Investigating a Self-Management Strategy for Symptoms of Attention-Deficit Hyperactive Disorder and Drug Use.

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Abstract

Introduction: The purpose of the present research was to examine the mediating effect that self-management has on the relationships between ADHD symptoms and nicotine dependence, alcohol use, and drug use among an undergraduate student population.

Method: Data were drawn from undergraduate psychology students (N=141). We tested self-management as a mediator between (1) ADHD symptoms and nicotine use, (2) ADHD symptoms and alcohol use, and (3) ADHD symptoms and drug use.

Results: Self-management was a significant mediator between ADHD symptoms and drug use, but not nicotine dependence or alcohol use.

Conclusion: Self-management was a significant mediator between ADHD symptoms and drug use, which suggests that self-management may play a role in the relationship between ADHD symptoms and drug use. Individuals who have symptoms associated with ADHD and who also have high levels of self-management are less likely to use drugs.

Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental psychiatric disorder that is defined by impaired levels of inattention and hyperactivity-impulsivity (Childress & Berry, 2012). The literature has shown that ADHD is related to various co-occurring mental disorders. The purpose of the present research was to examine the relationship of self-reported ADHD symptoms to nicotine use, alcohol use, and drug use within a self-management framework among a university undergraduate population.

Attention Deficit Hyperactivity Disorder is associated with negative outcomes across social, neuropsychological, affective, and academic domains (Lee, Humphreys, Flory, Liu, & Glass, 2011). Adults with ADHD experience higher levels of marital and family dysfunction (Eakin et al., 2004), problems with friends and intimate relationships, and often engage in novelty-seeking and risky behaviours (Young & Bramham, 2012). Furthermore, adults with ADHD are more likely to have lower occupational achievement (Breslin & Pole, 2009), a higher risk of being fired (Barkley & Murphy, 2010), a higher probability of being unemployed (Biederman, Petty, Woodworth, Lomedico, Hyde, & Faraone, 2012; Fletcher, 2014; Huntley & Young, 2014), lower educational attainment (Gjervan, Torgersen, Nordahl, & Rasmussen, 2012) and increased likelihood of engaging in nicotine dependence, alcohol use and drug use.

ADHD and Substance Use

The overlap between ADHD and substance use disorders (SUDs) among adults has been an area of increasing clinical, research, and public health interest. Adults with ADHD have a doubled risk of developing a substance use disorder.
compared to those without ADHD, with an earlier onset of substance use, worse substance use outcome, and are less likely to remain in treatment (Biederman et al., 1995). Among adults with ADHD, prevalence rates are estimated to be between 7.3% and 16.7% for nicotine dependence, (Covey, Manubay, Jiang, Nortick, & Palumbo, 2008), between 17% to 45% for alcohol dependence, and between 9% to 30% for drug dependence (Wilens & Upadhyaya, 2007).

In addition, individuals with SUDs report increased levels of ADHD symptoms. (Sobanski, 2006; Upadhyaya & Carpenter, 2008) and the prevalence of ADHD is noted to be significantly higher among populations with SUDs compared to the general population (van de Glind et al., 2014). Individuals with ADHD also tend to maintain their substance addiction longer compared to their peers without ADHD (Wilens, Biederman, & Mick, 1998).

Among university populations, students with ADHD are at a greater risk for academic and psychological difficulties than their peers (Weyandt, 2006). University students with ADHD have been found to have more difficulty in selecting a major (DuPaul, Weyandt, O’Dell, & Varejao, 2009), report more academic concerns/problems, have lower grade point averages (Blase et al., 2009), are more likely to be on academic probation (Heiligenstein, Guenther, Levy, Savino, & Fulwiler, 1999), and engage in substances use.

The typical undergraduate university program overlaps with the peak developmental period for problematic substance use (Littlefield, Sher, & Wood, 2009), and for students with ADHD symptoms, environmental influences specific to the traditional university experience may uniquely influence patterns of nicotine, alcohol and drug use (Brown et al., 2008). As such, university students have been the focus of recent research regarding ADHD and substance use (Salla, Galera, Guichard, Tzourio, & Michel, 2017). Research has indicated that ADHD symptoms have been linked to nicotine dependence, alcohol use and drug use (Connolly, Speed, & Hesson, 2016; Hesson & Fowler, 2015), and this relationship is consistent among research investigating university populations (Green & Rabiner, 2012; Mesman, 2015).

