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ORIGINAL RESEARCH

Alcohol, Marijuana, and Tobacco Use Among Canadian Youth: Do We Need More Multi-Substance Prevention Programming?

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Abstract Data from the Canadian Youth Smoking Survey ($n = 27{,}030$ in 2006; $n = 16{,}705$ in 2004; $n = 11{,}757$ in 2002) were used to examine changes in the prevalence and comorbid use of alcohol, tobacco, and marijuana over time and examine if demographic factors and binge drinking are associated with comorbid substance use among youth. Alcohol was the most prevalent substance used, and it was rare to find youth who had used tobacco or marijuana without also having tried alcohol. Youth who reported binge drinking were substantially more likely to also have tried tobacco and/or marijuana. These data suggest that multi-substance prevention programs are required for youth populations.

Keywords Adolescent/youth · Cannabis · Alcohol · Prevalence · Prevention · Public health · Tobacco

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Introduction

Despite the health risks and public harm associated with heavy drinking, tobacco, and marijuana use (Nutt et al. 2007; Rehm et al. 2006; Hall and Solowij 1998) and restrictions prohibiting the use of these substances among youth populations, these substances continue to be used by a large number of youth in both Canada (Leatherdale et al. 2007, 2008; Adlaf and Paglia 2005; Poulin and Elliot 1997) and the United States (Centers for Disease Control and Prevention [CDC] 2008, 2004). Considering that comorbid use of these substances is common (CDC 2008; Leatherdale et al. 2007, 2008; Botvin and Griffin 2007; Anderson 2006) and that early onset of use can lead to heavier use during adulthood (Schmid et al. 2007; Wilson et al. 2002), preventing alcohol, tobacco, and marijuana use among youth populations should be a public health priority.

At the present time, most evidence-based youth-focused substance use prevention efforts primarily address tobacco use rather than more universal multi-substance prevention (Ringwalt et al. 2008). Even when programs do address other risk behaviors (e.g., alcohol or marijuana), the current focus appears to be more on providing substance-specific prevention programming rather than providing programming that can address multiple risk behaviors simultaneously (Wiefferink et al. 2006). This occurs despite evidence that risk behaviors among youth and young adults are often interrelated (Leatherdale et al. 2008;

Botvin and Griffin 2007; Camenga et al. 2006). For instance, research has identified that young adults who binge drink are substantially more likely to smoke than non-binge drinkers (Bobo and Husten 2000). There is also emerging evidence that the clustering of risk behaviors has become more prevalent over time. Camenga and colleagues (2006) recently identified that today's youth smokers are more likely to engage in numerous risk behaviors, such as drug use and binge drinking, than youth smokers a decade ago. Considering that youth who use alcohol, tobacco, and/or marijuana in elementary school are substantially more likely to continue using these harmful substances when they are older (Wilson et al. 2002), there is a need to better understand the factors associated with alcohol, tobacco, and marijuana use at an early age.

The current study seeks to examine the prevalence of use of these substances in greater detail using the most recent wave of Youth Smoking Survey (YSS) data (2006), including (a) characterizing changes in the prevalence of alcohol, tobacco, and marijuana use over time among Canadian youth; (b) examining binge drinking and intentions to try marijuana; (c) examining comorbid use of alcohol, tobacco, and marijuana use; and (d) examining if binge drinking is associated with comorbid alcohol, tobacco, and/or marijuana use.

Methods

Design

This study used nationally representative data collected as part of the 2006, 2004, and 2002 waves of the Canadian Youth Smoking Survey. Detailed information on the sample design, methods, and survey rates for each wave of the YSS are available (see Health Canada 2008, 2007, 2005). In brief, for the data used in this manuscript (grades 7–9), these three waves of YSS data collection used a similar sampling methodology and research design where the target populations consisted of all young Canadian residents in the appropriate grades attending public and private schools in 10 Canadian provinces; youth residing in the Yukon, Nunavut, and the Northwest Territories were excluded from the target populations, as were youth living in institutions or on First Nation Reserves and youth attending special schools or schools on military bases. The sample designs all consisted of a two-stage stratified clustered design with schools as primary sampling units and classes as secondary sampling units. All of the students in the selected classes were surveyed. The sample design featured three levels of stratification: province, grade level, and census metropolitan area. The sample of schools was selected systematically with probability proportional to school size. The selection of the secondary sampling units (i.e., classes) was conducted by field staff who randomly selected one class in the desired grade.

