes (2001) | Conners' Adult ADHD Rating Scales (CAARS) | observer or self-report | 30 | 10 to 15 minutes | 4-point severity & frequency rating scale | Sensitivity – 87%<br>Specificity – 82% | designed to elicit information relative to attention and affect in adults |
| Kooij et al. (2008) | Brown Attention - Deficit Disorder Scale for Adults (BADDS) | self-report | 40 | 15 minutes | 4-point frequency rating scale | Sensitivity – 84.4% | cognitive symptoms associated with difficulty initiating and maintaining optimal arousal and concentration level |
| Copeland (1991) | Copeland Symptom Checklist for Adult ADHD | self-report | 63 | 20 minutes | 3-point severity rating scale | none available | broad range of cognitive, emotional and social symptoms |
| Kessler et al. (2005) | WHO Adult ADHD Self-Report Scale (ASRS) - Version 1.1 | self-report | | 5 minutes | 5-point severity rating scale | Sensitivity – 56.3%<br>Specificity – 98.3% | items are consistent with DSM-IV criteria and address manifestations of ADHD symptoms in adults |

| Reference | Screening Tool/Rating Scale | Administration Type | # of Items | Time to Complete | Format | Psychometric Properties | Content/Notable Features |
|---|---|---|---|---|---|---|---|
| Kessler et al. (2005) | Adult Self-Report Scale (ASRS) Screener | self-report | | 2 minutes | 5-point severity rating scale | Sensitivity – 68.7%<br>Specificity – 99.5% | a self-administered 6-item subset of the WHO's Adult ADHD Self-Report Scale V1.1 |

Note: ADHD = attention-deficit/hyperactivity disorder; DSM – IV = diagnostic and statistical manual of mental disorders – fourth edition

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