Self-Management

Through self-management of health habits, people reduce major health risks and live healthier and more productive lives (Bandura 1991; Ridder & de Wit, 2006). Self-management is successful because it allows for one’s purposive processing of information for selecting, formulating, and evaluating goals, as well as providing a course of action to reach those goals (Bandura, 2001). Self-management uses self-regulatory techniques to give people direction, and also creates incentives, which enables them to sustain their efforts to reach goals. These self-management techniques have been examined as primary interventions with adult problem behaviours and have been shown to have promising results (Febbraro & Clum, 1998; Harmon, Nelson, & Hayes, 1980; Shapiro, DuPaul, & Bradley-Klug, 1998).

Although there are many forms of self-management and many of the terms for self-management have varied throughout the past decade, the current research will focus on three facets of behavioural self-management: self-monitoring, self-evaluation, and self-reinforcement.
These three processes operate in a single closed feedback loop, such that the output of one serves as the input for another. The focus of this self-management strategy is on a series of steps created to monitor people's progress, evaluate their behaviours, then reward or punish themselves based on their own evaluation. Simply put, it may be understood in terms of the processes that guide the setting and achievement of goals (Mezo, 2009).

Most research addressing relationships between self-management processes and substance use has focused primarily on psychotic disorders, antisocial personality disorder, and mood disorders (Zvolensky, Buckner, Norton, & Smits, 2011). However, research has also indicated that self-management processes are negatively related to the consumption of nicotine, alcohol and other drugs (Connolly, Noel, & Mezo, 2017; Foxx & Axelroth, 1983; Khantzian, 1990).

**The Current Study**

To date, little research addressing self-management processes in ADHD and nicotine dependence, alcohol use, and drug use has been completed. The current study will set out to fill this gap in the literature by addressing the following questions: (1) Is self-management related to ADHD symptoms, nicotine dependence, alcohol use, and drug use? (2) Does self-management mediate the relationship between ADHD symptoms and nicotine dependence, alcohol use, and drug use?

We hypothesized that (1) higher levels of ADHD symptoms will be positively related to higher levels of nicotine dependence, alcohol use, and drug use. Those with poor self-management skills are prone to experiencing high levels of nicotine dependence, alcohol use, and substance use symptoms, therefore (2) it is predicted that self-management will be negatively related to ADHD, nicotine dependence, alcohol use and drug use.

In addition to these correlational relationships, we will test three mediation models: self-management as a mediating variable in the relationships between (3) ADHD symptoms and nicotine dependence (4) ADHD symptoms and alcohol use, and (5) ADHD symptoms and drug use. We predict that these relationships would be mediated by self-management (see Figure 1).

Furthermore, it is expected that self-management will mediate the relationship between ADHD presentations and nicotine dependence, alcohol use, and substance use (see Figure 2).

**Methods**

**Participants**

Participants were 141 students (31 males and 110 females) enrolled in undergraduate psychology courses at Memorial University of Newfoundland. Participants ranged in age from 18 years to 46 years with a mean age of 21.55 years (SD = 3.86 years). The sample was 88.7% (n
= 125) Caucasian, 4.3% (n = 6) Asian, 1.4% (n = 2) Aboriginal, 0.7% (n = 1) African-American, and 0.7% (n = 1) Hispanic. Six (4.3%) participants did not indicate their ethnic group. For educational level attained 92.9% (n = 131) reported completing high school, and 7.1% (n = 10) completed business, trade, or vocational school after high school. The average reported annual family income was between $50,000 and $59,999.

Measures

Demographic Information Form. The demographic information sheet consisted of a series of questions regarding the participants’ age, gender, ethnicity, marital status, number of children, current employment, and income (assessment of socioeconomic status). The demographic information sheet appeared at the front of every package following the consent form.