Participants

Data were collected from respondents in grades 7–9 who completed the substance use section of the 2002 ($n = 11{,}757$), 2004 ($n = 16{,}705$), or 2006 ($n = 27{,}030$) surveys.

Measures

The YSS collected information on age, gender, and smoking behavior as well as alcohol and marijuana use. The measures used in this manuscript are consistent with previous research using YSS data (Leatherdale et al. 2007, 2008). Ever use of tobacco was defined how the respondents answered, "Have you ever smoked a whole cigarette?" (yes or no). Ever use of alcohol use was assessed by asking respondents, "Have you ever had a drink of alcohol; that is, more than just a sip?" (yes or no). Those that answered "yes" were asked if they have ever had five drinks or more of alcohol on one occasion (yes or no). Respondents were also asked whether they "have ever used or tried marijuana or cannabis (a joint, pot, weed, hash)" (yes or no). Those that answered "no" were asked if they have ever seriously thought about trying marijuana or cannabis? (yes or no). Respondents who reported trying or using alcohol, marijuana, or tobacco were asked, "What age were you when you first did this?" to measure age of initiation (response categories started at "8 years of age or younger" and increased by 1 year increments). Respondents were also asked, "How much money do you usually get each week to spend on yourself or to save?" ($0, $1-5, $6-10, $11-20, $21-40, $41-100) to measure weekly spending money. Based on the response distribution, response categories were collapsed ($0, $1-20, $20 or more).

Analyses

Descriptive analyses of alcohol, marijuana, and tobacco use and comorbid use were examined according to year of data collection and sex. For the descriptive statistics, survey weights were used to adjust for non-response between provinces and groups, thereby minimizing any bias in the analyses caused by differential response rates across regions or groups. Using the 2006 data, we then conducted a series of logistic regression models to examine the characteristics associated with comorbid alcohol and tobacco use; comorbid alcohol and marijuana use; and comorbid alcohol, tobacco, and marijuana use. The statistical package SAS 8.02 was used for all analyses (SAS 2001).

Results

Table 1 presents the descriptive statistics for substance use, and Table 2 presents the descriptive statistics for comorbid substance use among Canadian youth in grades 7–9 by year of data collection

Table 1 Descriptive statistics by year of data collection

Student characteristics	Response	2002	2004	2006	% Change		
		$n = 11{,}757$ (%)	$n = 16{,}705$ (%)	$n = 27{,}030$ (%)	2002–2004 (%)	2004–2006 (%)	2002–2006 (%)
Ever smoked a whole cigarette	Yes	18.2	12.7	13.8	−30.2*	8.7*	−24.2*
	No	81.8	87.3	86.2			
Ever tried alcohol	Yes	54.5	62.9	59.1	15.4*	−6.0*	8.4*
	No	45.5	37.1	40.9			
Had ≥5 drinks on one occasion[a]	Yes	41.0	36.6	38.5	−10.7*	5.2	−6.1*
Ever tried marijuana	Yes	18.2	16.7	16.9	−8.2*	1.2	−7.1*
	No	81.8	83.3	83.1			
Intends to try marijuana in the future[b]	Yes	n/a	9.9	8.2		−17.2*	

n/a, not available in 2002 Youth Smoking Survey

* $p < .05$

[a] Only those youth who have tried alcohol

[b] Only those youth who have never tried marijuana

Table 2 Prevalence of comorbid tobacco, alcohol, and marijuana use by year of data collection

Student characteristics	2002	2004	2006	% Change		
	$n = 11{,}757$ (%)	$n = 16{,}705$ (%)	$n = 27{,}030$ (%)	2002–2004 (%)	2004–2006 (%)	2002–2006 (%)
None	44.0	36.2	39.8	−17.7*	9.9*	−9.5*
Tobacco only	0.9	0.4	0.6	−55.6*	50.0*	−33.3*
Alcohol only	31.8	43.2	39.1	35.8*	−9.5*	23.0*
Marijuana only	0.4	0.3	0.3	−25.0	0.0	−25.0
Tobacco and alcohol only	5.1	3.5	3.6	−31.4*	2.9	−29.4*
Tobacco and marijuana only	0.3	0.2	0.2	−33.3	0.0	−33.3
Alcohol and marijuana only	5.6	7.4	6.7	32.1*	−9.5*	19.6*
Tobacco, alcohol, and marijuana	11.9	8.8	9.6	−26.1*	9.1*	−19.3*

* $p < .05$

Table 3 Adjusted odds ratios [and 95% confidence intervals] of factors associated with comorbid alcohol, tobacco, and marijuana use among youth (2006)

Parameters	Model 1 Ever tried alcohol and tobacco vs. Ever tried alcohol only or tobacco only	Model 2 Ever tried alcohol and marijuana vs. Ever tried alcohol only or marijuana only	Model 3 Ever tried alcohol, tobacco and marijuana vs. Ever tried alcohol only, or tobacco only, or marijuana only
Sex			
Female	1.00	1.00	1.00
Male	0.82 [0.75, 0.90]***	1.13 [1.03, 1.24]**	0.95 [0.85, 1.07]
Grade			
7	1.00	1.00	1.00
8	1.23 [1.07, 1.41]**	1.55 [1.35, 1.79]***	1.42 [1.18, 1.71]***
9	1.49 [1.30, 1.71]***	2.68 [2.34, 3.06]***	2.29 [1.92, 2.72]***
Weekly spending money			
$0	1.00	1.00	1.00
$1 to $20	1.30 [1.13, 1.51]***	1.65 [1.43, 1.91]***	1.48 [1.23, 1.78]***
$21 or more	1.30 [1.12, 1.51]***	1.87 [1.61, 2.17]***	1.59 [1.31, 1.92]***
Binge drinking			
No	1.00	1.00	1.00
Yes	8.91 [8.06, 9.86]***	9.58 [8.72, 10.52]***	21.18 [18.49, 24.27]***

Odds ratios adjusted for all other variables in the table; Model 1: 1 = Ever tried alcohol and tobacco (n = 3,672), 0 = Ever tried alcohol only or tobacco only (n = 9,902); Model 2: 1 = Ever tried alcohol and marijuana (n = 4,227), 0 = Ever tried alcohol only or marijuana only (n = 9,092); Model 3: 1 = Ever tried alcohol, tobacco, and marijuana (n = 2,694), 0 = Ever tried alcohol only or tobacco only or marijuana only (n = 8,268)

** $p < .01$; *** $p < .001$

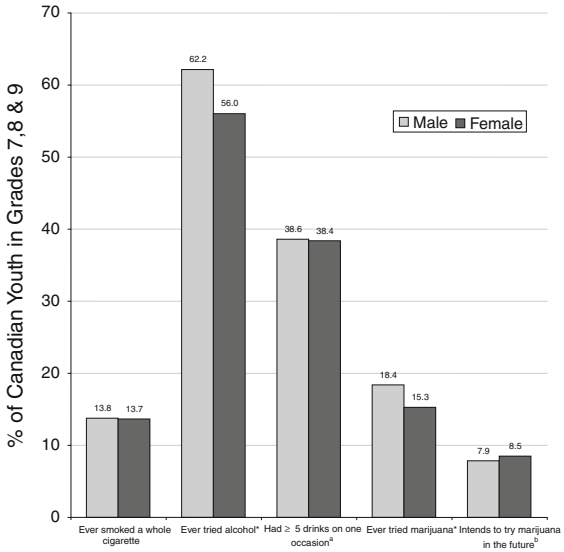

Fig. 1 Gender differences in the prevalence of alcohol, tobacco, and marijuana use among youth in Canada, 2006. [a] Only among those who have ever tried alcohol [b] Never tried marijuana only * $p < .05$

(2002, 2004, and 2006). Table 3 presents the results of the logistic regression analyses examining comorbid alcohol, tobacco, and marijuana use.

Prevalence of Alcohol Use, 2006

Alcohol continues to have the highest prevalence of ever use among Canadian youth. In 2006, 59.1% (n = 698,000) of youth reported having ever tried alcohol, and among those who report ever using alcohol, 38.5% (n = 267,000) reported binge drinking at least once. As shown in Fig. 1, although rates of alcohol use were higher among males than females, there were no sex differences in the prevalence of binge drinking. Among respondents who reported ever having tried alcohol, the mean age for first use was 11.7 (SD = 12.6) years.