Conners Adult ADHD Rating Scale – Self-Report: Short Version (CAARS-S:S; Conners, Erhardt, & Sparrow, 1999). The CAARS-S:S is a measure designed to assess ADHD symptoms in adults. The measure is comprised of a 26-item rating scale scored on a 4-point Likert-type scale (0 = not at all or never, 1 = just a little, once in a while, 2 = pretty much, often; and 3 = very much, very frequently). It incorporates the 18 items of the ADHD diagnostic criteria to screen for ADHD. It is available in various versions; the self-report short scale was used for the current study. For the short version of the CAARS, a score ≥ 23 indicates possible adult ADHD. The CAARS-S:S was found to have an adequate internal consistency of α = .89, and test–retest average correlations were r = .91 (Conners, Erhardt, & Sparrow, 1999). Four subscales each composed of 5 items (A: inattention/memory; B: hyperactivity; C: impulsivity; and D: self-concept) as well as a 12-item overall CAARS index can be calculated. The CAARS has demonstrated a test-retest reliability of r = 0.89, and an internal consistency ranging from α = 0.88 to 0.92 for the CAARS subscales (Erhardt, Epstein, Conners, Parker, & Sitarenios, 1999).

Self-Control and Self-Management Scale (SCMS; Mezo, 2009). The SCMS is a 16-item instrument assessing three self-management skills: self-monitoring, self-evaluation, and self-reinforcement. Each item is a statement describing a behavior of one of the three self-management skills. The SCMS is scored on a six-point Likert scale (0 – Very undescriptive of me, to 5 – Very descriptive of me). Total scores on this instrument range from 0 to 80; scores on the self-evaluation and self-reinforcement subscales range from 0 to 25, and scores on the self-monitoring subscale range from 0 to 30. This study used the self-evaluation subscale as the measure of self-evaluation. Sample self-evaluation subscale items include, “The goals I achieve do not mean much to me”, “I have learned that it is useless to make plans” and “When I set
important goals for myself, I usually do not achieve them." Following reverse scoring of the self-evaluation subscale, higher scores indicate higher degrees of self-evaluation skills. The SCMS was found to be reliable $\alpha = 0.81$, test-retest correlation of $r = 0.75$) and exhibited a robust three factor structure (Mezo & Short, 2012).

**Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991).** The Fagerström Test for Nicotine Dependence is a self-report scale used for assessing the intensity of physical addiction to nicotine. The test was designed to provide an ordinal measure of nicotine dependence related to cigarette smoking. It contains six items that evaluate the quantity of cigarette consumption, the compulsion to use, and dependence. In scoring the FTND yes/no items are scored from 0 to 1 and multiple-choice items are scored from 0 to 3. Cumulative FTND scores range from 0 to 10, with values of 7 or higher suggestive of clinically significant nicotine dependence (Killen, Fortmann, Newman, & Varady, 1991). Previous research has shown an association between FTND scores and other measures of nicotine dependence, providing support for the construct validity of the FTND (Heatherton, Kozlowski, Frecker, & Fagerström, 1991). The FTND has demonstrated test-retest reliability over a 15-day period, $r = 0.85$, and an internal consistency of $\alpha = 0.64$ (Pomerleau, Carton, Lutzke, Flessland, & Pomerleau, 1994).

**Michigan Alcoholism Screening Test (MAST; Selzer, 1975).** The MAST is a self-report questionnaire designed to identify alcohol abuse and measure self-appraisal of social, vocational, and family problems frequently associated with alcohol abuse. Its focus on alcohol use behaviours and adverse consequences make it a widely used measure for examining significant problems associated with alcohol use in medical, legal, and interpersonal areas of life (Conley, 2001). Sample items include, "Do you feel you are a normal drinker?", "Do you ever feel guilty about your drinking?" and "Are you able to stop drinking when you want to?" Items are rated dichotomously and are weighted between 1 -5, with a weight of 5 being considered diagnostic of alcohol abuse. A total score of 5 or more is considered to indicate problematic alcohol use behaviour. Evidence of reliability and validity has been found in several studies, most of which include clinical populations. The MAST has evidence of good internal consistency ($\alpha = .86$; Conley, 2001) and test–retest reliability over a one-week interval ($r = .95$; Teitelbaum & Carey, 2000). It has also demonstrated high convergent validity with DSM-IV diagnostic criteria for alcohol use disorders (Conley, 2001).

**Drug Abuse Screening Test (DAST-20; Skinner, 1982).** The Drug Abuse Screening
Test is a 20-item self-report questionnaire designed to identify substance abuse (i.e., abuse of opiates, stimulants, and/or depressants), except for alcohol abuse. Sample items include; "Have you used drugs other than those required for medical reasons?", Are you always able to stop using drugs when you want to?" and "Do you ever feel bad or guilty about your drug use?" Items are rated dichotomously with either "Yes" or “No”. One point is scored for each question answered “yes” except for questions 4 and 5, for which a “No” receives 1 point.