Prevalence of Tobacco Use, 2006

In 2006, 13.8% (n = 175,100) of youth reported having ever smoked a whole cigarette, and the

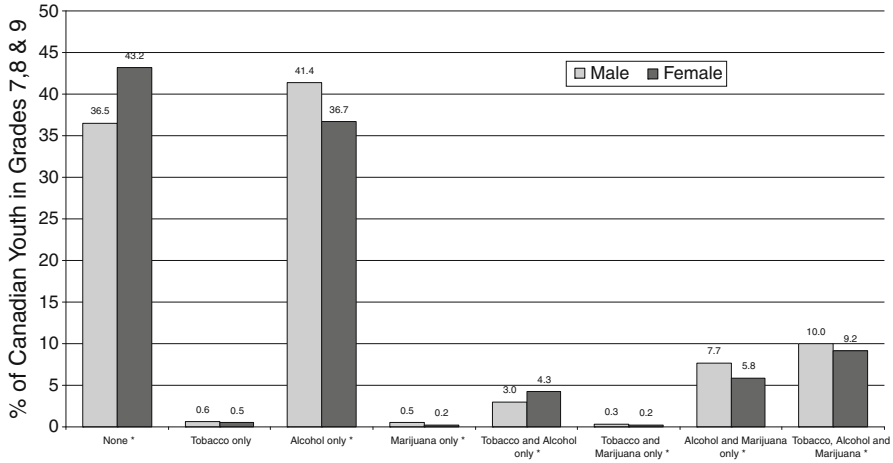

Fig. 2 Gender differences in the prevalence of comorbid tobacco, marijuana, and alcohol use among youth, Canada, 2006. * $p < .05$

average age for smoking the first cigarette among ever users was 12.2 ($SD = 10.6$) years. As shown in Fig. 1, there were no sex differences in the rates of having smoked a whole cigarette.

Prevalence of Marijuana Use, 2006

In 2006, 16.9% ($n = 197{,}000$) of youth reported having ever tried marijuana, with 8.2% ($n = 77{,}700$) of respondents who have never tried marijuana reporting that they intend to try marijuana in the future. As shown in Fig. 1, although rates of marijuana use were higher among males than females ($\chi^2 = 43.4$, $df = 1$, $p < .001$), there were no sex differences in the prevalence of intentions to use marijuana among never users. In 2006, the average age for first using marijuana among ever users was 12.7 ($SD = 9.5$) years.

Comorbid Substance Use, 2006

In 2006, the largest subpopulations of youth consisted of those who reported having never experimented with alcohol, tobacco, or marijuana (39.8%; $n = 463{,}400$) and youth who reported only ever trying alcohol (39.1%; $n = 454{,}800$); very few youth reported using tobacco only (0.6%), marijuana only (0.3%), or tobacco and marijuana only (0.2%). In terms of comorbid use, 3.6% ($n = 42{,}400$) of youth reported using tobacco and alcohol, 6.7% ($n = 78{,}400$) of youth reported using alcohol and marijuana, and 9.6% ($n = 111{,}800$) of youth reported using alcohol, tobacco and marijuana. As shown in Fig. 2, the prevalence of comorbid alcohol and tobacco use was significantly higher among females compared to males, whereas the prevalence of comorbid alcohol and marijuana use and comorbid alcohol, tobacco, and marijuana use was significantly higher among males compared to females.

Changes in Substance Use Prevalence over Time

Despite the apparent large decline (24.2%) in the prevalence of youth having ever smoked a whole cigarette between 2002 and 2006, the prevalence of youth reporting they have ever smoked a whole cigarette actually significantly increased by 8.7% between 2004 and 2006. This represents an increase of approximately 18,000 smoking youth between 2004 and 2006. Similarly, the prevalence of having ever tried marijuana decreased by 7.1% between 2002 and 2006 yet there was a slight increase in the prevalence of ever use of marijuana (1.2%) between 2004 and 2006. In spite of the increase in ever use between 2004 and 2006, the prevalence of youth reporting they intend to try marijuana in the future significantly declined by 17.2% over the same period of time. Although the prevalence of ever having tried alcohol significantly increased by 8.4% between 2002 and 2006, the prevalence of ever use declined by 6% between 2004 and 2006. Conversely, although the prevalence of binge drinking declined by 6.1% between 2002 and 2006, there was a 5.2% increase in the prevalence of binge drinking between 2004 and 2006.

Changes in Comorbid Substance Use over Time

Although the prevalence of youth having ever tried alcohol, tobacco, and marijuana decreased by 19.3% between 2002 and 2006, the prevalence of youth reporting they have tried all three of these substances actually increased by 9.1% between 2004 and 2006 (this represents an increase of ~8,800 youth). Conversely, the prevalence of youth reporting they have ever tired both alcohol and marijuana increased by 19.6% between 2002 and 2006 but decreased by 9.5% between 2004 and 2006. Between 2002 and 2006 there were also significant declines in the prevalence of youth reporting ever use of tobacco and alcohol (29.4%) and tobacco and marijuana (33.3%); no significant changes in these groups were observed between 2004 and 2006.

Factors Associated with Comorbid Alcohol and Tobacco Use

Among youth who report having ever used alcohol or tobacco (Model 1), those youth who binge drink were over eight times more likely to report ever using both alcohol and tobacco compared to youth who do not binge drink (OR 8.91, 95% CI [8.06, 9.86]). Youth in grade 8 (OR 1.23, 95% CI [1.07, 1.41]) and grade 9 (OR 1.49, 95% CI [1.30, 1.71]) were more likely to report using both alcohol and tobacco than youth in grade 7. Youth with $1 to $20 (OR 1.30, 95% CI [1.13, 1.51] or $21 or more (OR 1.30, 95% CI [1.12, 1.51]) of weekly spending money were also more likely to report using both alcohol and tobacco than youth with no weekly spending money. Males were less likely than females to report using both alcohol and tobacco (OR 0.82, 95% CI [0.75, 0.90]).

Factors Associated with Comorbid Alcohol and Marijuana Use

Among youth who report having ever used alcohol or marijuana (Model 2), those who binge drink were substantially more likely to report ever using alcohol and marijuana compared to youth who do not binge drink (OR 9.58, 95% CI [8.72, 10.52]). Youth in grade 8 (OR 1.55, 95% CI 1.35–1.79) and grade 9 (OR 2.68, 95% CI [2.34, 3.06]) were more likely to report using both alcohol and marijuana than youth in grade 7. Youth with $1 to $20 (OR 1.65, 95% CI [1.43, 1.91]) or $21 or more (OR 1.87, 95% CI [1.61, 2.17)) of weekly spending money were also more likely to report using both alcohol and marijuana than youth with no weekly spending money. Males were more likely than females to report using both alcohol and marijuana (OR 1.13, 95% CI [1.03, 1.24]).

Factors Associated with Comorbid Alcohol, Tobacco, and Marijuana Use

Among youth who report having ever used alcohol, tobacco, or marijuana (Model 3), those youth who binge drink were over 21 times more likely to report ever using alcohol, tobacco, and marijuana compared to youth who do not binge drink (OR 21.18, 95% CI [18.49, 24.26]). Youth in grade 8 (OR 1.42, 95% CI [1.18, 1.71]) and grade 9 (OR 2.29, 95% CI [1.92, 2.72]) were more likely to report using alcohol, tobacco, and marijuana than youth in grade 7. Youth with $1 to $20 (OR 1.48, 95% CI [1.23, 1.78]) or $21 or more (OR 1.59, 95% CI [1.31, 1.92]) of weekly spending money were also more likely to report using alcohol, tobacco, and marijuana than youth with no weekly spending money. The likelihood of using alcohol, tobacco, and marijuana was not significantly different between males and females.

Discussion

Knowledge about the onset of alcohol, tobacco, and drug use among youth is important because it can provide insight to guide the provision and timing of prevention interventions (Botvin and Griffin 2007; Wilson et al. 2002). We identified that alcohol, tobacco, and marijuana continue to be used by a substantial number of youth in Canada and that comorbid experimentation was also very widespread among users. Alcohol was the most prevalent substance used by youth, and it was rare to find youth who had used tobacco or marijuana without also having tried alcohol. Binge drinking was common among youth who use alcohol, and youth who reported binge drinking were substantially more likely to also have tried tobacco and/or marijuana. These data suggest prevention programs that address all three of these risk behaviors should be provided to youth populations and that these programs should commence no later than elementary school considering

the high prevalence of alcohol, tobacco, and marijuana experimentation among the youth in this nationally representative sample.

A common ethos in school-based prevention programming is to focus prevention activities on reducing the uptake of one substance, with the goal of reducing its prevalence of use rather than focusing on preventing substance use more globally (Poulin and Elliot 1997). More recently however, there have been increasing calls for integrating school-based prevention efforts for multiple risk behaviors that are related (Wiefferink et al. 2006; Camenga et al. 2006). Our data provide evidence to support such an integrated approach to prevention programming. Despite some declines in the rates of comorbid substance use in recent years, we identify that a substantial number of youth continue to report experimenting in more than one substance use risk behavior. This finding is consistent with research highlighting that alcohol, tobacco, and/or marijuana use tend to cluster in youth populations (Tu et al. 2008; Botvin and Griffin 2007; Schmid et al. 2007; Wiefferink et al. 2006; Camenga et al. 2006; Choquet et al. 2004). Moreover, we also identified that alcohol use, binge drinking in particular, could be used as a screening measure for identifying youth at risk for comorbid substance use. For instance, youth who reported binge drinking were over 21 times more likely to report also having tried tobacco and marijuana. Considering that comorbid substance use behaviors increase the risk for later alcohol problems and dependence in adulthood (Madden and Heath 2002), heavy drug use (DuRant et al. 1999), and other risky behaviors such as fighting (DuRant et al. 1999), our results support previous research highlighting the need to for school-based practitioners to implement evidence-based universal substance use prevention programs in schools (Ringwalt et al. 2008).