The DAST-20 has demonstrated good internal consistency, $\alpha = 0.92$ (Cocco & Carey, 1998), and a two-week test–retest reliability of $r = 0.85$ (El-Bassel et al., 1997).

**Procedure**

Upon ethics approval from the Memorial University Interdisciplinary Committee on Ethics in Human Research, participants were recruited from undergraduate psychology courses. Course instructors were contacted through the psychology department electronic mailing list. With permission from course instructors the researcher gave a brief in-class presentation about the study. The script was read to introduce the investigator, inform students about the premise of the study, and provide information about consent and instructions on how to complete the questionnaire packet. Questionnaire packet were disseminated to all students in the class, and students were asked to complete the questionnaire on their own time and deposit the completed questionnaire in the psychology department office. Questionnaire packets were labeled numerically and did not include any personally identifiable information to ensure anonymity.

Students who did not wish to participate had the option to return their blank questionnaire packet to the psychology office depository. There was no consequence for students who did not wish to participate in the study. Additionally, students from the Psychology Research Experience Pool (PREP) were recruited. Undergraduate psychology students from PREP accessed a list of departmentally approved research experiences via the Web and choose to participate in a study for course credit.

The experimenter was present to respond to questions or problems prior to consent, and during participation. After completion of the questionnaire students were given a feedback sheet that contained additional information about the study, and contact information for researchers and the university ethics board. Participants completed the questionnaire packet between 10 to 20 minutes. There was no consequence for students who chose to participate as an observer and do not wish to include their data in the study.

**Planned Analyses**

To examine whether self-management explained how symptoms of ADHD are associated with severity of nicotine dependence, alcohol use and drug use, we tested correlations and mediation models. The correlation model included nicotine dependence, alcohol use, drug use,
self-management, and ADHD symptoms. The first mediation model tested self-management as a mediating variable in the relationship between ADHD symptoms and nicotine dependence. The second mediation model tested self-management as a mediating variable in the relationship between ADHD symptoms and alcohol use. The third model tested self-management as a mediating variable in the relationship between ADHD symptoms and drug use. Researchers then investigated whether three subscales of the CAARS (hyperactivity, impulsivity, and inattentive) were related to nicotine dependence, alcohol use, and drug use by testing self-management as a mediating variable between each of these relationships.

The mediating roles of self-management between ADHD symptoms and nicotine dependence, alcohol use, and drug use were explored using the bootstrap method via the SPSS Macro for Multiple Mediation 2.16 (Preacher & Hayes, 2004). This macro was used to generate 95% confidence intervals based on 5000 bootstrap samples with replacement to test the significance of the indirect effect of independent variables (ADHD and subscales) on dependent variables (nicotine dependence, alcohol use, drug use) through the proposed mediator (self-management). Mediation analyses were tested using the bootstrapping method with bias-corrected confidence estimates (MacKinnon, Lockwood, & Williams, 2004; Preacher & Hayes, 2004). A variable was deemed to exert a significant indirect effect (mediator) if the confidence interval did not contain zero.

**Results**

Six participants reported having a received a formal diagnosis of ADHD, and four were currently prescribed medication for ADHD. In total, 11 participants were identified as ‘at risk’ for ADHD, 10 participants met MAST criteria for disordered alcohol use, 11 participants met DAST-20 criteria for possible substance use disorder. Means, standard deviations, ranges, t-values, and internal consistencies for the CAARS-S:S, SCMS, FTND, MAST, and DAST-20 are reported in Table 1. The scores are given separately for males and females. The table also shows the t values between males and females, and effect sizes. Most scales were consistent between genders, however the FTND, MAST, and DAST indicate higher levels of nicotine dependence, alcohol use, and drug use among males, which is consistent with other published studies (Greenbaum, Del Boca, Darkes, Wang, & Goldman, 2005; Wagner, de Andrade Stempliuk, Zilberman, Barroso, & de Andrade, 2007). All the measures had acceptable or better Cronbach's alphas, except for the SCMS Self-Reinforcement subscale and the MAST, which were low by comparison (0.68 and 0.62, respectively).