The domain of tobacco control has guidelines for evidence-based prevention programming which are clearly tobacco specific. For instance, the Centers for Disease Control in the United States do not recommend including alcohol prevention activities in school-based tobacco control programs within their Best Practices Guidelines for Comprehensive Tobacco Control (CDC 1999). We also know that the tobacco control community has paid little attention to the relationship between marijuana use and tobacco use in the past (CDC 2000; Leatherdale et al. 2007). However, according to our nationally representative data, less than one percent of Canadian youth reported that they had tried tobacco but not tried either alcohol or marijuana. Since ongoing combined use of both substances might interfere with tobacco prevention and cessation efforts (Amos et al. 2004; Humfleet and Haas 2004), it may be important for alcohol and marijuana use to also be considered within tobacco control activities as they may be critical factors inhibiting the success of such programs. Future research should evaluate the impact that alcohol and drug use existing tobacco control prevention activity outcomes. Moreover, it may also be important to evaluate the secondary impact that alcohol or drug prevention programs may have on smoking uptake.

According to the Youth Risk Behavior Surveillance System (YRBSS) in the United States, over a quarter of students in grades 9–12 report binge drinking in the past month, with binge drinking being more common among male youth relative to female youth (CDC 2008). Although our sample is younger and binge drinking is not measured relative to past month use, our results suggest that binge drinking is also problematic within the Canadian context. We identified that in 2006, over a third of Canadian students in grades 5–9 who have previously tried alcohol reported binge drinking at least once, with overall rates of binge drinking being similar among males and females. Moreover, we also identified that binge drinkers were substantially more likely to also have reported experimenting with tobacco and marijuana relative to youth who do not binge drink. These findings illustrate remarkably high rates of underage youth trying alcohol as well as a high prevalence of binge drinking and comorbid experimentation with tobacco and/or marijuana among a young sample of Canadian youth. Because knowledge of the developmental progression of substance use onset can inform the timing of prevention interventions (Botvin and Griffin 2007), research needs to evaluate the impact that the timing and/or order of implementation of substance specific prevention programs have on alcohol, tobacco, and marijuana use onset. For example, considering our findings and previous research suggests that alcohol use onset precedes tobacco and marijuana onset (Leatherdale et al. 2008), it may be wise for practitioners to implement alcohol prevention programs

prior to tobacco or drug programs, and these programs may need to be in place very early in elementary school grades. This type of staggered and targeted approach to substance use prevention programming would require robust evaluation, but it may help to improve program outcomes and ensure limited prevention resources are used in a manner where they are most likely to have impact.

Consistent with previously published data from the 2004 YSS (Leatherdale et al. 2008), the 2006 YSS data presented here also suggests that more Canadian youth report having ever tried marijuana than tobacco even though marijuana is still considered to be an illicit drug. Rates of ever use of marijuana were higher among males than females, and it appears that most marijuana ever users also report having tried alcohol. It has previously been suggested that although most research on marijuana use only focuses on differentiating users from non-users, the most useful insight for prevention programmers would come from identifying youth at risk for using marijuana (Crano et al. 2008). As such, our finding that very few youth who have never tried marijuana actually intend to try marijuana in the future, and that the prevalence of youth intending to try marijuana has actually declined by more than 17% since 2004, suggests that marijuana use among youth in Canada may be on the decline. We recommend that future surveillance activities continue to measure intentions to use marijuana among youth as such insight may be a valuable indicator of sub-populations of students at-risk for future substance use as research has identified that youth who do not intend to try marijuana are also less likely to use tobacco or alcohol (Crano et al. 2008).

We also identified that youth with more than $20 of weekly spending money were more likely to report comorbid substance use. This is not surprising considering that youth with financial resources available to them would often have better access to such substances. Because youth populations are sensitive to both alcohol and tobacco taxes (Chaloupka et al. 2002; Chaloupka 1999), it is clear that policies designed to increase the price of alcohol and tobacco are critical components of comprehensive prevention programming; as long as marijuana remains classified as an illicit substance, taxation policies will remain irrelevant. Consistent with previous research (Leatherdale et al. 2008; Choquet et al. 2004; Wilson et al. 2002), we also identified that there were sex differences in the prevalence of alcohol, tobacco, and marijuana use, including some combinations of comorbid use, among males and females. These data suggest that research should consider evaluating the impact of prevention programs that are differentially tailored to the unique needs of male and female youth.