**Correlational Relationships**

In advance of conducting mediation analyses addressing the hypotheses of this study, bivariate correlations were conducted across the full sample of measures. To establish whether or not a correlational relationship existed between ADHD symptoms, self-management, nicotine dependence, alcohol use and drug use, bivariate correlation analyses were carried out between the CAARS-S:S, SCMS, FTND, MAST, and DAST-20 (see Table 2).
Further bivariate correlations were conducted between the CAARS-S:S subscales, the SCMS, FTND, MAST, and DAST-20. These analyses were conducted to determine whether ADHD symptom groupings were related with self-management, nicotine dependence, alcohol use and drug use (see Table 3).

**Mediation Analyses**

The first mediation model tested self-management as a mediating variable in the relationship between ADHD symptoms and nicotine dependence. Demographic covariates were entered as statistical controls. The mediation analysis (see Figure 3) showed a positive association between ADHD and nicotine dependence, $b = 0.06, t (141) = 1.90, p = 0.059$. ADHD was negatively related to self-management, $b = -1.01, t (141) = -7.40, p < 0.001$. Self-management was not associated with nicotine dependence, $b = -0.01, t (141) = -0.67, p = 0.507$.

Analyses indicate that self-management was not a significant mediating variable in the relationship between symptoms of ADHD and severity of nicotine dependence. The bootstrapped unstandardized indirect effect was not statistically significant, $b = 0.01, 95\% CI [-0.01, 0.05]$.

The second mediation model tested self-management as a mediating variable in the relationship between ADHD symptoms and alcohol use. Demographic covariates were entered as statistical controls. The mediation analysis (see Figure 4) showed a positive association between ADHD symptoms and alcohol use, $b = 0.09, t (141) = 2.97, p = 0.004$. ADHD symptoms were negatively related to self-management, $b = -1.01, t (141) = -7.40, p < 0.001$. Self-management was not associated with alcohol use, $b = -0.01, t (141) = -0.59, p = 0.560$. Self-management was not a significant mediating variable in the relationship between symptoms of ADHD and severity of alcohol use. The bootstrapped unstandardized indirect effect was not statistically significant, $b = 0.01, 95\% CI [-0.03, 0.06]$.

The third mediation model tested self-management as a mediating variable in the relationship between ADHD symptoms and drug use. Demographic covariates were entered as statistical controls. The mediation analysis (see Figure 5) showed a positive association between ADHD symptoms and drug use, $b = 0.08, t (141) = 2.52, p = 0.013$. It was found that ADHD symptoms were negatively related to self-management, $b = -1.01, t (141) = -7.40, p < 0.001$. Self-management was negatively associated with drug use, $b = -0.05, t (141) = -2.36, p = 0.020$. ADHD symptoms and self-management accounted for 12% of the variance in drug use, $F (10,$
130) = 2.92, \( p = 0.003 \), where self-mediation partially mediated the relationship between symptoms of ADHD and severity of drug use. The bootstrapped confidence intervals did not pass through zero, indicating that the unstandardized indirect effect is significant, \( b = .05 \), 95% CI [0.02, 0.11].

Further analyses were conducted to determine whether self-management mediated the relationships between the CAARS-S:S subscales (CAARS-S:S Inattentive, CAARS-S:S Hyperactive, CAARS-S:S Impulsive) and drug use. The mediation models tested self-management as a mediating variable in the relationship between scores on the hyperactivity, inattentive, and impulsive subscales and drug use.

The first of these additional mediation models tested self-management as a mediator between hyperactivity symptoms (CAARS-S:S Hyperactive subscale) and drug use. The mediation analysis (see Figure 6) showed a positive association between hyperactivity symptoms and drug use, \( b = 0.08 \), \( t (141) = 1.45 \), \( p = 0.05 \). Hyperactivity symptoms were negatively related to self-management, \( b = -0.87 \), \( t (141) = -3.48 \), \( p = 0.001 \). Self-management was negatively associated with drug use, \( b = -0.06 \), \( t (141) = -3.07 \), \( p = 0.003 \). Hyperactivity symptoms and self-management accounted for over 11% of the variance in drug use, \( F (10, 130) = 2.87 \), \( p = 0.003 \), where self-management partially mediated the relationship between hyperactivity symptoms and severity of drug use. The bootstrapped unstandardized indirect effect was statistically significant, \( b = .05 \), 95% CI [0.02, 0.13].