Because the majority of school-based substance use prevention programs are targeted at secondary school students (Botvin and Griffin 2007), our data suggest that there is a need to implement and evaluate the impact of substance use prevention programs within elementary school settings. In order to best understand the timing of substance use behaviors and the development of comorbid use, ongoing monitoring and surveillance of individual-level youth substance use behaviors is required. Such data systems could be further strengthened by also incorporating school-level data on prevention programs related to alcohol, tobacco, and marijuana use in order to facilitate ongoing evaluations of the impact such programs and/or mix of programs have on substance use onset.

Limitations

This study has several limitations common to survey research. Although the response rate was high and the data were weighted to help account for non-response, the findings are nevertheless subject to sample bias. In addition, the findings likely reflect some underreporting for alcohol, marijuana, and tobacco use as is common in survey research (Bovet et al. 2006). It should also be noted that the cross-sectional nature of the design does not allow for causal inferences regarding the association between alcohol, marijuana, and tobacco use. Longitudinal data are required to determine the temporal sequence of the onset of use for these substances and whether either substance serves as a "gateway" drug for the other. Finally, YSS did not ask about the relatively common practice of combining tobacco and marijuana (e.g., blunts; Hall and Solowij 1998), which may have implications for common definitions of ever use of tobacco or marijuana.

Conclusion

The results of this paper suggest that alcohol, tobacco, and marijuana continue to be used by a

substantial number of youth in Canada and that comorbid use is also very widespread among users. Alcohol was the most prevalent substance used by youth, and it was rare to find youth who had used tobacco or marijuana without also having tried alcohol. Binge drinking was common among youth who used alcohol, and youth who reported binge drinking were substantially more likely to also have tried tobacco and/or marijuana. Future research should consider developing a better understanding of the link between alcohol use and tobacco and marijuana use among this key population. Furthermore, because of the obvious limitations associated with substance-specific prevention programming, it may be beneficial to examine the benefits of using a more comprehensive multi-substance approach to youth prevention programming.

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References

Adlaf, E. M., & Paglia, A. (2005). *Drug use among Ontario students 1977–2005: OSDUS highlights*. Toronto, Canada: Centre for Addiction and Mental Health.

Amos, A., Wiltshire, S., Bostock, Y., Haw, S., & McNeil, A. (2004). 'You can't go without a fag…you need it for hash'—a qualitative exploration of smoking, cannabis and young people. *Addiction, 99*(1), 77–81.

Anderson, P. (2006). Global use of alcohol, drugs and tobacco. *Drug & Alcohol Review, 25*(6), 489–502.

Bobo, J. K., & Husten, C. (2000). Sociocultural influences on smoking and drinking. *Alcohol Research & Health, 24*(4), 225–232.

Botvin, G. J., & Griffin, K. W. (2007). School-based programmes to prevent alcohol, tobacco and other drug use. *International Review of Psychology, 19*(6), 607–615.

Bovet, P., Viswanathan, B., Faeh, D., & Warren, W. (2006). Comparison of smoking, drinking, and marijuana use between students present or absent on the day of a school-based survey. *Journal of School Health, 76*(4), 133–137.

Camenga, D. R., Klein, J. D., & Roy, J. (2006). The changing risk profile of the American adolescent smokers: Implications for prevention programs and tobacco interventions. *Journal of Adolescent Health, 39*(1), 120e1–120e10.

Centers for Disease Control, Prevention. (1999). *Best practices for comprehensive tobacco control programs*. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

Centers for Disease Control, Prevention. (2000). *Reducing tobacco use: A report of the surgeon general*. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

Centers for Disease Control and Prevention. (2004). Surveillance Summaries, May 21, 2004. *Morbidity Mortality Weekly Reports, 53*, SS-2.

Centers for Disease Control and Prevention. (2008). Youth risk behavior surveillance—United States, 2007. *Morbidity Mortality Weekly Reports, 57*, SS-4.

Chaloupka, F. J. (1999). Macro-social influences: The effects of prices and tobacco-control policies on the demand for tobacco products. *Nicotine & Tobacco Research, 1*(Suppl 1), S105–S109.

Chaloupka, F. J., Grossman, M., & Saffer, H. (2002). The effect of price on alcohol consumption and alcohol-related problems. *Alcohol Research & Health, 26*(1), 22–34.

Choquet, M., Morin, D., Hassler, C., & Ledoux, S. (2004). Is alcohol, tobacco, and cannabis use as well as polydrug use increasing in France? *Addictive Behaviors, 29*(3), 607–614.

Crano, W. D., Siegel, J. T., Alvaro, E. M., Lac, A., & Hemovich, V. (2008). The at-risk adolescent marijuana non-user: Expanding the standard distinction. *Prevention Science, 9*(2), 129–137.

DuRant, R. H., Smith, J. A., Kreiter, S. R., & Krowchuk, D. P. (1999). The relationship between early age of onset of initial substance use and engaging in multiple health risk behaviors among young adolescents. *Archives of Pediatrics and Adolescent Medicine, 153*(3), 286–291.

Hall, W., & Solowij, N. (1998). Adverse effects of cannabis. *Lancet, 352*(9140), 1611–1616.

Health Canada. (2005). *2002 Youth Smoking Survey Technical Report*. Ottawa, Canada: Minister of Health. Retrieved from http://www.hc-sc.gc.ca/hl-vs/pubs/tobac-tabac/yss-etj-2002/index_e.html.

Health Canada. (2007). *2004-05 Youth Smoking Survey*. Ottawa, Canada: Minister of Health. Retrieved from http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/survey-sondage_2004-2005-eng.php.

Health Canada. (2008). *2006-07 Youth Smoking Survey*. Ottawa, Canada: Minister of Health. Retrieved from http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/_survey-sondage_2006-2007/result-eng.php.

Humfleet, G. L., & Haas, A. L. (2004). Is marijuana use becoming a 'gateway' to nicotine dependence? *Addiction, 99*(1), 5–6.

Leatherdale, S. T., Hammond, D., & Ahmed, R. (2008). Alcohol, marijuana, and tobacco use patterns among youth in Canada. *Cancer Causes and Control, 19*(4), 361–369.

Leatherdale, S. T., Hammond, D., Kaiserman, M., & Ahmed, R. (2007). Marijuana use among young adult smokers and non-smokers in Canada: Are they smoking what we think they are smoking? *Cancer Causes and Control, 18*(4), 391–397.

Madden, P. A., & Heath, A. C. (2002). Shared genetic vulnerability in alcohol and cigarette use and dependence. *Alcoholism, Clinical and Experimental Research, 26*(12), 1919–1921.

Nutt, D., King, L. A., Saulsbury, W., & Blakemore, C. (2007). Development of a rational scale to assess the harm of drugs of potential misuse. *Lancet, 369*(9566), 1047–1053.

Poulin, C., & Elliot, D. (1997). Alcohol, tobacco and cannabis use among Nova Scotia adolescents: Implications for prevention and harm reduction. *Canadian Medical Association Journal, 156*(10), 1387–1393.

Rehm, J., Taylor, B., & Room, R. (2006). Global burden of disease from alcohol, illicit drugs and tobacco. *Drug & Alcohol Review, 25*(6), 503–513.

Ringwalt, C., Hanley, S., Vincus, A. A., Ennett, S. T., Rohrbach, L. A., & Bowling, J. M. (2008). The prevalence of effective substance use prevention curricula in the Nation's high schools. *Journal of Primary Prevention, 29*(6), 479–788.

SAS Institute Inc. (2001). *The SAS system for windows*. Cary, NC: SAS Institute Inc.

Schmid, B., Hohm, E., Blomeyer, D., Zimmermann, U. S., Schmidt, M. H., Esser, G., et al. (2007). Concurrent alcohol and tobacco use during early adolescence characterizes a group at risk. *Alcohol and Alcoholism, 42*(3), 219–225.

Tu, A. W., Ratner, P. A., & Johnson, J. L. (2008). Gender differences in the correlates of adolescents' cannabis use. *Substance Use & Misuse, 43*(10), 1438–1463.

Wiefferink, C. H., Peters, L., Hoekstra, F., Dam, G. T., Buijs, G. J., & Paulussen, T. G. W. M. (2006). Clustering of health-related behaviors and their determinants: Possible consequences for school health interventions. *Prevention Science, 7*(2), 127–149.

Wilson, N., Battistich, V., Syme, L., & Boyce, T. (2002). Does elementary school alcohol, tobacco, and marijuana use increase middle school risk? *Journal of Adolescent Health, 30*(6), 442–447.