The second of these additional mediation models tested self-management as a mediating variable in the relationship between inattentive symptoms (CAARS-S:S Inattentive subscale) and drug use. Demographic covariates were entered as statistical controls. The mediation analysis (see Figure 7) showed a positive association between inattentive symptoms and drug use, \( b = 0.17 \), \( t (141) = 3.40 \), \( p = 0.001 \). Inattentive symptoms were negatively related to self-management, \( b = -1.68 \), \( t (141) = -8.79 \), \( p < 0.001 \). Self-management was negatively associated with drug use, \( b = -0.04 \), \( t (141) = -1.72 \), \( p = 0.09 \). Inattentive symptoms and self-management accounted for over 13% of the variance in drug use, \( F (10, 129) = 3.17 \), \( p = 0.001 \), where self-management partially mediated the relationship between inattentive symptoms and severity of drug use. The bootstrapped unstandardized indirect effect was statistically significant, \( b = .06 \), 95% CI [0.0007, 0.16].

The third of these additional mediation models tested self-management as a mediating variable in the relationship between impulsive symptoms (CAARS-S:S Impulsive) and drug use. Demographic covariates were entered as statistical controls. The mediation analysis (see Figure 8) showed a positive association between impulsivity symptoms and drug use, \( b = 0.13 \), \( t (141) = \).
2.07, \( p = 0.04 \). Impulsive symptoms were negatively related to self-management, \( b = -1.07, t \) (141) = -3.78, \( p = 0.001 \). Self-management was negatively associated with drug use, \( b = -0.06, t \) (141) = -2.86, \( p = 0.005 \). Impulsive symptoms and self-management accounted for 12% of the variance in drug use, \( F(10, 130) = 2.98, p = 0.002 \), where self-management partially mediated the relationship between impulsive symptoms and severity of drug use. The bootstrapped unstandardized indirect effect was statistically significant, \( b = .05, 95\% CI [0.02, 0.13] \).

**Discussion**

Comorbidity between ADHD and substance use disorders has been well established (Connolly et al., 2016; Hesson & Fowler, 2015). However, the purpose of the present research was to investigate whether symptoms of ADHD and symptoms of substance use are related in the context of a self-management framework. By understanding the symptoms of ADHD and self-management together, we increase the degree to which we understand ADHD and substance use trajectories as they relate to self-management.

The relationships were examined in a sample drawn from an undergraduate student population from Memorial University of Newfoundland. It was observed that (1) ADHD symptom severity was significantly related to nicotine dependence, alcohol use, and drug use. (2) Self-management was significantly related to ADHD symptoms, nicotine dependence, alcohol, use, and drug use symptoms. (3) Self-management did not mediate the relationship between symptoms of ADHD and nicotine dependence. (4) Self-management did not mediate the relationship between ADHD symptoms and alcohol use. (5) Self-management was a significant mediator between ADHD symptoms and drug use. (6) Self-management was a significant mediator between all three ADHD symptoms groupings, as assessed with the CAARS:S subscales, and drug use.

We observed that self-management was a significant mediator between ADHD symptoms and drug use, which suggests that self-management may play a role in the relationship between ADHD symptoms and drug use. Findings indicate that those exhibiting high levels of self-management skills are better able to cope with their ADHD symptoms, which results in lower levels of drug use. These findings suggest that ADHD is associated with a failure to self-manage, meaning that self-management skills enables one to cope with ADHD symptoms and in turn avoid or reduce drug use. Individuals with ADHD symptoms can decrease their reliance on drugs by increasing one's ability to effectively self-manage.

**Limitations**

The data reported herein was self-reported, which means it was not possible to determine whether participants met diagnostic criteria for ADHD. In terms of substance use measures, social desirability, or “faking good,” is an individual difference variable and response bias reflecting the need to respond in a culturally appropriate and acceptable manner (Crowne &
Marlowe, 1960). Research has indicated that social desirability affects responses to alcohol and drug consumption and influences outcomes considerably. Higher social desirability, is a moderately strong predictor of lower self-reported alcohol and drug use (Welte & Russell, 1993). In the context of the present study, social desirability could have accounted for an underrepresentation of actual levels of nicotine dependence, alcohol use and other drug use.

Another limitation is that the study is cross sectional, which makes it impossible to examine the cause-and-effect relation between ADHD symptoms and nicotine dependence, alcohol use, and drug use. Although it is inferred that ADHD symptoms developed prior to substance use, this assertion cannot be confirmed due to the design of this study. It is possible that ADHD symptoms can be exhibited during the duration of action following the administration of a substance, however substance use cannot cause ADHD.

It is possible that participants may have been experiencing attentional difficulties due to anxiety and or depression. Research has indicated that ADHD is often comorbid with anxiety and depression (Simon, Czobor, & Bitter, 2013), the use of alcohol and substance use for managing anxiety and depression can lead to the development of co-occurring mood and substance use disorders (Robinson, Sareen, Cox, & Bolton, 2011).

Furthermore, the results of this study could be influenced by sample bias. Although students from a public university were surveyed, our sample is hardly representative of the general population because males were underrepresented. In the study sample males accounted for approximately 22% of the sample population, versus nearly 50% of the general population.

Based on the CCHS-MH (2012) database, over 22% of the Canadian population smokes cigarettes on either an occasional or daily basis. In contrast, approximately 7% of the sample population reported smoking. This low prevalence of smoking among the undergraduate sample population could account for the non-significant mediating effect of self-management. Moreover, among university undergraduate student populations, alcohol binge drinking is a normalized and regularly occurring behaviour (Green & Rabiner, 2012). Thus, the non-significant results from this analysis could be due to the increased prevalence of alcohol consumption and normalized patterns of consumption across the entire sample population.
Future research could benefit by separate the influence of comorbid disorders as a means of more accurately estimating the influence of ADHD on substance use. Future research should be directed towards assessing the relation between ADHD diagnosis and more serious patterns of alcohol and drug dependence, as this study examined levels of alcohol and drug use related problems. Furthermore, future studies could explore whether improvements in self-management skills lead to better regulation of substance consumption among those who have received a formal ADHD diagnosis. It could also be worthwhile to investigate ADHD symptoms as they relate to specific drug types in a self-management framework.

**Conclusion**

Despite impairments in interpersonal social functioning with family and peers, financial management, employment performance, and academic difficulty, few university students with ADHD receive non-pharmacological treatments. Rather than placing a heavy reliance on pharmacological treatments, self-management interventions could be an effective tool to manage ADHD symptoms and drug use while minimizing academic difficulties and other negative and long lasting consequences among university populations.

This research has shown that individuals who have symptoms associated with ADHD and who also have high levels of self-management are less likely to use drugs. The benefit of self-management interventions in this context is obvious. Self-management allows and encourages individuals to participate in setting their own goals and determining the type of intervention that is likely to be helpful for them. The individual is capable of exercising self-control over his or her own behaviours affecting their health outcomes, and as such can manage their level of drug use. Self-management also has the added benefit of being a cost effective and side-effect free treatment (Bodenheimer, LorigHolman & Grumbach, 2002).

Despite the limitations of the current study, the findings suggest that university students with ADHD symptoms are at risk for problematic nicotine, alcohol and drug use, and that increased levels of self-management can decrease drug use. Although these findings are preliminary, they are useful for informing current intervention and prevention efforts on university campuses. Our findings have broadened the scope of self-management training as an efficacious tool in reducing or preventing drug use among university students presenting with ADHD symptoms. This research has provided an empirical foundation for the development of prevention and treatment programs addressing substance use problems among university students with ADHD symptoms, as well as managing their ADHD symptoms. Studies have indicated that pharmacological and psychological treatments work best when applied concurrently, rather than relying on one or the other. Therefore, instead of replacing pharmacological treatments entirely, self-management could be used as part of a combined intervention strategy. This means that rather than relying solely on pharmacological interventions to decrease ADHD symptoms, individuals can follow a self-management strategy of monitoring, evaluating, and reinforcing their own behaviours.

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**Declarations**

**Ethics approval and consent to participate**

Ethics approval for the study was attained from the Memorial University Interdisciplinary Committee on Ethics in Human Research (ICEHR Number: 20160879-SC).

**Consent for publication**

Not applicable.

**Availability of data and materials**

The data that support the findings of this study are not openly available due to the sensitive nature of health data and are
available from the corresponding author upon reasonable request.

**Competing interests**
The authors declare that they have no competing interests.

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The authors declare that there are no sources of funding.

**Authors’ contributions**
RC collected, analyzed, and interpreted the data, and was the primary author of the manuscript. JH was a major contributor in writing the manuscript. All authors read and approved the final manuscript.

**Tables**

Table 1. **Means, Standard Deviations (SD), Ranges, t Values, Effect Sizes and Internal Consistencies of the Conners Adult ADHD Rating Scale – Self-Report: Short Version (CAARS-S:S), Self-Control and Self-Management Scales (SCMS), Fagerström Test for Nicotinic Dependence (FTND), Michigan Alcoholism Screening Test (MAST), and Drug Abuse Screening Test (DAST-20), (N = 141).**

<table>
<thead>
<tr>
<th>Psychological Measure</th>
<th>Total (N = 141)</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
<th>SE</th>
<th>Cohen’s d</th>
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<td>12.06</td>
<td>5.28</td>
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<td>2.77</td>
<td>0-13</td>
<td>3.94</td>
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<td>1-10</td>
<td>4.05</td>
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<td>6.94</td>
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<td>0-15</td>
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<td>2.17</td>
<td>0-10</td>
<td>1.38</td>
<td>3.22</td>
<td>0-9</td>
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<tr>
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<td>0-9</td>
<td>2.97</td>
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<td>0-11</td>
<td>1.32</td>
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</table>

*Note.* CAARS-S:S = Conners Adult ADHD Rating Scale – Self-Report: Short Version; SCMS = Self-Control and Self-Management Scale; FTND = Fagerström Test for Nicotinic Dependence; MAST = Michigan Alcoholism Screening Test; DAST 20 = Drug Abuse Screening Test. * = <.001

Table 2. **Correlational analyses of the of the Conners Adult ADHD Rating Scale – Self-Report: Short Version (CAARS-S:S), Self-Control and Self-Management Scales (SCMS), Fagerström Test for Nicotinic Dependence (FTND), Michigan Alcoholism Screening Test (MAST), and Drug Abuse Screening Test (DAST-20), (N = 141).**
Table 3. Correlational analyses of the Conners Adult ADHD Rating Scale – Self-Report: Short Version (CAARS-S:S) subscales, Self-Control and Self-Management Scales (SCMS), Fagerström Test for Nicotinic Dependence (FTND), Michigan Alcoholism Screening Test (MAST), and Drug Abuse Screening Test (DAST-20), (N = 141).

<table>
<thead>
<tr>
<th>Measure</th>
<th>DAST-20</th>
<th>MAST</th>
<th>FTND</th>
<th>SCMS</th>
<th>CAARS-S:S (Impulsive)</th>
<th>CAARS-S:S (Hyperactive)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAARS-S:S (Inattentive)</td>
<td>0.372*</td>
<td>0.230*</td>
<td>0.166*</td>
<td>-0.659*</td>
<td>0.462*</td>
<td>0.486*</td>
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<tr>
<td>CAARS-S:S (Hyperactive)</td>
<td>0.184*</td>
<td>0.206</td>
<td>0.096</td>
<td>-0.316*</td>
<td>0.407*</td>
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<tr>
<td>CAARS-S:S (Impulsive)</td>
<td>0.189</td>
<td>0.210*</td>
<td>0.066</td>
<td>-0.322*</td>
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<tr>
<td>SCMS</td>
<td>-0.349*</td>
<td>-0.208*</td>
<td>-0.192*</td>
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<tr>
<td>FTND</td>
<td>0.295*</td>
<td>0.279*</td>
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<td>MAST</td>
<td>0.633*</td>
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</table>

Note. Pearson correlations; CAARS-S:S = Conners Adult ADHD Rating Scale – Self-Report: Short Version; SCMS = Self-Control and Self-Management Scale; FTND = Fagerström Test for Nicotinic Dependence; MAST = Michigan Alcoholism Screening Test; DAST 20 = Drug Abuse Screening Test. *p < .05
Hypothesis two: Proposed mediation of self-management between presentations of ADHD and nicotine dependence, alcohol use, and drug use.

Unstandardized regression coefficients for the relationship between ADHD and nicotine dependence as mediated by self-management. *p < 0.05

Unstandardized regression coefficients for the relationship between ADHD and alcohol use as mediated by self-management. *p < 0.05

Unstandardized regression coefficients for the relationship between ADHD and drug use as mediated by self-management. *p < 0.05
**Figure 6**

Unstandardized regression coefficients for the relationship between CAARS-S:S: Hyperactivity subscale and drug use as mediated by self-management. *p < 0.05

**Figure 7**

Unstandardized regression coefficients for the relationship between CAARS-S:S: Inattentive subscale and drug use as mediated by self-management. *p < 0.05

**Figure 8**

Unstandardized regression coefficients for the relationship between CAARS-S:S: Impulsivity subscale and drug use as mediated by self-management. *p < 0.05